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Technical Report No. 1127-1

PRACTICAL OPTIMAL FLIGHT CONTROL SYSTEM DESIGN FOR HELICOPTER AIRCRAFT

Volume II

Software User's Guide

March 1979

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Susan A. Riedel

March 1979

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National Aeronautics and Space Administration
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16. Abstract

A method by which modern and classical control theory techniques may be integrated in a synergistic fashion and used in the design of practical flight control systems is presented here. A general procedure is developed, and several illustrative examples are included. Emphasis is placed not only on the synthesis of the design, but on the assessment of the results as well.

The first step here is to establish the differences, distinguishing characteristics and connections between the modern and classical control theory approaches. Ultimately, this uncovers a relationship between bandwidth goals familiar in classical control and cost function weights in the equivalent optimal system. In order to obtain a practical optimal solution, it is also necessary to formulate the problem very carefully, and each choice of state, measurement and output variable must be judiciously considered. These so-called "engineering art" matters allow us to bridge the gap between the optimal control theory and its practical application.

Once design goals have been established and problem formulation completed, the control system is synthesized in a straightforward manner. Three steps are involved: filter-observer solution, regulator solution and the combination of those two into the controller. Assessment of the controller, which is often the bulk of the task at hand, permits an examination and expansion of the synthesis results. Often, the composite picture which results may lead to a revised design which is simpler and more practical.

(continued on following page)

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Key contributions in this work include the solution of the singular Kalman filter problem and the development of a user-oriented computer software package for the design and assessment of optimal control systems. Volume I of this report is the technical report.

FOREWORD

This report was prepared by Systems Technology, Inc., Hawthorne, California, under National Aeronautics and Space Administration Contract NAS2-9946. The program was administered by the NASA/Ames Research Center, Moffett Field, California. The NASA technical monitor was Dr. Heinz Erzberger.

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SECTION I

INTRODUCTION

This manual describes a software system which integrates the design principles from optimal control theory and those from classical control theory to allow a user to design and analyze a control system. The interactive and very modular approach used here permits synthesis to proceed in exactly that sequence of steps which the user deems most appropriate for the particular problem. Figure 1 illustrates the block structure which forms the backbone of the design system. Each block is a separate executable file which performs the specific task noted in the figure. The user interaction with each block is minimal; in some cases, all that is required is input of two file names; in other cases, additional data is needed. The file system structure allows the different blocks to communicate information to one another. At each block, a "problem file" is read and/or written. The problem files are unformatted binary files (to conserve disk space) which store all intermediate results. The user accesses the problem files via a service routine, which selectively reads and formats to the line printer any user-requested elements in a given problem file.

There are two types of blocks shown in Fig. 1a. The first type (Blocks 1, 3, 4, 5, 6, 9, 10) implements various aspects of the optimal control design process using software adapted from Ref. 1. All output from these blocks is stored in problem files. The second type of block (Blocks 2, 7, 8) provides links between the optimal control design and the classical control analysis techniques. These blocks produce TRFN files, which can then be used in the TRFN/USAM2 software, parts of which are indicated in Fig. 1b. For further information concerning use of this software, see Ref. 2. The typical sequence of steps in designing an optimal control system is to begin with Block 1 at the top of Fig. 1a and work clockwise through all the blocks, making the appropriate indicated excursions to the blocks in Fig. 1b to use the classical control analysis methods. Blocks can be repeated to

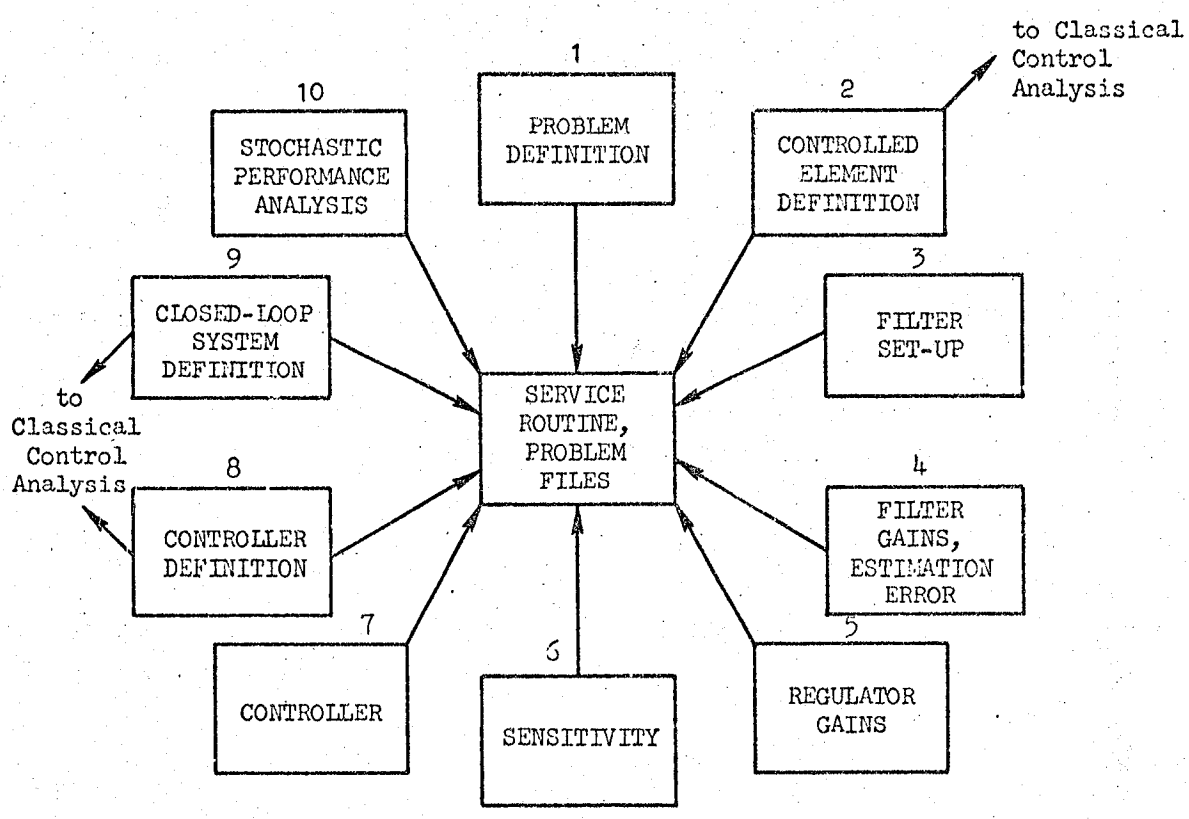

Figure 1a. Software Structure, Optimal Control

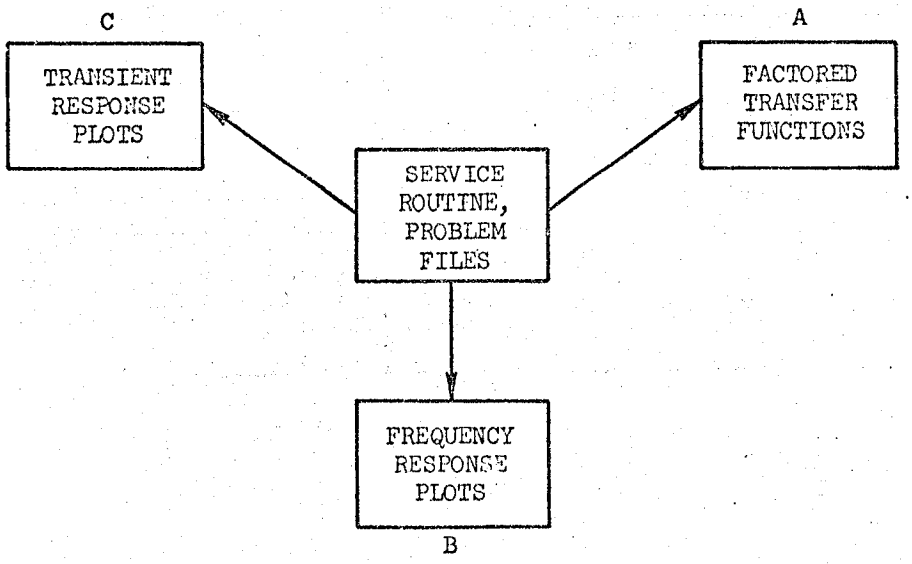

Figure 1b. Software Structure, Classical Control

cycle a design. Some blocks (such as the sensitivity block, for example) can be bypassed altogether.

This software was written in FORTRAN IV and developed on a PDP 11/10 under the RT-11 operating system. The system requires a single job monitor. The service routine and all the problem files reside on the DX0: disk; the executable files for the blocks reside on the DX1: disk. To execute a given block, simply type

```
RUN DX1:BLOCXX
```

where XX = 01, 02, ... 10. To run the service routine, type

```
RUN DX0:SERVIC
```

This manual is organized to correspond with the blocks — each of the sections describes a single block (and the service routine), including purpose, inputs required, computations performed and output, applicable restrictions, example input and output. A simple two state, two control point example is used to illustrate software use throughout. The appendix contains the source code listing for each mainline and subroutine in the optimal control package. For information on the theory and computational methods used in this software package, see Ref. 3.

SECTION II

PROBLEM DEFINITION — BLOCK 1

Purpose: This block accepts the dimensions, mnemonics and non-zero elements of all the matrices needed to define the problem's plant, outputs, and measurements in state vector form; it must always be accessed before attempting to solve any optimal control problem.

Input: The general state vector form assumed for the optimal control problem is stated below:

$$\dot{x} = Fx + Gu + \Gamma w, \; x(0) = X_o \qquad (1)$$

$$z = Hx + v \qquad (2)$$

$$y = H_R x \qquad (3)$$

where x = state vector

u = control vector

w = process noise vector

z = measurement vector

v = measurement noise vector

y = output vector

The particular form of the problem used here is shown in block diagram form in Fig. 2. The non-zero elements of the matrices shown must be input at this point in the problem, as well as certain dimensions, mnemonics, and file names. Notice that the state vector is comprised of two parts: the shaping filter states (x_S) and the controlled element states (x_C). The output vector, y, also has two components: those

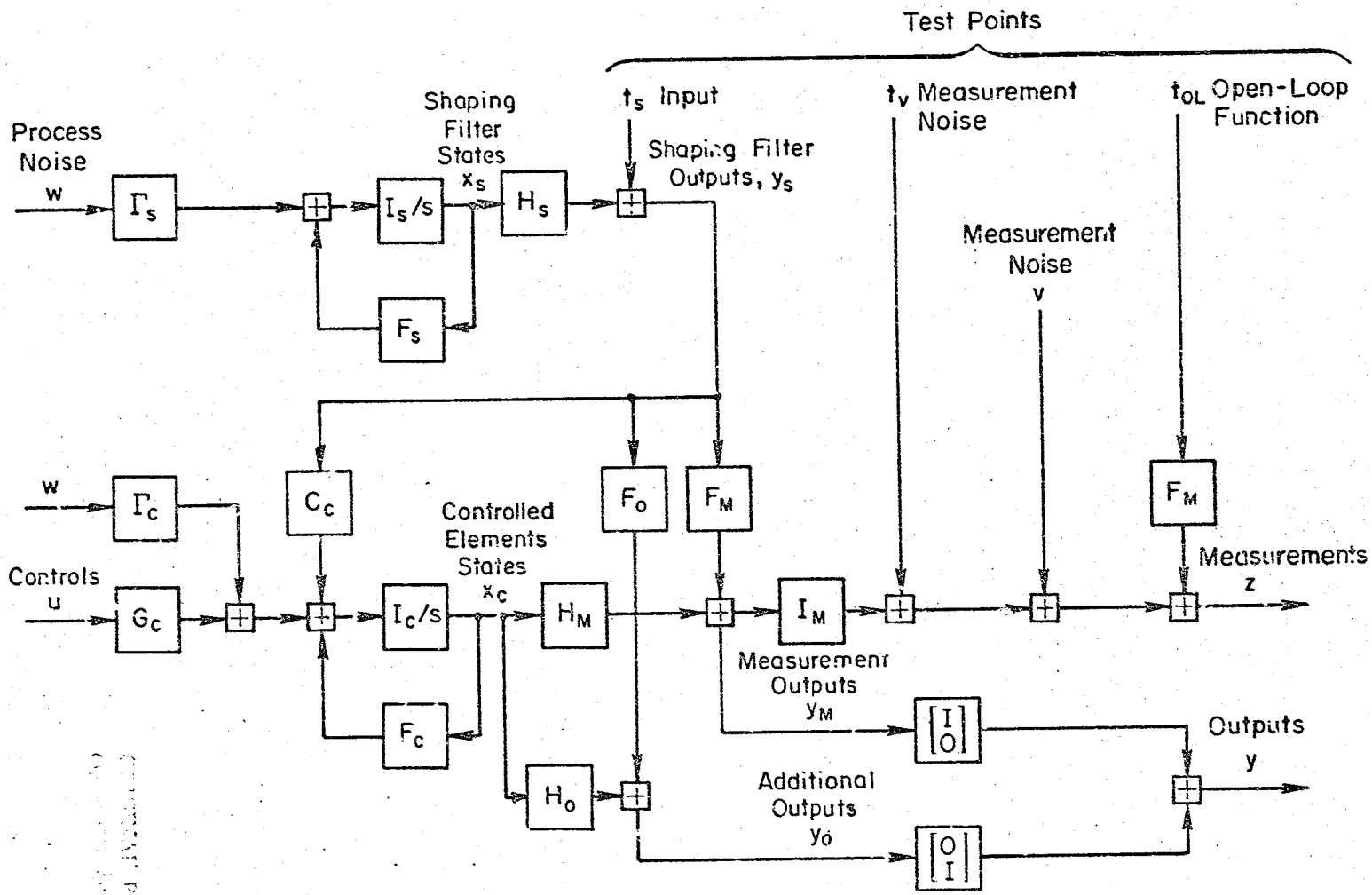

Figure 2. Form of Problem; Plant Measurements and Outputs

outputs which are, exclusive of measurement noise, the measurements (y_M), and any other outputs desired (y_O). Finally, provision is made for three vector test points: at the input point (t_S), at the measurement noise point (t_V), and for obtaining opened-loop transfer functions (t_{OL}).

Figure 3 presents the form of the data file which must be input in Block 1. The first line contains a 20 character title associated with this problem. The second line contains the dimensions of the problem vectors, in the order indicated. These dimensions are defined as follows:

n_{xS} - number of shaping filter states

n_{xC} - number of controlled element states

n_u - number of control inputs

n_w - number of process noise inputs

n_z - number of measurements

n_{yS} - number of shaping filter outputs

n_{yO} - number of additional outputs

All dimensions must be input, even if zero, and must be integers separated by spaces or commas.

The next several lines contain three-character mnemonics, separated by a single comma or space, associated with elements in the various vectors. The dimensions of these vectors are indicated in parentheses in Fig. 3. If a particular vector has zero dimension, no mnemonics are input.

Following the mnemonics are the non-zero elements of the matrices used to define the problem. The order of the matrices and their dimensions is shown in Fig. 3. The form of the input is:

i,j,XX.XX

AAA...	20 character title
$n_{xS}, n_{xC}, n_u, n_w, n_z, n_{yS}, n_{y_O}$	vector dimensions
MU1,MU2,...	u mnemonics (n_u)
MW1,MW2,...	w mnemonics (n_w)
MYS,MYS,...	y_S mnemonics ≡ t_S mnemonics (n_{yS})
MV1,MV2,...	v mnemonics ≡ t_V mnemonics (n_z)
MT1,MT2,...	t_{OL} mnemonics (n_{yS})
MZ1,MZ2,...	z mnemonics (n_z)
MYO,MYO,...	y_O mnemonics (n_{y_O})
i,j,Γ_S(i,j)	Γ_S elements (n_{xS}, n_w)
0	
i,j,F_S(i,j)	F_S elements (n_{xS}, n_{xS})
0	
i,j,H_S(i,j)	H_S elements (n_{yS}, n_{xS})
0	
i,j,Γ_C(i,j)	Γ_C elements (n_{xC}, n_w)
0	
i,j,G_C(i,j)	G_C elements (n_{xC}, n_u)
0	
i,j,C_C(i,j)	C_C elements (n_{xC}, n_{yS})
0	
i,j,F_C(i,j)	F_C elements (n_{xC}, n_{xC})
0	
i,j,H_M(i,j)	H_M elements (n_z, n_{xC})
0	
i,j,F_M(i,j)	F_M elements (n_z, n_{yS})
0	
i,j,H_O(i,j)	H_O elements (n_{y_O}, n_{xC})
0	
i,j,F_O(i,j)	F_O elements (n_{y_O}, n_{yS})
0	
DEV:FILE.EXT	output problem file name

Figure 3. Form of Input Data File for Block 1

where i is the integer representing the row number of the element, j is the integer representing the column number of the element, and XX.XX is the real number value (non-zero) of the element. Each non-zero element occupies a separate line, and the end of a particular matrix is signaled by the integer zero. If a matrix has zero dimensions, the integer zero must still be used.

The final line in this data file contains the name of the problem file to be used in outputting the data. This name must conform to RT-11 file name conventions.

Output: All data input is written to the output problem file. In addition, the input is combined into augmented arrays so that the problem is formulated in terms of the more conventional state vector equations. Those equations and the composition of the various matrices are given below. <u>All</u> matrices are written to the problem file.

$$\dot{x} = Fx + Gu + \Gamma w + E_3 t_S$$

$$y_M = Hx + E_2 t_S$$

$$z = I_M y_M + v + t_V + F_M t_{OL}$$

$$y = H_R x + E_1 t_S$$

where

$$x(n_{x_T}) = \begin{Bmatrix} x_S(n_{x_S}) \\ x_C(n_{x_C}) \end{Bmatrix} \quad \left[n_{x_T} = n_{x_S} + n_{x_C} \right]$$

$$F(n_{x_T}, n_{x_T}) = \begin{bmatrix} F_S(n_{x_S}, n_{x_S}) & 0(n_{x_S}, n_{x_C}) \\ C_C(n_{x_C}, n_{y_S}) \times H_S(n_{y_S}, n_{x_S}) & F_C(n_{x_C}, n_{x_C}) \end{bmatrix}$$

$$G(n_{x_T}, n_u) = \begin{bmatrix} 0(n_{x_S}, n_u) \\ G_C(n_{x_C}, n_u) \end{bmatrix}$$

$$\Gamma(n_{x_T}, n_w) = \begin{bmatrix} \Gamma_S(n_{x_S}, n_w) \\ \Gamma_C(n_{x_C}, n_w) \end{bmatrix}$$

$$E_3(n_{x_T}, n_{x_S}) = \begin{bmatrix} 0(n_{x_S}, n_{x_S}) \\ C_C(n_{x_C}, n_{x_S}) \end{bmatrix}$$

$$H(n_z, n_{x_T}) = \begin{bmatrix} F_M(n_z, n_{y_S}) \times H_S(n_{y_S}, n_{x_S}) & H_M(n_z, n_{x_C}) \end{bmatrix}$$

$$E_2(n_z, n_{y_S}) = F_M(n_z, n_{y_S})$$

$$y(n_{y_T}) = \begin{Bmatrix} y_M(n_z) \\ y_0(n_{y_0}) \end{Bmatrix} \quad \begin{bmatrix} n_{y_T} = n_z + n_{y_0} \end{bmatrix}$$

$$H_R(n_{y_T}, n_{x_T}) = \begin{bmatrix} F_M(n_z, n_{y_S}) \times H_S(n_{y_S}, n_{x_S}) & H_M(n_z, n_{x_C}) \\ F_0(n_{y_0}, n_{y_S}) \times H_S(n_{y_S}, n_{x_S}) & H_0(n_{y_0}, n_{x_C}) \end{bmatrix}$$

$$E_1(n_{y_T}, n_{y_S}) = \begin{bmatrix} F_M(n_z, n_{y_S}) \\ F_0(n_{y_0}, n_{y_S}) \end{bmatrix}$$

Restrictions: The following restrictions apply to data input for this portion of the problem:

1. The error message

   DIMENSIONS TOO LARGE OR Z IS 0

   is printed when any or all of the following occur

   $n_{x_S} > 5$

   $n_{x_C} > 10$

   $n_u > 5$

$n_w > 15$

$n_z > 15$, $n_z = 0$

$n_{y_S} > 5$

$n_{y_O} > 5$

2. The error message

   DIMENSIONS OUT OF RANGE FOR i,j,X(i,j)

   is printed if a matrix element is specified with an i or j which exceeds prescribed dimensions.

3. The error message

   WRONG FORMAT

   is printed if a matrix element is not recognizable (e.g., too many commas).

4. The RT-11 operating system will print fatal error messages if the file name is specified incorrectly, or if there is not enough room on the disk to write the file.

5. Certain other restrictions are not specifically flagged in the software. Their satisfaction is the responsibility of the user:

   - The software is restricted to that class of singular filter problems which do not require differentiation of any measurement.
   - The above requirement can be met via augmentation of the Γ matrix. This augmentation is provided by the user. The user must specify a process noise vector dimension (n_w) which is at least equal to the total number of states

$(n_{x_T})^*$. Augmentation of the process noise vector is considered to occur in the last n_{x_C} elements. Augmentation is operative only for filter problem solution (Blocks 3 and 4). In all other blocks, the effects of the last n_{x_C} process noise components are deleted.

- The user must verify independently that the plant is both detectable and stabilizable. This may be verified by requiring stability of the shaping filters and by examining various arrays of factored controlled element transfer functions.

Example: Figure 4 is the computer dialog and input file listing for this two state, two control example problem. Figure 5 presents the F,G, Γ, and H matrices which are output to the problem file. Note that all data in the example output in this manual have been read from the problem file and formatted via the service routine. Further notice that the first controlled element state is X06. This is the case because the first five plant state vector elements are reserved for shaping filter states.

* Any (or all) of the augmenting components may be zeroed by appropriate specification of the Γ matrix and/or the process noise intensities.

```
PROBLEM DEFINITION — BLOCK 1

INPUT DATA FILE NAME? DXO:2BY2.DAT*
```

Figure 4a. Input for Block 1

```
2X2 EXAMPLE CASE          - Problem Definition Title
Ø,2,2,4,2,Ø,Ø             - Dimensions
UØ1,UØ2
WØ1,WØ2,WX1,WX2           - MNEMONICS
VØ1,VØ2
ZØ1,ZØ2
Ø                         - Γ_S
Ø                         - F_S
Ø                         - H_S
1,1,1.
2,2,1.
1,3,1.                    - Γ_C
2,4,1.
Ø
1,1,1.
2,2,1.                    - G_C
Ø                         - C_C
Ø
1,2,1.
2,1,-2.                   - F_C
2,2,-3.
Ø
1,1,1.
2,2,1.                    - H_M
Ø
Ø                         - F_M
Ø                         - H_O
Ø                         - F_O
DXO: 2BY2.B1              - OUTPUT FILE NAME
```

Figure 4b. Listing of DXO:2BY2.DAT

*In this report, all user responses in computer dialog are underlined.

```
VECTOR DIMENSIONS :
  NXS =  Ø NXC =  2 NU =  2 NW =  2 NZ =  2 NYS =  Ø NYO =  Ø
```

F MATRIX

	1 X06	2 X07	
1	Ø.ØØØ	1.ØØ	X06
2	-2.ØØ	-3.ØØ	X07

G MATRIX

	1 UØ1	2 UØ2	
1	1.ØØ	Ø.ØØØ	X06
2	Ø.ØØØ	1.ØØ	X07

GAMMA MATRIX

	1 WØ1	2 WØ2	3 WX1	4 WX2	
1	1.ØØ	Ø.ØØØ	1.ØØ	Ø.ØØØ	X06
2	Ø.ØØØ	1.ØØ	Ø.ØØØ	1.ØØ	X07

H MATRIX

	1 X06	2 X07	
1	1.ØØ	Ø.ØØØ	ZØ1
2	Ø.ØØØ	1.ØØ	ZØ2

Figure 5. Output from Block 1; Problem Definition

SECTION III

CONTROLLED ELEMENT DEFINITION — BLOCK 2

Purpose: This block uses the matrices input in Block 1 to compose a TRFN-compatible file. TRFN is an interactive software package for computing the factored transfer function characteristic polynomial and numerators of various kinds from Laplace transformed equations of the form $A_{TF}(s)x_{TF}(s) = B_{TF}(s)u_{TF}(s)$. Block 2 accesses data output from Block 1.

Input: The input to this block consists of three items:

1. The name of the problem file from which the data are to be read.
2. The name of the output file to which the TRFN file is written.
3. A sixty character title for the TRFN file.

Output: The output from this block is a TRFN-compatible file. (For a complete description of TRFN see Ref. 2.) The general form of the file is

$$Ax_{TF} = Bu_{TF}$$

where

$$x_{TF}(n_{xC} + n_{yT}) = \begin{Bmatrix} x_C(n_{xC}) \\ y(n_{yT}) \end{Bmatrix}$$

$$u_{TF}(n_u + n_{yS} + n_w) \qquad \begin{Bmatrix} u(n_u) \\ t_S(n_{yS}) \\ w(n_w) \end{Bmatrix}$$

$$A(n_{x_C}+n_{y_T}, n_{x_C}+n_{y_T}) = \begin{bmatrix} sI-F_C(n_{x_C}, n_{x_C}) & 0(n_{x_C}, n_{y_T}) \\ -H_M(n_z, n_{x_C}) & I(n_{y_T}, n_{y_T}) \\ -H_O(n_{y_O}, n_{x_C}) & \end{bmatrix}$$

$$B(n_u+n_{y_S}+n_w) = \begin{bmatrix} G_C(n_{x_C}, n_u) & C_C(n_{x_C}, n_{y_S}) & \Gamma_C(n_{x_C}, n_w) \\ 0(n_{y_T}, n_u) & E_1(n_{y_T}, n_{y_S}) & 0(n_{y_T}, n_w) \end{bmatrix}$$

Restrictions: The RT-11 operating system will halt with a fatal error if the format of either file name is incorrect, or if there is not enough room on the disk for the file.

Example: Figure 6 shows the computer dialog for this block; Fig. 7 presents the listing of the resulting TRFN file.

```
CONTROLLED ELEMENT DEFINITION -- BLOCK 2

INPUT PROBLEM FILE NAME?  DX0:2BY2.B1

OUTPUT TRFN FILE NAME?  DX0:2BY2.B2

TRFN TITLE (60 CHARS):

2BY2 EXAMPLE CONTROLLED ELEMENT TRANSFER FUNCTIONS
```

Figure 6. Input for Block 2

```
          1       1   0.00000000E+00   0.10000000E+01   0.00000000E+00       0
          1       2   0.00000000E+00   0.00000000E+00  -0.10000000E+01       0
          2       1   0.00000000E+00   0.00000000E+00   0.27000000E+01       0
          2       2   0.00000000E+00   0.10000000E+01   0.30000000E+01       0
          3       1   0.00000000E+00   0.00000000E+00  -0.10000000E+01       0
          4       2   0.00000000E+00   0.00000000E+00  -0.10000000E+01       0
          3       3   0.00000000E+00   0.00000000E+00   0.10000000E+01       0
          4       4   0.00000000E+00   0.00000000E+00   0.10000000E+01       0
          0
          1       1   0.00000000E+00   0.00000000E+00   0.10000000E+01       0
          2       2   0.00000000E+00   0.00000000E+00   0.10000000E+01       0
          1       3   0.00000000E+00   0.00000000E+00   0.10000000E+01       0
          2       4   0.00000000E+00   0.00000000E+00   0.10000000E+01       0
          0
2BY2 EXAMPLE   CONTROLLED ELEMENT TRANSFER FUNCTIONS
          4       4       0
X03 X07 Z01 Z02
U01 U02 W01 W02
```

This output file format is described below:

I , J , A_2 , A_1 , A_0 , K ! 0	Nonzero elements of left-hand matrix*
I , J , B_2 , B_1 , B_0 , K ! 0	Nonzero elements of right-hand matrix*
Title: 60 characters of User's choice to identify the job.	
N , M , ID	Matrix sizes and code for Δ output†
AAA_1 , AAA_2 , ··· , AAA_N	Column code, left-hand side, 3 characters†§**
BBB_1 , BBB_2 , ··· , BBB_M	Column code, right-hand side, 3 characters†§

*If K = 0, the element in the Ith row, Jth column is set to: $A_2s^2 + A_1s + A_0$. If K = 1 and $A_2 \neq 0$, the element in the Ith row, Jth column is set to: $A_2[(s + A_1)(s + A_0)]$. If K = 1 and $A_2 = 0$, the element in the Ith row, Jth column is set to: $A_1[(s + A_0)]$. If K = 2, the element in the Ith row, Jth column is set to: $A_2[s^2 + 2A_1A_0s + A_0^2]$.

†If M = 0, the line of data will terminate the file read. If ID = 0, the Δ equation will be output. If ID ≠ 0, the denominator polynomial is set to unity and not printed.

†There must be at least N left-hand column identifiers and M right-hand identifiers. Each identifier must be three characters long.

§Commas and semicolons between column identifiers may be replaced with any other character.

**If there is more than 18 column identifiers, place a + in column 72 and continue on the next line.

Figure 7. Output File Listing for Block 2

SECTION IV

FILTER SET-UP — BLOCK 3

Purpose: This block is used to form various matrices which will be used by Block 4 to solve for the filter gains. Block 3 accesses data output from Block 1. The non-zero elements of the diagonal Q and R matrices are input for this block. The routine determines whether or not the problem is singular (one or more diagonal elements of R is zero). The Euler-Lagrange system matrix is computed accordingly in one of two ways, depending on whether or not the filter problem is singular. Results are written to the output problem file.

Input: The input to this routine consists of the following information in response to prompting by the software:

1. Input problem file, in standard RT-11 format.
2. Output problem file, in standard RT-11 format.
3. Filter problem title, limited to 20 characters.
4. Augmentation constant, a real number.
5. The non-zero diagonal elements of the Q matrix, in the form

   i, Q(i) $\qquad (n_w \geq n_{x_C})$

   where i is the integer row and column of the real number Q(i). The end of the Q input is signaled by an integer zero.
6. The non-zero diagonal elements of the R matrix, in the form

   i, R(i) $\qquad (n_z)$

where i is the integer row and column of the real number R(i). The end of the R input is signaled by an integer zero.

Output: Once input is completed, a check is made to determine whether the problem is singular. If all the diagonal elements of R are non-zero, the Euler-Lagrange system matrix is formed as follows:

$$EL_F = \begin{bmatrix} F & -GQG' \\ -H'R^{-1}H & -F' \end{bmatrix}$$

It, as well as the Q and R matrices (and some other data required for compatibility with the singular case) is written to the problem file.

If one or more of the diagonal elements of R are zero, the measurements are reordered so that all of the noise-free measurements are in the lower partition of z. This reordering affects the measurement and measurement noise mnemonics and transforms the H and R matrices. A T_z matrix is generated which transforms the original measurements to the reordered measurements:

$$T_z(n_z, n_z) \times z(n_z) = \begin{bmatrix} z_1(m_1) \\ z_2(m_2) \end{bmatrix}$$

where z_1 is the vector of noisy measurements

z_2 is the vector of noise-free measurements

m_1 is the number of noisy measurements

m_2 is the number of noise-free measurements.

Next, the state vector is transformed, if necessary, so that the lower partition of H is [0 I]. This results in a transformation of the state vector, changes in the mnemonics,

and appropriate transformations of the F, G, and Γ matrices, as well as the H matrix. A T matrix is defined which transforms the original state vector to the reordered state vector:

$$T(n_{x_T}, n_{x_T}) \times x(n_{x_T}) = \begin{bmatrix} x_1(m_1') \\ z_2(m_2) \end{bmatrix}$$

where x_1 is the vector of the remaining original states

m_1' is the number of remaining original states

Notice that the noise-free measurements become states as the result of this transformation. The remaining states (x_1) are a subset of the original plant states. The transformed F, G, Γ, R, and H matrices are partitioned as follows:

$$F(n_{x_T}, n_{x_T}) \longrightarrow \begin{bmatrix} F_{11}(m_1', m_1') & F_{12}(m_1', m_2) \\ F_{21}(m_2, m_1') & F_{22}(m_2, m_2) \end{bmatrix}$$

$$G(n_{x_T}, n_u) \longrightarrow \begin{bmatrix} G_1(m_1', n_u) \\ G_2(m_2, n_u) \end{bmatrix}$$

$$\Gamma(n_{x_T}, n_w) \longrightarrow \begin{bmatrix} \Gamma_1(m_1', n_w) \\ \Gamma_2(m_2, n_w) \end{bmatrix}$$

$$R(n_w) \longrightarrow \text{diag} \{ R_1(m_1) \quad Q(m_2) \}$$

$$H(n_{x_T}, n_z) \longrightarrow \begin{bmatrix} H_{11}(m_1', m_1) & H_{12}(m_1', m_2) \\ 0(m_2, m_1) & I(m_2, m_2) \end{bmatrix}$$

The reordered mnemonics, the T_z and T matrices, the partitions of the F, G, Γ, and H matrices, and the Q and transformed R matrices are all written to the problem file.

For this singular filter problem, the Euler-Lagrange system matrix is formed as follows:

$$EL_F = \begin{bmatrix} (F_{11} - \Gamma_1 Q\Gamma_2' A F_{21}) & (-\Gamma_1 Q\Gamma_1' + \Gamma_1 Q\Gamma_2' A\Gamma_2 Q\Gamma_1') \\ (-H_{11}' R^{-1} H_{11} - F_{21}' A F_{21}) & (-F_{11}' + F_{21}' A\Gamma_2 Q\Gamma_1') \end{bmatrix}$$

where $\quad A = (\Gamma_2 Q\Gamma_2')^{-1}$

If necessary, $\Gamma_2 Q\Gamma_2'$ is augmented to have full rank as follows:

$$\Gamma_2 Q\Gamma_2' + \begin{bmatrix} AC_1 & & 0 \\ & AC_2 & \\ 0 & & \ddots \end{bmatrix} = A^{-1}$$

where the AC's have the value of the augmentation constant (an input at the beginning of this block) or zero. The augmentation proceeds by beginning with the upper left element of the $\Gamma_2 Q\Gamma_2'$ matrix and progressively building up the dimension of this upper left partition. At each stage of the buildup, the rank of the upper left partition is tested. This is shown schematically below:

$$\Gamma_2 Q\Gamma_2' = \begin{bmatrix} - & - & 1 & & \\ - & - & - & 2 & \\ & & & \ddots & n \end{bmatrix}$$

If the nth partition of $\Gamma_2 Q\Gamma_2'$ is not of full rank, AC_n has the value of the augmentation constant. Otherwise, it has a zero value. This is a protective measure to insure that A exists. If A exists, the filter solutions obtained do not require differentiation of any measurement. This automatic augmentation of $\Gamma_2 Q\Gamma_2'$ can be avoided if the user specifies Γ_s, Γ_c, and Q such that $\Gamma_2 Q\Gamma_2'$ is nonsingular prior to augmentation. Both the EL_F and A matrices are written to the problem file, as well as the new dimensions (m_1, m_2, m_1'). For further information regarding the singular filter problem, see Ref. 4.

Restrictions: The following restrictions apply to data input in this portion of the problem:

1. RT-11 operating system will halt on a fatal error if either file name does not conform to its standard, or if there is not enough room on the disk to which to write the data.

2. The error message

   DIMENSIONS OUT OF RANGE FOR i, X(i)

   will be printed if a matrix diagonal element is specified with an i which exceeds the specified dimension.

3. The error message

   WRONG FORMAT

   is printed if a matrix element is unrecognizable (e.g., too many commas).

The following errors or warnings may occur in the course of the filter set up:

1. The following advisory information is printed if the G, Γ, or H matrices do not have full rank:

   G MATRIX DOES NOT HAVE FULL RANK
   GM MATRIX DOES NOT HAVE FULL RANK*
   H MATRIX DOES NOT HAVE FULL RANK

   Full rank is sometimes desired for each of these matrices so these advisories indicate possible problem ambiguities which should be considered before proceeding.

2. The following warning is printed if the matrix product $\Gamma_2 Q \Gamma_2'$ does not have full rank:

   GM2*QD*GM2T HAS BEEN AUGMENTED

   indicating that the augmentation constant was used to give $\Gamma_2 Q \Gamma_2'$ full rank so that it could be inverted.

* Rank test requires rank $n_w - n_{x_c}$ or greater.

Example: Figure 8 presents the input dialog for this block. Figure 9 presents some of the data which is output to the problem file. Notice that this problem is singular and requires reordering of the measurements and the states.

```
                FILTER SET-UP -- BLOCK 3

INPUT PROBLEM FILE NAME ? DX0:2BY2.B1
OUTPUT PROBLEM FILE NAME ? DX0:2BY2.B3
PROBLEM TITLE (20 CHARS) : FILTER SOLUTION
AUGMENTATION CONSTANT : 0.01
NON-ZERO DIAGONAL Q ELEMENTS
2,12.0
3,.01
0
NON-ZERO DIAGONAL R ELEMENTS :
2,4.
0
```

Figure 8. Input to Block 3

```
MEASUREMENT PARTITION : M1 =   1 M2 =   1
NUMBER OF FILTER STATES : M1P =  1
```

Q MATRIX DIAGONAL, FILTER 1

0.000	1 W01
12.0	2 W02
0.100E-01	3 WX1
0.000	4 WX2

R MATRIX DIAGONAL, FILTER 1

4.00	1 Z02
0.000	2 Z01

Notice Reordering of Measurements

F11 MATRIX 1 E07

-3.00	1 E07

F12 MATRIX 1 Z01

-2.00	1 E07

F21 MATRIX 1 E07

1.00	1 Z01

F22 MATRIX 1 Z01

0.000	1 Z01

Partioned F Matrix

EULER LAGRANGE SYS MATRIX, FILTER

1 E07	2 E07	
-3.00	-12.0	1 E07
-100.	3.00	2 E07

Closed-loop System Matrix from root square locus

Figure 9. Output from Block 3; Filter Solution Set-Up

SECTION V

FILTER GAINS, ESTIMATION ERROR — BLOCK 4

Purpose: This routine uses an eigenvector decomposition method to solve the algebraic Riccati equation using the Euler-Lagrange system matrix computed in Block 3. This results in closed loop eigenvalues and eigenvectors and Riccati equation solutions from which the filter gains can be computed. Also computed are the rms vector and correlation matrix for the state estimation error.

Input: The input to this block consists of the input problem file title and the output problem file title — both entries are prompted by the software.

Output: The filter solution is obtained via eigenvector decomposition using the QR algorithm (see Ref. 5). Open-loop plant eigenvalues and closed loop eigenvalues and eigenvectors are computed and written to the problem file (eigenvectors are normalized). The Riccati matrix, P_x, is computed and from this the filter gains are computed:

$$K_{11} = P_x H_{11}' R^{-1}$$

$$K = (P_x F_{21}' + \Gamma_1 Q \Gamma_2')A$$

The K_{11} gains operate on the noisy measurements, while the K_{12} gains operate on the noise-free measurements in generating estimates of the plant states. Figure 10 shows the form of the filter solution in terms of K_{11}, K_{12}, and the partitions of the plant matrices. Finally, the equation

$$\sigma_i = \sqrt{(T^{-1} P_x T^{-T})_{ii}}$$

is used to compute the rms estimation error distributed across the original states — the corresponding correlation

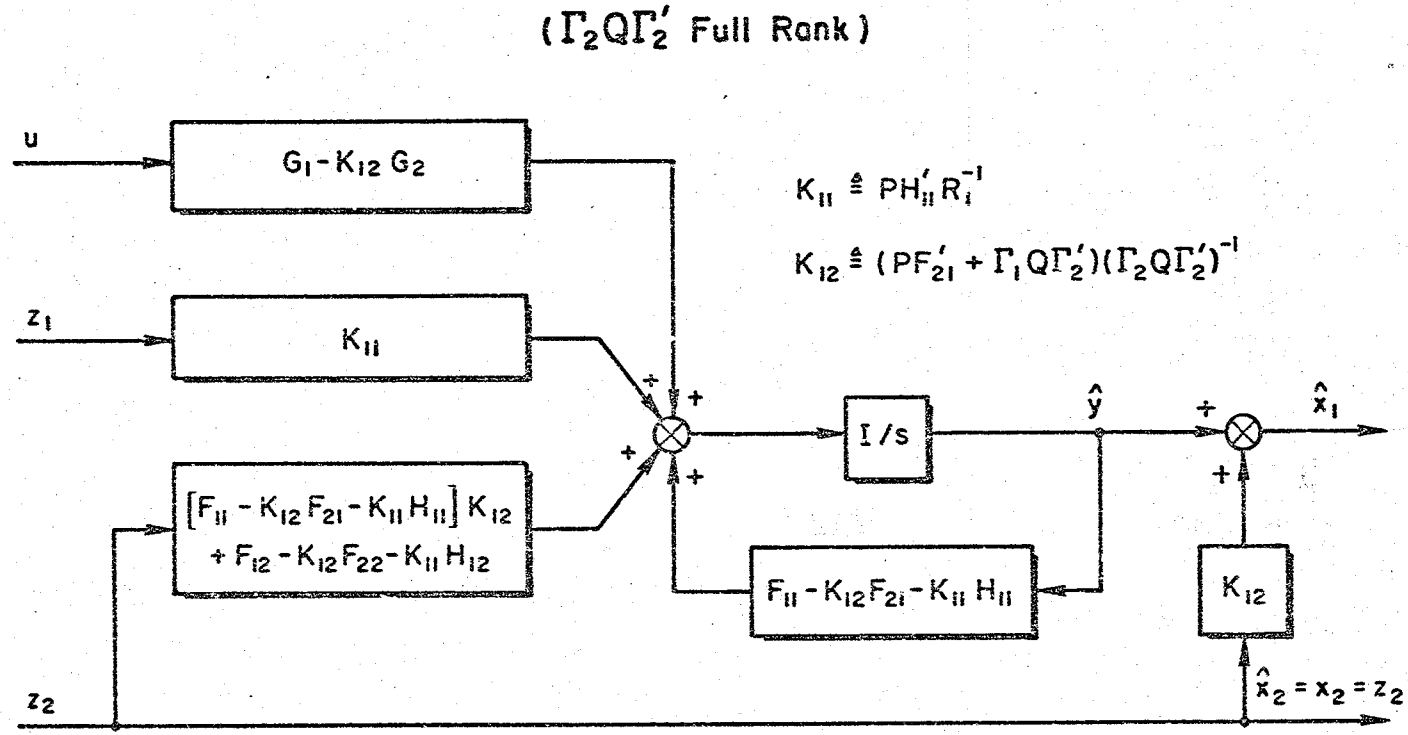

Figure 10. Filter-Observer Structure

matrix is also computed. The Riccati matrix, filter gains, rms vector, and correlation matrix are all written to the problem file.

Restrictions: On input a fatal error will be trapped by the RT-11 operating system if the filter names specified are not in accordance with the standard, or if there is not enough free space on the disk to write the output problem file. During the eigenvector decomposition and subsequent computations, the following errors can occur:

1. The error message

   ERROR COMPUTING CLOSED LOOP EIGENSYSTEM

   will be printed and execution halted if the eigensystem subroutine failed to converge on a given eigenvalue.

2. The warning

   REAL PART OF C.L. EIGENVALUE = 0.0

   will be printed if the real part of a closed-loop eigenvalue is identically zero. If this occurs, the selection of eigenvectors used in eigenvector decomposition will probably not be correct.*

3. The error message

   ERROR IN EIGENVALUE SELECTION

   will be printed and execution halted if there are not m_1 eigenvalues with positive real parts.*

4. The error message

   ERROR IN EIGENVECTOR DECOMPOSITION

   will be printed and execution halted if the matrix used to compute the Riccati matrix is singular.

---

* This is a limitation of the current software rather than a theoretical limition of the computational method.

5. The warning

FILTER RICCATI MATRIX NOT NON-NEGATIVE

will be printed if any diagonal element of P_X is less than zero. That element will be set to zero (as well as the intersecting row and column) elements and execution resumed.

Example: Figure 11 presents the input dialog for this block; Fig. 12 contains some of the matrices which are computed. Note that the closed loop filter eigenvalues will appear as a closed loop roots in the final closed loop system transfer functions.

```
FILTER GAINS, ESTIMATION ERROR — BLOCK 4
 INPUT PROBLEM FILE NAME ? DX0:2BY2.B3
 OUTPUT PROBLEM FILE NAME ? DX0:2BY2.B4
```

Figure 11. Input for Block 4

CLOSED LOOP EIGENVALUES, FILTER
1

34.8 180.	1 E07

Eigenvalues are in polar form with argument in degrees

K11 GAIN MATRIX, FILTER
1
Z02

0.793E-01	1 E07

K12 GAIN MATRIX, FILTER
1
Z01

31.7	1 E07

EXX denotes a filter state variable

RMS STATE EST ERROR, FILTER
1

0.000	1 X06
0.563	2 X07

Figure 12. Output from Block 4; Singular Filter Solution

SECTION VI

REGULATOR GAINS — BLOCK 5

Purpose: This block accepts user input of the Q_R and R_R non-zero diagonal elements and uses this information and information computed in Block 1 to solve the regulator problem. Note that solution of the regulator problem is in no way dependent upon the filter solution. The regulator problem, like the filter problem, is solved via eigenvector decomposition.

Input: The input to this routine is analogous to Block 3 and is prompted by the software. It includes:

1. Input problem file name.
2. Output problem file name.
3. Title for regulator solution, 20 characters.
4. The non-zero diagonal elements of the Q_R matrix, in the format

   $$i,\ Q_R(i)\quad (n_{yT})$$

   where i is the row and column integer of the real element $Q_R(i)$. The end of the Q_R input is signaled by an integer zero.
5. The non-zero diagonal elements of the R_R matrix, in the format

   $$i,\ R_R(i)\quad (n_u)$$

   where i is the row and column integer of the real element $R_R(i)$. The end of the R_R input is signaled by the integer zero.

Output: The first step in computing the regulator gains is to form the Euler-Lagrange system matrix, as follows:

$$EL_R = \begin{bmatrix} F' & H'Q_RH \\ GR_R^{-1}G' & -F \end{bmatrix}$$

Using this matrix, the open loop eigenvalues, closed loop eigenvalues, and normalized eigenvectors are computed. All are written to the output problem file, along with the Q_R, R_R, and EL_R matrices. The closed loop eigenvectors are used to compute the Riccati matrix via eigenvector decomposition. The Riccati matrix, S, is used in turn to compute the regulator gains:

$$C = R_R^{-1}G'S$$

The S and C matrices are written to the output problem file.

Restrictions: The following errors will be signaled if found in the input data:

1. RT-11 operating system will halt execution with a fatal error if the problem file names are not input in accordance with the proper file name specification, or if there is not enough contiguous free space on the disk to accommodate the output file.

2. The error message

   DIMENSIONS OUT OF RANGE FOR i, X(i)

   will be printed if i exceeds the specified dimension of X.

3. The error message

   WRONG FORMAT

   will be printed if the matrix entry is unrecognizable [e.g., decimal point missing from X(i)].

The following errors may be flagged during eigenvector decomposition and regulator gain computation:

1. The error message

   RRD DOES NOT HAVE FULL RANK

   will be printed and execution halted if any diagonal element of R_R is zero.

2. The error message

   ERROR COMPUTING CLOSED LOOP EIGENSYSTEM

   will be printed and execution halted if the eigensystem subroutine failed to converse on a given eigenvalue.

3. The warning

   REAL PART OF C.L. EIGENVALUE = 0.0

   will be printed if the real part of a closed loop eigenvalue is identically zero. If this occurs, the selection of eigenvectors used in eigenvector decomposition will probably not be correct.*

4. The error message

   ERROR IN EIGENVALUE SELECTION

   will be printed and execution halted if there are not n_{xT} eigenvalues with positive real parts.*

5. The error message

   ERROR IN EIGENVECTOR DECOMPOSITION

   will be printed and execution halted if the matrix used to compute the Riccati matrix is singular.

Example: Figure 13 is the computer dialog for Block 5; Fig. 14 is a sample of the output from this routine. Notice that the closed loop eigenvalues from the regulator solution are closed loop roots of the overall system.

---

* This characteristic of the software currently denies the possibility of designing optimal regulators having one or more closed loop eigenvalues having zero or negative real part. This software characteristic can be modified to accommodate these cases, as this limitation is not a theoretical one.

```
REGULATOR GAINS — BLOCK 5

INPUT PROBLEM FILE NAME ? DXO:2BY2.B4
OUTPUT PROBLEM FILE NAME ? DXO:2BY2.B5
PROBLEM TITLE (20 CHARS) : REGULATOR SOLUTION
NON-ZERO DIAGONAL QR ELEMENTS:
2,5.
0
NON-ZERO DIAGONAL RR ELEMENTS :
1,.14286
2,.25
```

Figure 13. Input for Block 5

Q MATRIX DIAGONAL, REGULATOR 1

	1
0.000	Z01
	2
5.00	Z02

R MATRIX DIAGONAL, REGULATOR 1

	1
0.143	U01
	2
0.250	U02

CLOSED LOOP EIGENVALUES, REGULATOR 1

3.00	1
180.	X06
4.00	2
180.	X07

REGULATOR GAIN MATRIX

1 X06	2 X07	
1.75	-0.875	1 U01
-0.500	2.25	2 U02

Figure 14. Output from Block 5; Regulator Solution

SECTION VII

SENSITIVITY — BLOCK 6

Purpose: This routine computes the normalized sensitivity of the closed loop regulator eigenvalues to changes in the F, G, and C matrices. Such sensitivity calculations can be used to identify the important elements of a given gain matrix or parameters in the plant matrices to which the controller design is highly sensitive. The normalized sensitivity can be considered a measure of the fractional eigenvalue shift per unit fractional change in a matrix element. For further treatment of this topic, see Ref. 6. Execution of this block must be preceded by execution of Block 5.

Input: Input to this block consists of three elements: the input problem file name, the output problem file name, and the 20 character title to be associated with this portion of the problem.

Output: Mathematically, the following normalized sensitivities are computed for each distinct eigenvalue and stored in the output problem file:

$$\hat{\frac{\partial \lambda_i}{\partial F_{jk}}} = \frac{\frac{\partial \lambda_i}{\partial F_{jk}} F_{jk}}{\lambda_i}$$

$$\hat{\frac{\partial \lambda_i}{\partial G_{jk}}} = \frac{\frac{\partial \lambda_i}{\partial G_{jk}} G_{jk}}{\lambda_i}$$

$$\hat{\frac{\partial \lambda_i}{\partial C_{jk}}} = \frac{\frac{\partial \lambda_i}{\partial C_{jk}} C_{jk}}{\lambda_i}$$

where

$\hat{(\cdot)}$ is normalized of $(\cdot)$

λ_i is the ith eigenvalue

X_{jk} (where X = F, G, or C) is the element of X in the jth row, kth column

Thus, for each eigenvalue three matrices are computed; each matrix contains complex numbers which indicate the normalized sensitivity of the particular eigenvalue to the corresponding element in the original gain matrix. Small numbers in the sensitivity matrix indicate insensitivity of the appropriate regulator eigenvalue (and thus, the appropriate closed loop root) to the element in the corresponding matrix. All sensitivity matrices are written to the output problem file.

Restrictions: RT-11 operating system will halt with a fatal error if the problem file names are incorrectly specified, or if contiguous disk space is not available for the output file.

The error message

ERROR INVERTING EIGENVECTOR MATRIX

will be printed and execution halted if the eigenvector matrix is singular.

Example: Figure 15 is the input dialog for this block. Figure 16 presents illustrative sensitivity matrices for the example problem.

```
        SENSITIVITY — BLOCK 6

INPUT PROBLEM FILE NAME ? DX0:2BY2.B5

OUTPUT PROBLEM FILE NAME ? DX0:2BY2.B6

PROBLEM TITLE (20 CHARS) : SENSITIVITY
```

Figure 15. Input for Block 6

NORMALIZED F MATRIX SENSITIVITY TO EIGENVALUE : -4.00 0.000

1 X06	2 X07	
0.000 90.0	0.500 0.000	1 X06
1.25 0.000	1.25 180.	2 X07

Sensitivity vectors are in polar form with the argument in degrees

NORMALIZED G MATRIX SENSITIVITY TO EIGENVALUE : -4.00 0.000

1 U01	2 U02	
1.75 180.	0.000 90.0	1 X06
0.000 90.0	1.25 0.000	2 X07

NORMALIZED C MATRIX SENSITIVITY TO EIGENVALUE : -4.00 0.000

1 X06	2 X07	
1.31 180.	0.437 180.	1 U01
0.312 0.000	0.937 0.000	2 U02

Figure 16. Output for Block 6; Closed-Loop Regulator Eigenvalue Sensitivities

SECTION VIII

CONTROLLER --- BLOCK 7

Purpose: This routine combines the filter and the regulator solutions to compute coefficient matrices which define the optimal controller. Use of this block presumes a filter solution; a regulator solution is optional. If a regulator solution is not provided, the regulator gain matrix, C, is set to zero.

Input: Inputs to this block consist of the input problem file name, the output problem file name, and a 20 character problem title. All inputs are prompted by the software.

Output: The controller structure is defined by the following equations.

$$\dot{\hat{y}}(m_1') = A_F(m_1', m_1') \times \hat{y}(m_1') + B_F(m_1', n_z) \times z(n_z)$$

$$u(n_u) = C_F(n_u, m_1') \times \hat{y}(m_1') + D_F(n_u, n_z) \times z(n_z)$$

where $\hat{y}$ = filter states

The coefficient matrices in the controller equations are defined by:

$$A_F = \left[F_{11}-K_{12}F_{21}-K_{11}H_{11}-(G_1-K_{12}G_2)CT^{-1}\begin{bmatrix}I\\0\end{bmatrix}\right]$$

$$B_F = \left[K_{11} \;\vdots\; (F_{11}-K_{12}F_{21}-K_{11}H_{11})K_{12}+F_{12}-K_{12}F_{22}-K_{11}H_{12}\right] T_z$$
$$-\left[(G_1-K_{12}G_2)CT^{-1}\begin{bmatrix}0 & K_{12}\\0 & I\end{bmatrix}\right]T_z$$

$$C_F = -CT^{-1}\begin{bmatrix}I\\0\end{bmatrix}$$

$$D_F = -CT^{-1}\begin{bmatrix}0 & K_{12}\\0 & I\end{bmatrix}T_z$$

In addition, a controller system matrix, A_c, is computed to be used in the closed loop system performance analysis, Block 10:

$$A_c(n_{xT} + m_i', n_{xT} + m_i') = \begin{bmatrix} F + G[D_F \mid 0]H & GC_F \\ [B_F \mid 0]H & A_F \end{bmatrix}$$

The controller coefficient matrices and the A_c matrix are written to the output problem file.

Restrictions: RT-11 operating system will halt with a fatal error if the input and output problem file names are incorrectly specified, or if there is not enough contiguous disk space for the output problem file.

Example: Figure 17 is the input dialog for this block; Fig. 18 presents the controller coefficient matrices for the example problem.

```
CONTROLLER --- BLOCK 7

INPUT PROBLEM FILE NAME ? DXO:2BY2.B6
OUTPUT PROBLEM FILE NAME ? DXO:2BY2.B7
PROBLEM TITLE (20 CHARS) : CLOSED LOOP PA
```

Figure 17. Input for Block 7

AF MATRIX

1	
E07	
-64.8	1 E07

BF MATRIX

1	2	
Z01	Z02	
-0.200E+04	0.793E-01	1 E07

CF MATRIX

1	
E07	
0.875	1 U01
-2.25	2 U02

DF MATRIX

1	2	
Z01	Z02	
26.0	0.000	1 U01
-70.9	0.000	2 U02

Figure 18. Output for Block 7; Controller Coefficient Matrices

SECTION IX

CONTROLLER DEFINITION --- BLOCK 8

Purpose: This routine uses the controller equations generated in Block 7 to produce a TRFN-compatible file. Controller transfer functions can be computed using this file and the TRFN program (Ref. 2).

Input: The inputs to this block consist of the input problem file name, the output TRFN file name, and a 60 character title for the TRFN file. All are prompted by the software.

Output: The output from this block is a TRFN-compatible file — for a complete description, see Ref. 2. The general form of the controller representation is:

$$A_{TF}x_{TF} = B_{TF}u_{TF}$$

where

$$x_{TF}(m_1'+n_u) = \begin{Bmatrix} \hat{y}(m_1') \\ u(n_u) \end{Bmatrix}$$

$$u_{TF}(n_z) = \begin{Bmatrix} z_1(m_1) \\ z_2(m_2) \end{Bmatrix}$$

$$A(m_1'+n_u, m_1'+n_u) = \begin{bmatrix} (sI-[F_{11}-K_{12}F_{21}-K_{11}H_{11}]) & (-G_1+K_{12}G_2) \\ C_T^{-1}\begin{bmatrix} I \\ 0 \end{bmatrix} & I \end{bmatrix}$$

$$B(m_1'+n_u, n_z) = \begin{bmatrix} K_{11} & ([F_{11}-K_{12}F_{21}-K_{11}H_{11}]K_{12}+F_{12}-K_{12}F_{22}-K_{11}H_{12}) \\ 0 & -C_T^{-1}\begin{bmatrix} 0 & K_{12} \\ 0 & I \end{bmatrix} \end{bmatrix}$$

Restrictions: RT-11 operating system will halt with a fatal error if either file name is specified incorrectly, or if there is not enough contiguous space on the disk to accommodate the output TRFN file.

Example: Figure 19 is the dialog used on input to this block; Fig. 20 lists the resulting TRFN file.

```
        CONTROLLER DEFINITION --- BLOCK 8

INPUT PROBLEM FILE NAME ? DX0:2BY2.B7

OUTPUT TRFN FILE NAME ? DX0:2BY2.B8

TRFN TITLE (60 CHARS) :

2BY2 EXAMPLE CONTROLLER TRANSFER FUNCTIONS
```

Figure 19. Input for Block 8

```
      1       1  0.0000000E+00  0.1000000E+01  0.3489312E+02       0
      2       1  0.0000000E+00  0.0000000E+00 -0.8749831E+00       0
      3       1  0.0000000E+00  0.0000000E+00  0.2250000E+01       0
      1       2  0.0000000E+00  0.0000000E+00  0.3173445E+02       0
      1       3  0.0000000E+00  0.0000000E+00 -0.1000000E+01       0
      2       2  0.0000000E+00  0.0000000E+00  0.1000000E+01       0
      3       3  0.0000000E+00  0.0000000E+00  0.1000000E+01       0
      0
      1       1  0.0000000E+00  0.0000000E+00  0.7933613E-01       0
      1       2  0.0000000E+00  0.0000000E+00 -0.1106796E+04       0
      2       2  0.0000000E+00  0.0000000E+00  0.2601713E+02       0
      3       2  0.0000000E+00  0.0000000E+00 -0.7090252E+02       0
      0
2BY2 EXAMPLE   CONTROLLER TRANSFER FUNCTIONS
      3       2       0
E07 U01 U02
Z02 Z01
```

This output file format is described in Fig. 7.

Figure 20. Output File Listing for Block 8

SECTION X

CLOSED LOOP SYSTEM DEFINITION — BLOCK 9

Purpose: This routine uses the controlled element equation developed in Block 1 and the controller equations from Block 7 to compute a TRFN-compatible file from which closed loop system transfer functions can be obtained. In addition, the I_M identity matrix (refer to Fig. 2) can have some or all of its diagonal elements zeroed. This has the effect of selectively opening loops at the point of measurement. This, in turn, allows computation of any desired opened loop transfer functions.

Input: The inputs to this routine consist of the following:

1. The input problem file name.
2. The output TRFN file name.
3. The n_z diagonal elements of I_M. These are all input on one line, separated by commas. For the closed loop system, all have a value of 1.0. If opened loop transfer functions are desired, the elements of the I_M diagonal corresponding to the opened loops should have a value of 0.0.
4. The 60 character title for the TRFN file.

All inputs are prompted.

Output: The output from this block is a TRFN-compatible file — for a complete description, see Ref. 2. The general form of the file is:

$$A_{TF}x_{TF} = B_{TF}u_{TF}$$

where

$$x_{TF}(n_{xC}+m_1'+n_{yT}) = \begin{Bmatrix} x_C(n_{xC}) \\ \hat{y}(m_1') \\ y(n_{yT}) \end{Bmatrix}$$

$$u_{TF}(n_{yS}+n_z+n_{yS}+n_{yS}) = \begin{Bmatrix} t_S(n_{yS}) \\ t_V(n_z) \\ t_{OL}(n_{yS}) \\ w(n_{yS}) \end{Bmatrix}$$

$$A_{TF}(n_{xC} + m_1' + n_{yT},\ n_{xC} + m_1' + n_{yT})$$

$$= \begin{bmatrix} sI - (F_C + G_C D_F I_M H_M) & -G_C C_F & 0 \\ -B_F I_M H_M & sI - A_F & 0 \\ H_{TF} & 0 & I \end{bmatrix}$$

$$H_{TF} = \begin{bmatrix} H_M \\ H_O \end{bmatrix}$$

$$B_{TF}(n_{xC} + m_1 + n_{yT},\ n_{yS} + n_z + n_{yS} + n_{yS})$$

$$= \begin{bmatrix} C_C + G_C D_F I_M F_M & G_C D_F & G_C D_F F_M & \Gamma_C \\ B_F I_M F_M & B_F & B_F F_M & 0 \\ E_1 & 0 & 0 & 0 \end{bmatrix}$$

Restrictions: RT-11 operating system will halt with a fatal error if either file name is specified incorrectly, or if there is not enough contiguous disk space available for the TRFN file output.

Example: Figure 21 is the dialog used with this block; Fig. 22 lists the resulting TRFN file generated. This output file format is described in Fig. 7.

```
      CLOSED LOOP SYSTEM DEFINITION — BLOCK 9
INPUT PROBLEM FILE NAME ? DX0:2BY2.B7
OUTPUT TRFN FILE NAME ? DX0:2BY2.B9
TRFN TITLE (60 CHARS):
2BY2 EXAMPLE CLOSED LOOP SYSTEM TRANSFER FUNCTIONS
IM DIAGONAL ELEMENTS (NZ-OF-THEM):
1.,1.
```

Figure 21. Input for Block 9

```
     1        1   0.0000000E+00  0.1000000E+01 -0.2601713E+02        0
     1        2   0.0000000E+00  0.0000000E+00 -0.1000000E+01        0
     2        1   0.0000000E+00  0.0000000E+00  0.7290252E+02        0
     2        2   0.0000000E+00  0.1000000E+01  0.3000000E+01        0
     3        1   0.0000000E+00  0.0000000E+00  0.2003338E+04        0
     3        2   0.0000000E+00  0.0000000E+00 -0.7933613E-01        0
     4        1   0.0000000E+00  0.0000000E+00 -0.1000000E+01        0
     5        2   0.0000000E+00  0.0000000E+00 -0.1000000E+01        0
     1        3   0.0000000E+00  0.0000000E+00 -0.8749831E+00        0
     2        3   0.0000000E+00  0.0000000E+00  0.2250000E+01        0
     3        3   0.0000000E+00  0.1000000E+01  0.6483090E+02        0
     4        4   0.0000000E+00  0.0000000E+00  0.1200000E+01        0
     5        5   0.0000000E+00  0.0000000E+00  0.1000000E+01        0
     0
     1        1   0.0000000E+00  0.0000000E+00  0.2601713E+02        0
     2        1   0.0000000E+00  0.0000000E+00 -0.7290252E+02        0
     3        1   0.0000000E+00  0.0000000E+00 -0.2003338E+04        0
     3        2   0.0000000E+00  0.0000000E+00  0.7933613E-01        0
     1        3   0.0000000E+00  0.0000000E+00  0.1000000E+01        0
     2        4   0.0000000E+00  0.0000000E+00  0.1000000E+01        0
     0
2BY2 EXAMPLE  CLOSED LOOP SYSTEM TRANSFER FUNCTIONS
     5        4        0
X01 X02 E01 Z01 Z02
V01 V02 W01 W02
```

Figure 22. Output File Listing for Block 9

SECTION XI

STOCHASTIC PERFORMANCE ANALYSIS — BLOCK 10

Purpose: This routine computes the rms and covariance matrices arising from process noise, measurement noise, and the total for both noise components. These matrices are computed for both the closed loop system state vector and a vector composed of the outputs and controls. For the state vector this is accomplished by solving the equation

$$A(COV) + (COV)A' + Q = 0$$

for the covariance, COV. In addition, the correlation matrix for output and controls is computed. Execution of this block must be preceded by execution of Block 7.

Input: The input to this block consists of the problem file name for the input, and the problem file name for the output. Both are prompted by the software.

Output: A steady state covariance routine is used to solve the equation

$$A(COV) + (COV)A' + Q = 0$$

for COV given A for a stable system. The A_C matrix used here is computed and output by Block 6:

$$A_C = \begin{bmatrix} F + G[D_F \mid 0]H & GC_F \\ [B_F \mid 0]H & A_F \end{bmatrix}$$

The Q_W matrix used to compute the process noise contribution to the covariance matrix is

$$Q_W = \begin{bmatrix} \Gamma \\ 0 \end{bmatrix} Q \begin{bmatrix} \Gamma' & 0 \end{bmatrix}$$

The Q_V matrix used to compute the measurement noise contribution to the covariance matrix is

$$Q_v = \begin{bmatrix} 0 \\ B_F \end{bmatrix} T_Z^{-1} R T_Z^{-T} [0 \quad B_F']$$

From these Q's and A_c, the covariance matrices COV_w and COV_r are computed. The total covariance is the sum:

$$COV_{TOT} = COV_w + COV_v$$

The covariance of the output and controls is obtained as follows:

$$COV_{yu} = \begin{bmatrix} H_R & 0 \\ D_F H & C_F \end{bmatrix} COV_{TOT} \begin{bmatrix} H_R' & H' D_F' \\ 0 & C_F' \end{bmatrix}$$

The rms vectors are computed from the covariance matrices. All rms vectors and covariance matrices are written to the output file.

Restrictions: RT-11 operating system will halt with a fatal error if either file name is not input according to convention, or if disk space is not available for the output file.

Example: Figure 23 presents the input dialog for this block; Fig. 24 contains some rms vectors which are computed for the example problem.

```
STOCHASTIC PERFORMANCE ANALYSIS — BLOCK 10

  INPUT PROBLEM FILE NAME ? DX0:2BY2.B7

  OUTPUT PROBLEM FILE NAME ? DX0:2BY2.B10
```

Figure 23. Input to Block 10

RMS, PROCESS NOISE

1

	1
0.497	X06
	2
1.10	X07
	3
15.3	E07

RMS, MEASUREMENT NOISE

1

	1
8.72	X06
	2
27.6	X07
	3
279.	E07

RMS, TOTAL

1

	1
8.74	X06
	2
27.7	X07
	3
280.	E07

RMS, OUTPUT+CONTROLS

1

	1
8.74	Z01
	2
27.7	Z02
	3
138.	U01
	4
364.	U02

Figure 24. Output for Block 10

SECTION XII

SERVICE ROUTINE

Purpose: This routine allows the user to access the output problem files and format the data in a report-ready form.

Input: The user inputs the name of the output problem file to be accessed, and then the numbers identifying the elements in that file which are to be printed. Table 1 lists the elements available for printout. Notice that the complete list is only applicable when all blocks have been run. Otherwise, only an appropriate subset of the elements can be located in a given problem file. An index of zero terminates the file element requests.

Output: The output of the service routine is a formatted listing of the desired elements of the problem file.

Restrictions: RT-11 operating system will halt with a fatal error if the problem file name is incorrectly specified.

Example: Figure 25 is the dialog used to obtain the file element shown in Fig. 24.

```
PROBLEM FILE NAME ? DXC:2BY2.B10
INPUT INDEX OF EACH ELEMENT TO BE LISTED
ONE PER LINE — LAST INDEX SHOULD BE 0
122
124
126
128
0
```

Figure 25. Service Routine Input

TABLE 1. INDEX TO PROBLEM FILE ELEMENTS

INDEX	BLOCK CREATED	ELEMENT	ROW DIM	COLUMN DIM
1	Block 1	Title	—	—
2		Input dimensions	—	—
3		u mnemonics	1	n_u
4		w mnemonics	1	n_w
5		y_S mnemonics	1	n_{yS}
6		v mnemonics	1	n_z
7		t_{OL} mnemonics	1	n_{yS}
8		y_M mnemonics	1	n_z
9		y_O mnemonics	1	n_{yO}
10		z mnemonics	1	n_z
11		x_S mnemonics	1	n_{xS}
12		x_C mnemonics	1	n_{xC}
13		Γ_S	n_{xS}	n_w
14		F_S	n_{xS}	n_{xS}
15		H_S	n_{yS}	n_{xS}
16		Γ_C	n_{xC}	n_w
17		G_C	n_{xC}	n_u
18		C_C	n_{xC}	n_{yS}
19		F_C	n_{xC}	n_{xC}
20		H_M	n_z	n_{xC}
21		F_M	n_z	n_{yS}
22		H_O	n_{yO}	n_{xC}
23		F_O	n_{yO}	n_{yS}
24		F	n_{xT}	n_{xT}
25		G	n_{xT}	n_u
26		Γ	n_{xT}	n_w
27		H	n_z	n_{xT}
28		H_R	n_{yT}	n_{xT}
29		E_1	n_{yT}	n_{yS}
30		E_2	n_z	n_{yS}

TABLE 1 (Continued)

INDEX	BLOCK CREATED	ELEMENT	ROW DIM	COLUMN DIM
31	Block 1	E_3	n_{xT}	n_{yS}
32	Block 3	v mnemonics (reordered)	1	n_z
33		z mnemonics (reordered)	1	n_z
34		x mnemonics (reordered)	1	n_{xT}
35		T_z	n_z	n_z
36		T	n_{xT}	n_{xT}
37		T^{-1}	n_{xT}	n_{xT}
38		F_{11}	m_1'	m_1'
39		F_{12}	m_1'	m_2
40		F_{21}	m_2	m_1'
41		F_{22}	m_2	m_2
42		G_1	m_1'	n_u
43		G_2	m_2	n_u
44		Γ_1	m_1'	n_w
45		Γ_2	m_2	n_w
46		H^*T	n_z	n_{xT}
47		H_{11}	m_1	m_1'
48		H_{12}	m_1	m_2
49		H_{22}	m_2	m_2
50		Q	1	n_w
51		R	1	n_z
52		EL_F	$2m_1'$	$2m_1'$
53		A	m_2	m_2
54		filter dimensions: m_1, m_1', m_2	—	—
55	Block 4	λ_{OL}	1	m_1'
56		λ_{CL}	1	m_1'
57		$W_{21}(\lambda)_{CL}$ (eigenvector partition for λ_{CL})	m_1'	m_1'
58		P	m_1'	m_1'
59		K_{11}	m_1'	m_1
60		K_{12}	m_1'	m_2

* σ ≡ rms vector.

TABLE 1 (Continued)

INDEX	BLOCK CREATED	ELEMENT	ROW DIM	COLUMN DIM
61	Block 4	σ_F^*	1	m_1'
62	↓	$\rho_F^\dagger$	m_1'	m_1'
63	Block 5	Q_R	1	n_{yT}
64		R_R	1	n_u
65		EL_R	$2n_{xT}$	$2n_{xT}$
66		λ_{OL}	1	n_{xT}
67		λ_{CL}	1	n_{xT}
68		$W_{21}(\lambda)_{CL}$ (eigenvector partition for λ_{CL})	n_{xT}	n_{xT}
69		S	n_{xT}	n_{xT}
70	↓	C	n_u	n_{xT}
71	Block 6	$\partial\lambda_1/\partial F$	n_{xT}	n_{xT}
72		$\partial\lambda_1/\partial G$	n_{xT}	n_u
73		$\partial\lambda_1/\partial C$	n_u	n_{xT}
74		$\partial\lambda_2/\partial F$	n_{xT}	n_{xT}
75		$\partial\lambda_2/\partial G$	n_{xT}	n_u
76		$\partial\lambda_2/\partial C$	n_u	n_{xT}
77		$\partial\lambda_3/\partial F$	n_{xT}	n_{xT}
78		$\partial\lambda_3/\partial G$	n_{xT}	n_u
79		$\partial\lambda_3/\partial C$	n_u	n_{xT}
80		$\partial\lambda_4/\partial F$	n_{xT}	n_{xT}
81		$\partial\lambda_4/\partial G$	n_{xT}	n_u
82		$\partial\lambda_4/\partial C$	n_u	n_{xT}
83		$\partial\lambda_5/\partial F$	n_{xT}	n_{xT}
84		$\partial\lambda_5/\partial G$	n_{xT}	n_u
85		$\partial\lambda_5/\partial C$	n_u	n_{xT}
86		$\partial\lambda_6/\partial F$	n_{xT}	n_{xT}
87		$\partial\lambda_6/\partial G$	n_{xT}	n_u
88	↓	$\partial\lambda_6/\partial C$	n_u	n_{xT}

* $\sigma \equiv$ rms vector.
† $\rho \equiv$ correlation matrix.

TABLE 1 (Continued)

INDEX	BLOCK CREATED	ELEMENT	ROW DIM	COLUMN DIM
89	Block 6	$\partial\lambda_7/\partial F$	n_{xT}	n_{xT}
90		$\partial\lambda_7/\partial G$	n_{xT}	n_u
91		$\partial\lambda_7/\partial C$	n_u	n_{xT}
92		$\partial\lambda_8/\partial F$	n_{xT}	n_{xT}
93		$\partial\lambda_8/\partial G$	n_{xT}	n_u
94		$\partial\lambda_8/\partial C$	n_u	n_{uT}
95		$\partial\lambda_9/\partial F$	n_{xT}	n_{xT}
96		$\partial\lambda_9/\partial G$	n_{xT}	n_u
97		$\partial\lambda_9/\partial C$	n_u	n_{xT}
98		$\partial\lambda_{10}/\partial F$	n_{xT}	n_{xT}
99		$\partial\lambda_{10}/\partial G$	n_{xT}	n_u
100		$\partial\lambda_{10}/\partial C$	n_u	n_{xT}
101		$\partial\lambda_{11}/\partial F$	n_{xT}	n_{xT}
102		$\partial\lambda_{11}/\partial G$	n_{xT}	n_u
103		$\partial\lambda_{11}/\partial C$	n_u	n_{xT}
104		$\partial\lambda_{12}/\partial F$	n_{xT}	n_{xT}
105		$\partial\lambda_{12}/\partial G$	n_{xT}	n_u
106		$\partial\lambda_{12}/\partial C$	n_u	n_{xT}
107		$\partial\lambda_{13}/\partial F$	n_{xT}	n_{xT}
108		$\partial\lambda_{13}/\partial G$	n_{xT}	n_u
109		$\partial\lambda_{13}/\partial C$	n_u	n_{xT}
110		$\partial\lambda_{14}/\partial F$	n_{xT}	n_{xT}
111		$\partial\lambda_{14}/\partial G$	n_{xT}	n_u
112		$\partial\lambda_{14}/\partial C$	n_u	n_{xT}
113		$\partial\lambda_{15}/\partial F$	n_{xT}	n_{xT}
114		$\partial\lambda_{15}/\partial G$	n_{xT}	n_u
115		$\partial\lambda_{15}/\partial C$	n_u	n_{xT}
116	Block 7	A_F	m_1'	m_1'
117		B_F	m_1'	n_z
118		C_F	n_u	m_1'
119		D_F	n_u	n_z

TABLE 1 (Concluded)

INDEX	BLOCK CREATED	ELEMENT	ROW DIM	COLUMN DIM
120	Block 7	A_c	$n_{xT}+m_1'$	$n_{xT} + m_1'$
121	Block 10	COV_w^*	$n_{xT}+m_1'$	$n_{xT} + m_1'$
122	↓	σ_w	1	$n_{xT} + m_1'$
123		COV_v^*	$n_{xT}+m_1'$	$n_{xT} + m_1'$
124		σ_v	1	$n_{xT} + m_1'$
125		C_{TOT}	$n_{xT}+m_1$	$n_{xT} + m_1$
126		σ_{TOT}	1	$n_{xT} + m_1$
127		C_{yu}	$n_{yT}+n_u$	$n_{yT} + n_u$
128		σ_{yu}	1	$n_{yT} + n_u$
129		ρ_{yu}	$n_{yT}+n_u$	$n_{yT} + n_u$

* COV ≡ covariance matrix.

SECTION XIII

CLASSICAL CONTROL PROCEDURES

For the sake of completeness, Figs. 26, 27, and 28 are included to present example closed loop transfer functions (computed using TRFN), frequency response plots (computed using USAM2), and transient response plots (computed using USAM2). Each of these STI-proprietary software packages have public domain counterparts.

```
GO (Y7LIB)ETRFN

                              1-Feb-79    17:24

  INPUT DATA FILE NAME:  2X2

  CASE:  2X2 EXAMPLE CASE CLOSED LOOP SYSTEM TRANSFER FUNCTIONS

DENOMINATOR:

   1.0000
  ( 3.0000     ) ( 4.0000     ) ( 34.014     )
  < 417.76     >


NUMERATOR:  X06/V01

   26.017
  ( 2.3806     ) (-4.6493     )
  <-287.96     >


NUMERATOR:  X07/V01

   -70.903
  (-.69486     ) ( 2.6863     )
  < 132.35     >


NUMERATOR:  E07/V01

   -2003.3
  ( .99926     ) ( 2.0036     )
  <-4010.8     >


NUMERATOR:  Z01/V01

   26.017
  ( 2.3806     ) (-4.6493     )
  <-287.96     >


NUMERATOR:  Z02/V01

   -70.903
  (-.69486     ) ( 2.6863     )
  < 132.35     >
```


---

*The following shorthand notation is used to represent transfer functions:

$$\frac{K(s+z)(s^2+2\zeta_1\omega_1 s+\omega_1^2)}{(s+p)(s^2+2\zeta_2\omega_2 s+\omega_2^2)} \equiv \frac{K(z)[\zeta_1;\ \omega_1]}{(p)[\zeta_2;\ \omega_2]}$$

Figure 26. Factored Transfer Functions

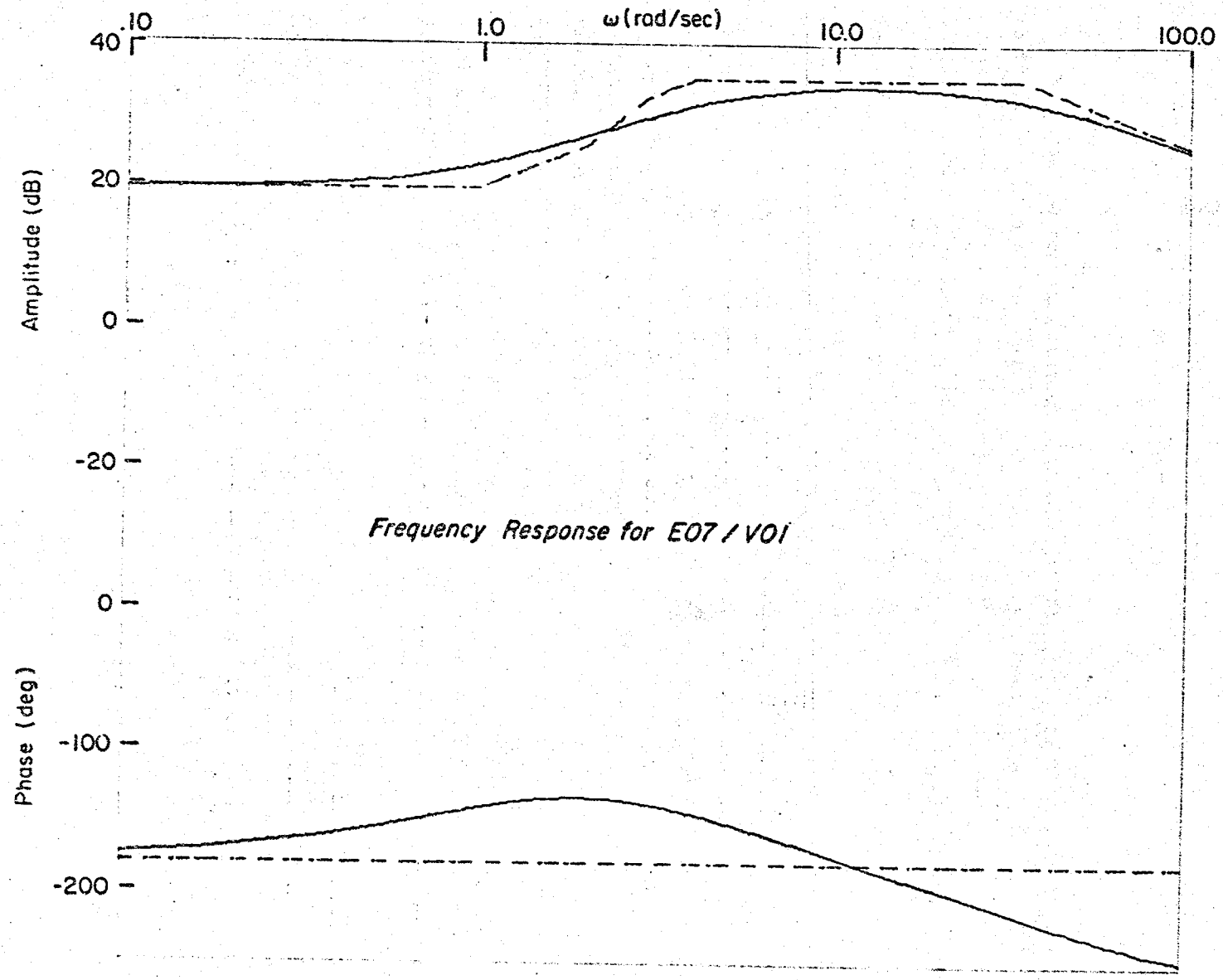

Figure 27. Frequency Response

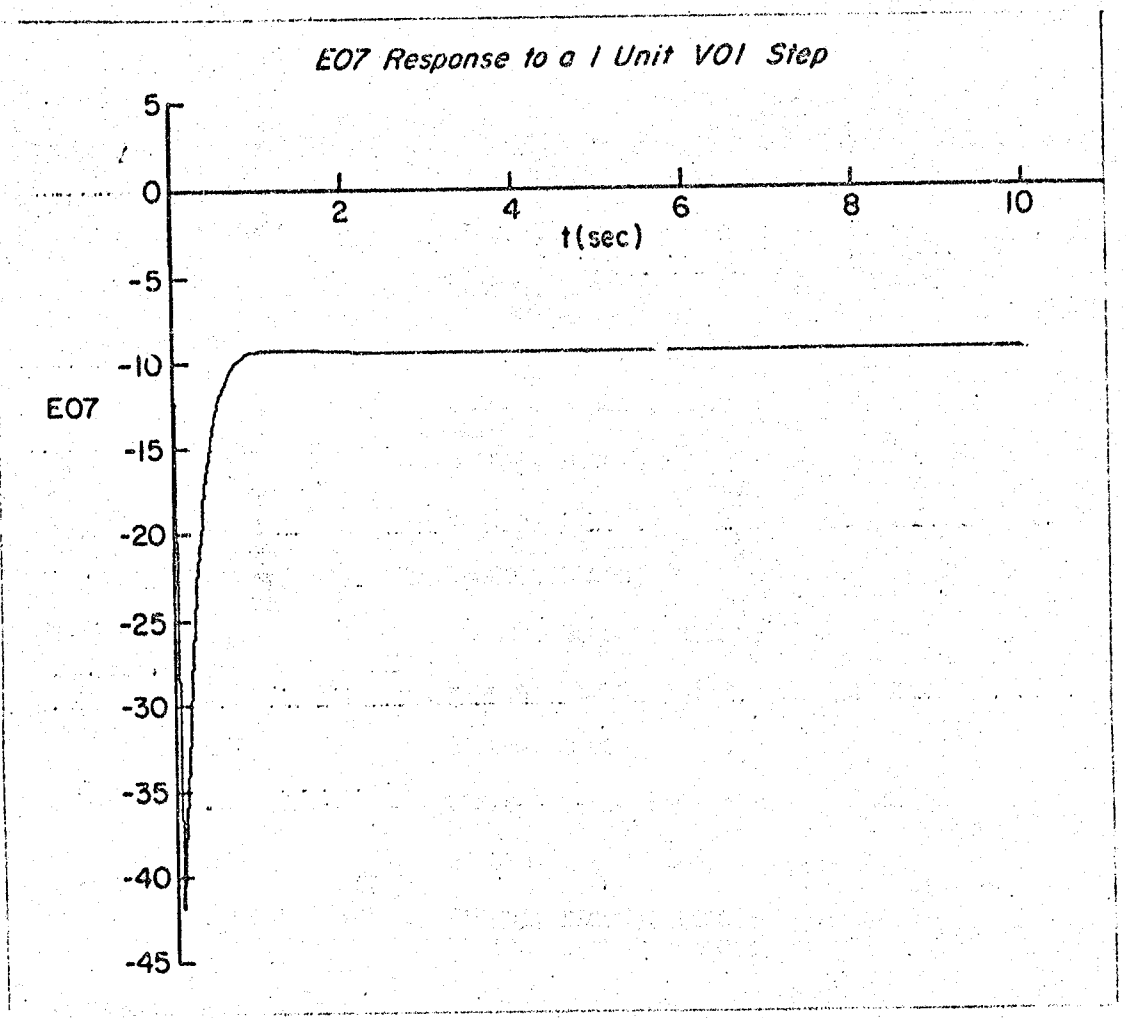

Figure 28. Transient Response

REFERENCES

1. Bryson, Arthur E., Jr., and W. Earl Hall, Jr., Optimal Control and Filter Synthesis by Eigenvector Composition, Stanford University SUDAAR No. 436, Nov. 1971.

2. Stapleford, R. L., Users' Manual for STI Control System Design Programs, Systems Technology, Inc., TR-407-1, July 1970 (Revised Aug. 1976).

3. Riedel, Susan A., and L. G. Hofmann, Practical Optimal Control for Flight Control Application. Vol. I: Technical Report, Systems Technology, Inc., TR-1127-1, forthcoming.

4. Hofmann, L. G., Transformations for Singular Filter Problems Enabling Eigenvector Decomposition, Systems Technology, Inc., WP-1127-1, Aug. 1978.

5. Wilkinson, J. H. and C. Reinsch, Linear Algebra, New York, Springer-Verlag, 1971.

6. Slater, G. L., "Approach Guidance for a STOL A/C," Univ. of Cincinnati, Dept. of Aerospace Engineering and Applied Mechanics, unpublished, circa 1976.

7. Smith, B. T., et al., Lecture Notes in Computer Science. Vol. 6: Matrix Eigensystem Routines - EISPACK Guide, New York, Springer-Verlag, 2nd ed., 1976.

8. Sandell, Nils R. and Michael Athans, Modern Control Theory. A Self-Study Subject Computer Manual, MIT, Center for Advanced Engineering Study, 1974.

9. Hofmann, L. G., Topics on Practical Application of Optimal Control to Single and Multiple Control-Point Flight Control Problems, AFFDL-TR-70-52, Feb. 1971.

10. Forsythe, George E., Michael A. Malcolm, and Cleve B. Moler, Computer Methods for Mathematical Computations, Englewood Cliffs, N.J., Prentice-Hall, Inc., 1977.

APPENDIX

PROGRAM LISTINGS

This appendix contains complete listings for all of the software used to implement the optimal control design package. The mainline routines which solve the filter and regulator problems were adapted from the Bach/Slater version of OPTSYS (Ref. 1). All of the programs which solve the eigenvalue problem were taken from EISPAK (Ref. 7). The generalized matrix inverse routine is from the CAES optimal control package (Ref. 8). The covariance equation routine was adapted from Kleinman (Ref. 9). Subroutines used to solve a set of complex linear equations were taken from Forsythe, et al. (Ref. 10).

Table 2 lists all the subroutines used, where they are used, and the source of the code. Table 3 lists all of the RT-11 specific features employed in this software, and a description of their functions. Appropriate replacements should be found if this software is to be run under another operating system. Table 4 lists the mnemonics used in the cross-reference listings.

The mainlines for each block follow. Listings for the two routines which comprise the service routine software are given next. Finally, a listing of each subroutine is given.

TABLE 2. SUBROUTINE LIBRARY

SUBROUTINE	BLOCK USED	REF
BALANC	BLOCO4, BLOCO5, BLOC10	7
BALBAK	BLOCO4, BLOCO5	7
DECOMP	BLOCO4, BLOCO5, BLOCO6	10
SOLVE	BLOCO4, BLOCO5, BLOCO6	10
EIGRF	BLOCO4, BLOCO5	—
ELMHES	BLOCO4, BLOCO5	7
ELTRAN	BLOCO4, BLOCO5	7
GMINV	BLOCO3, BLOCO7, BLOC10	8
HQR	BLOCO4, BLOCO5	7
HQR2	BLOCO4, BLOCO5	7
LEQT2C	BLOCO6	—
LINEQ1	BLOC10	9
REWR	BLOCO3, BLOCO4, BLOCO5 BLOCO6, BLOCO7, BLOC10	—

TABLE 3. RT-11 SPECIFIC FEATURES

CALL ASSIGN (lun, fname)	— assigns the file name fname to logical unit number lun, and opens file on first READ
CALL CLOSE (lun)	— writes an end-of-file to the file name assigned to lun, and frees lun for further assignment
CALL DATE (array)	— returns correct date as nine ASC11 characters
CALL TIME (array)	— returns correct system time as eight ASC11 characters
CALL TRANSL (in,out,r,p)	— replaces character string in with character string out after modifying all occurrences of substring r by substring p

TABLE 4. MNEMONICS USED IN CROSS-REFERENCE LISTINGS

	USED IN ARITHMETIC LINE
=	VARIABLE ASSIGNED VALUE
'	LABEL LOCATION DEFINED
AC	ACCEPT
AG	ARGUMENT IN FUNCTION, SUBROUTINE OR CALL
AS	ASSIGN LABEL NUMBER TO VARIABLE
BD	BLOCK DATA
BS	BACKSPACE
BY	BYTE
CE	CLOSE
CH	CHARACTER
CL	CALL
CM	COMMON VARIABLE
CN	COMMON NAME
CX	COMPLEX
DA	DATA
DE	DECODE
DF	DEFINE FILE
DI	DIMENSION
DP	DOUBLE PRECISION
DO	DO
EF	ENDFILE
EN	ENCODE
EQ	EQUIVALENCE
EX	EXTERNAL
EY	ENTRY
FB	BYTE FUNCTION
FC	COMPLEX FUNCTION
FD	DOUBLE PRECISION FUNCTION
FH	CHARACTER FUNCTION
FI	INTEGER FUNCTION
FL	LOGICAL FUNCTION
FN	FIND
FO	FORMAT
FR	REAL FUNCTION
FU	FUNCTION
GT	GO TO
IF	IF
IN	INTEGER
LG	LOGICAL
OP	OPEN
PA	PARAMETER
PG	PROGRAM
PR	PRINT
RD	READ
RC	READ
RL	REAL
RW	REWIND
TY	TYPE
VI	VIRTUAL
WR	WRITE

```
      C       BLOCK 1 - THIS MAINLINE ACCEPTS INPUT OF THE DIMENSIONS,
      C                 MNEMONICS AND NON-ZERO ARRAY ELEMENTS FOR THE
      C                 "FIXED" PORTION OF THE CONTROL PROBLEM.  IT
      C                 ASSEMBLES MATRICES NECESSARY FOR USE IN THE
      C                 FILTER AND REGULATOR BLOCKS DOWNSTREAM.
00001         DIMENSION TITLE(5),FNAME(4)
      C         MNEMONIC ARRAYS
00002         REAL MNU(5),MNX(15),MNYS(5),MNV(15),MNTOL(5),
     +        MNYM(15),MNYO(15),MNXS(5),MNXC(10),MNZ(15)
      C         INPUT MATRIX ARRAYS
00003         DIMENSION GMS(5,15),FS(5,5),HS(5,5),GMC(10,15),GC(10,5),
     +            CC(10,5),FC(10,10),HM(15,10),FM(15,5),HO(15,15),
     +            FO(15,5)
      C         OUTPUT MATRIX ARRAYS
00004         DIMENSION F(15,15),G(15,5),GM(15,15),H(15,15),HR(30,15),
     +            E1(30,5),E2(15,5),E3(15,5)
      C         INITIALIZE ARRAYS
00005         COMPLEX C0
00006         DATA GMS,FS,HS,GMC,GC,CC,FC,HM,FM,HO,FO/1050*0.0/
00007         DATA F,G,GM,H,HR,E1,E2,E3/1500*0.0/
      C         CONSTRUCT MNEMONICS FOR XS,XC AND Z
00008         DATA MNXS /'X01','X02','X03','X04','X05'/
00009         DATA MNXC /'X06','X07','X08','X09','X10',
     +              'X11','X12','X13','X14','X15'/
      C         OTHER DATA
00010         DATA IR1,R0,C0 /1,0.,(0.,0.)/
00011         DATA IIN,IOUT,IFIN,IFOUT,NDIM1,NDIM2,NDIM3/5,7,20,21,5,10,15/
00012         COMMON/IO/ IIN,IOUT,IFIN,IFOUT
      C         GET FILENAME FOR INPUT DATA
00013         WRITE(IOUT,10)
00014 10      FORMAT(10X,'PROBLEM DEFINITION - BLOCK 1',/,1X,
     +            'INPUT DATA FILE NAME ? ',$)
00015         READ(IIN,20) (FNAME(I),I=1,4)
00016 20      FORMAT(4A4)
00017         CALL ASSIGN(IFIN,FNAME)
      C         READ PROBLEM TITLE
00018         READ(IFIN,30) (TITLE(I),I=1,5)
00019 30      FORMAT(5A4)
      C         READ DIMENSION AND CHECK
00020         READ(IFIN,40) NXS,NXC,NU,NV,NZ,NYS,NYO
00021 40      FORMAT(7I)
00022         IF(NXS.LE.5.AND.NXC.LE.10.AND.NU.LE.5.AND.NV.LE.15
     +     .AND.NZ.LE.15.AND.NYS.LE.5.AND.NYO.LE.15
     +     .AND.NZ.NE.0)
     +      GO TO 50
00024         WRITE(IOUT,45)
00025 45      FORMAT(5X,'DIMENSIONS TOO LARGE OR Z IS 0')
00026         GO TO 1000
      C         READ MNEMONICS
00027 50      CONTINUE
00028         IF(NU.NE.0) READ(IFIN,60) (MNU(I),I=1,NU)
00030 60      FORMAT(15(A3,1X))
00031         IF(NV.NE.0) READ(IFIN,60) (MNV(I),I=1,NV)
00033         IF(NYS.NE.0) READ(IFIN,60) (MNYS(I),I=1,NYS)
```

```
00035          READ(IFIN,60) (MNV(I),I=1,NZ)
00036          IF(NYS.NE.0) READ(IFIN,60) (MNTOL(I),I=1,NYS)
00038          READ(IFIN,60) (MNYM(I),I=1,NZ)
00039          IF(NYO.NE.0) READ(IFIN,60) (MNYO(I),I=1,NYO)
     C           READ THE NON-ZERO ELEMENTS OF THE ARRAYS
00041 70       CALL READMX(NXS,MN,NDIM1,GMS,IERR)
00042          IF(IERR.NE.1) GO TO 70
00044 80       CALL READMX(NXS,NXS,NDIM1,FS,IERR)
00045          IF(IERR.NE.1) GO TO 80
00047 90       CALL READMX(NYS,NXS,NDIM1,HS,IERR)
00048          IF(IERR.NE.1) GO TO 90
00050 100      CALL READMX(NXC,MN,NDIM2,GMC,IERR)
00051          IF(IERR.NE.1) GO TO 100
00053 110      CALL READMX(NXC,NU,NDIM2,GC,IERR)
00054          IF(IERR.NE.1) GO TO 110
00056 120      CALL READMX(NXC,NYS,NDIM2,QC,IERR)
00057          IF(IERR.NE.1) GO TO 120
00059 130      CALL READMX(NXC,NXC,NDIM2,FC,IERR)
00060          IF(IERR.NE.1) GO TO 130
00062 140      CALL READMX(NZ,NXC,NDIM3,HM,IERR)
00063          IF(IERR.NE.1) GO TO 140
00065 150      CALL READMX(NZ,NYS,NDIM3,FM,IERR)
00066          IF(IERR.NE.1) GO TO 150
00068 160      CALL READMX(NYO,NXC,NDIM3,HO,IERR)
00069          IF(IERR.NE.1) GO TO 160
00071 170      CALL READMX(NYO,NYS,NDIM3,FO,IERR)
00072          IF(IERR.NE.1) GO TO 170
     C           READ FILENAME FOR OUTPUT FILE
00074          READ(IFIN,20) (FNAME(I),I=1,4)
00075          CALL ASSIGN(IFOUT,FNAME)
```

```
        C                  ( FS       0)
        C         FORM F = (           )
        C                  (CC*HS    FC)
00076         IF(NXS.EQ.0) GO TO 210
00078         DO 180 I=1,NXS
00079         DO 180 J=1,NXS
00080 180     F(I,J)=FS(I,J)
00081         IF(NXC.EQ.0.OR.NYS.EQ.0) GO TO 210
00083         DO 200 I=1,NXC
00084         L=I+NXS
00085         DO 200 J=1,NXS
00086         DUM=0.
00087         DO 190 K=1,NYS
00088 190     DUM=DUM+CC(I,K)*HS(K,J)
00089 200     F(L,J)=DUM
00090 210     CONTINUE
00091         IF(NXC.EQ.0) GO TO 230
00093         DO 220 I=1,NXC
00094         II=I+NXS
00095         DO 220 J=1,NXC
00096         JJ=J+NXS
00097 220     F(II,JJ)=FC(I,J)
00098 230     CONTINUE
        C                  ( 0 )
        C         FORM G = (   )
        C                  (GC )
00099         IF(NU.EQ.0) GO TO 250
00101         DO 240 I=1,NXC
00102         II=I+NXS
00103         DO 240 J=1,NU
00104 240     G(II,J)=GC(I,J)
00105 250     CONTINUE
        C                  (GMS)
        C         FORM GM = (   )
        C                  (GMC)
00106         IF(NW.EQ.0) GO TO 290
00108         IF(NXS.EQ.0) GO TO 270
00110         DO 260 I=1,NXS
00111         DO 260 J=1,NW
00112 260     GM(I,J)=GMS(I,J)
00113 270     CONTINUE
00114         IF(NXC.EQ.0) GO TO 290
00115         DO 280 I=1,NXC
00117         II=I+NXS
00118         DO 280 J=1,NW
00119 280     GM(II,J)=GMC(I,J)
00120 290     CONTINUE
        C         FORM H = (FM*HS    HM)
00121         IF(NYS.EQ.0.OR.NXS.EQ.0) GO TO 320
00123         DO 310 I=1,NZ
00124         DO 310 J=1,NXS
00125         DUM=0.
00126         DO 300 K=1,NYS
00127 300     DUM=DUM+FM(I,K)*HS(K,J)
```

```
00128 310   H(I,J)=DUM
00129 320   CONTINUE
00130       IF(NXC.EQ.0) GO TO 340
00132       DO 330 I=1,NZ
00133       DO 330 J=1,NXC
00134       JJ=J+NXS
00135 330   H(I,JJ)=HM(I,J)
00136 340   CONTINUE
      C                   (FM*HS   HM)
      C       FORM HR = (          )
      C                   (FO*HS   HO)
00137       IF(NYS.EQ.0.OR.NXS.EQ.0) GO TO 390
00139       DO 360 I=1,NZ
00140       DO 360 J=1,NXS
00141       DUM=0.
00142       DO 350 K=1,NYS
00143 350   DUM=DUM+FM(I,K)*HS(K,J)
00144 360   HR(I,J)=DUM
00145       IF(NYO.EQ.0) GO TO 390
00147       DO 380 I=1,NYO
00148       II=I+NZ
00149       DO 380 J=1,NXS
00150       DUM=0.
00151       DO 370 K=1,NYS
00152 370   DUM=DUM+FO(I,K)*HS(K,J)
00153 380   HR(II,J)=DUM
00154 390   CONTINUE
00155       IF(NXC.EQ.0) GO TO 420
00157       DO 400 I=1,NZ
00158       DO 400 J=1,NXC
00159       JJ=J+NXS
00160 400   HR(I,JJ)=HM(I,J)
00161       IF(NYO.EQ.0) GO TO 420
00163       DO 410 I=1,NYO
00164       II=I+NZ
00165       DO 410 J=1,NXC
00166       JJ=J+NXS
00167 410   HR(II,JJ)=HO(I,J)
00168 420   CONTINUE
      C                   (FM)
      C       FORM E1 = (  )
      C                   (FO)
00169       IF(NYS.EQ.0) GO TO 450
00171       DO 430 I=1,NZ
00172       DO 430 J=1,NYS
00173 430   E1(I,J)=FM(I,J)
00174       IF(NYO.EQ.0) GO TO 450
00176       DO 440 I=1,NYO
00177       II=I+NZ
00178       DO 440 J=1,NYS
00179 440   E1(II,J)=FO(I,J)
00180 450   CONTINUE
      C       FORM E2 = FM
00181       IF(NYS.EQ.0) GO TO 470
```

```
00183         DO 450 I=1,NZ
00184         DO 450 J=1,NYS
00185 460     E2(I,J)=FM(I,J)
00186 470     CONTINUE
      C                    ( 0 )
      C       FORM E3 =    (   )
      C                    (CC )
00187         IF(NXS.EQ.0.OR.NYS.EQ.0) GO TO 490
00189         DO 480 I=1,NXS
00190         II=I+NXC
00191         DO 480 J=1,NYS
00192 480     E3(II,J)=CC(I,J)
00193 490     CONTINUE
      C         OUTPUT AREA
00194         IDEN=1
00195         WRITE(IFOUT) IDEN,NDIM1,(TITLE(I),I=1,5)
00196         IDEN=2
00197         WRITE(IFOUT) IDEN,NXS,NXC,NU,NN,NZ,NYS,NYO
00198         IDEN=3
00199         IF(NU.EQ.0) WRITE(IFOUT) IDEN,IR1,R0
00201         IF(NU.NE.0) WRITE(IFOUT) IDEN,NU,(MNU(I),I=1,NU)
00203         IDEN=4
00204         IF(NN.EQ.0) WRITE(IFOUT) IDEN,IR1,R0
00206         IF(NN.NE.0) WRITE(IFOUT) IDEN,NN,(MNN(I),I=1,NN)
00208         IDEN=5
00209         IF(NYS.EQ.0) WRITE(IFOUT) IDEN,IR1,R0
00211         IF(NYS.NE.0) WRITE(IFOUT) IDEN,NYS,(MNYS(I),I=1,NYS)
00213         IDEN=6
00214         WRITE(IFOUT) IDEN,NZ,(MNV(I),I=1,NZ)
00215         IDEN=7
00216         IF(NYS.EQ.0) WRITE(IFOUT) IDEN,IR1,R0
00218         IF(NYS.NE.0) WRITE(IFOUT) IDEN,NYS,(MNTOL(I),I=1,NYS)
00220         IDEN=8
00221         WRITE(IFOUT) IDEN,NZ,(MNYM(I),I=1,NZ)
00222         IDEN=9
00223         IF(NYO.EQ.0) WRITE(IFOUT) IDEN,IR1,R0
00225         IF(NYO.NE.0) WRITE(IFOUT) IDEN,NYO,(MNYO(I),I=1,NYO)
00227         IDEN=10
00228         WRITE(IFOUT) IDEN,NZ,(MNYM(I),I=1,NZ)
00229         IDEN=11
00230         IF(NXS.EQ.0) WRITE(IFOUT) IDEN,IR1,R0
00232         IF(NXS.NE.0) WRITE(IFOUT) IDEN,NXS,(MNXS(I),I=1,NXS)
00234         IDEN=12
00235         IF(NXC.EQ.0) WRITE(IFOUT) IDEN,IR1,R0
00237         IF(NXC.NE.0) WRITE(IFOUT) IDEN,NXC,(MNXC(I),I=1,NXC)
00239         IDEN=13
00240         IF(NXS.EQ.0.OR.NN.EQ.0) WRITE(IFOUT) IDEN,IR1,IR1,R0
00242         IF(NXS.NE.0.AND.NN.NE.0)
             +      WRITE(IFOUT) IDEN,NXS,NN,((GMS(I,J),J=1,NN),I=1,NXS)
00244         IDEN=14
00245         IF(NXS.EQ.0) WRITE(IFOUT) IDEN,IR1,IR1,R0
00247         IF(NXS.NE.0)
             + WRITE(IFOUT) IDEN,NXS,NXS,((FS(I,J),J=1,NXS),I=1,NXS)
00249         IDEN=15
```

```
00250       IF(NYS.EQ.0.OR.NXS.EQ.0) WRITE(IFOUT) IDEN,IR1,IR1,R0
00252       IF(NYS.NE.0.AND.NXS.NE.0)
           +       WRITE(IFOUT) IDEN,NYS,NXS,((HS(I,J),J=1,NXS),I=1,NYS)
00254       IDEN=16
00255       IF(NXC.EQ.0.OR.NN.EQ.0) WRITE(IFOUT) IDEN,IR1,IR1,R0
00257       IF(NXC.NE.0.AND.NN.NE.0)
           +       WRITE(IFOUT) IDEN,NXC,NN,((GMC(I,J),J=1,NN),I=1,NXC)
00259       IDEN=17
00260       IF(NXC.EQ.0.OR.NU.EQ.0) WRITE(IFOUT) IDEN,IR1,IR1,R0
00262       IF(NXC.NE.0.AND.NU.NE.0)
           +       WRITE(IFOUT) IDEN,NXC,NU,((GC(I,J),J=1,NU),I=1,NXC)
00264       IDEN=18
00265       IF(NXC.EQ.0.OR.NYS.EQ.0) WRITE(IFOUT) IDEN,IR1,IR1,R0
00267       IF(NXC.NE.0.AND.NYS.NE.0)
           +       WRITE(IFOUT) IDEN,NXC,NYS,((CC(I,J),J=1,NYS),I=1,NXC)
00269       IDEN=19
00270       IF(NXC.EQ.0) WRITE(IFOUT) IDEN,IR1,IR1,R0
00272       IF(NXC.NE.0)
           + WRITE(IFOUT) IDEN,NXC,NXC,((FC(I,J),J=1,NXC),I=1,NXC)
00274       IDEN=20
00275       IF(NXC.EQ.0) WRITE(IFOUT) IDEN,IR1,IR1,R0
00277       IF(NXC.NE.0)
           + WRITE(IFOUT) IDEN,NZ,NXC,((HM(I,J),J=1,NXC),I=1,NZ)
00279       IDEN=21
00280       IF(NYS.EQ.0) WRITE(IFOUT) IDEN,IR1,IR1,R0
00282       IF(NYS.NE.0)
           + WRITE(IFOUT) IDEN,NZ,NYS,((EM(I,J),J=1,NYS),I=1,NZ)
00284       IDEN=22
00285       IF(NYO.EQ.0.OR.NXC.EQ.0) WRITE(IFOUT) IDEN,IR1,IR1,R0
00287       IF(NYO.NE.0.AND.NXC.NE.0)
           +   WRITE(IFOUT) IDEN,NYO,NXC,((HO(I,J),J=1,NXC),I=1,NYO)
00289       IDEN=23
00290       IF(NYO.EQ.0.OR.NYS.EQ.0) WRITE(IFOUT) IDEN,IR1,IR1,R0
00292       IF(NYO.NE.0.AND.NYS.NE.0)
           +  WRITE(IFOUT) IDEN,NYO,NYS,((FO(I,J),J=1,NYS),I=1,NYO)
00294       IDEN=24
00295       NXT=NXC+NXS
00296       WRITE(IFOUT) IDEN,NXT,NXT,((F(I,J),J=1,NXT),I=1,NXT)
00297       IDEN=25
00298       IF(NU.EQ.0) WRITE(IFOUT) IDEN,IR1,IR1,R0
00300       IF(NU.NE.0)
           + WRITE(IFOUT) IDEN,NXT,NU,((G(I,J),J=1,NU),I=1,NXT)
00302       IDEN=26
00303       IF(NN.EQ.0) WRITE(IFOUT) IDEN,IR1,IR1,R0
00305       IF(NN.NE.0)
           + WRITE(IFOUT) IDEN,NXT,NN,((GM(I,J),J=1,NN),I=1,NXT)
00307       IDEN=27
00308       WRITE(IFOUT) IDEN,NZ,NXT,((H(I,J),J=1,NXT),I=1,NZ)
00309       IDEN=28
00310       NZT=NZ+NYO
00311       WRITE(IFOUT) IDEN,NZT,NXT,((HR(I,J),J=1,NXT),I=1,NZ+NYO)
00312       IDEN=29
00313       IF(NYS.EQ.0) WRITE(IFOUT) IDEN,IR1,IR1,R0
00315       IF(NYS.NE.0)
```

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                +WRITE(IFOUT) IDEN,NZT,NYS,((E1(I,J),J=1,NYS),I=1,NZT)
00317            IDEN=30
00318            IF(NYS.EQ.0) WRITE(IFOUT) IDEN,IR1,IR1,R0
00320            IF(NYS.NE.0)
                +WRITE(IFOUT) IDEN,NZ,NYS,((E2(I,J),J=1,NYS),I=1,NZ)
00322            IDEN=31
00323            IF(NYS.EQ.0) WRITE(IFOUT) IDEN,IR1,IR1,R0
00325            IF(NYS.NE.0)
                +WRITE(IFOUT) IDEN,NXT,NYS,((E3(I,J),J=1,NYS),I=1,NXT)
00327            DO 500 I=32,130
00328 500        WRITE(IFOUT) I,IR1,IR1,C0
                 C       THE END
00329 1000       STOP
00330            END
```

```
ASSIGN  00017CL 00075CL
CC      00003DI 00006DA 00256AG 00088   00192   00268WR
C0      00005CX 00010DA 00328WR
DUM     00085=  00088=  00089   00125=  00127=  00128   00141=  00143=
        00144   00150=  00152=  00153
E1      00004DI 00007DA 00173=  00179=  00316WR
E2      00004DI 00007DA 00185=  00321WR
E3      00004DI 00007DA 00192=  00326WR
F       00004DI 00007DA 00080=  00089=  00097=  00295WR
FC      00003DI 00005DA 00059AG 00097   00273WR
FM      00003DI 00006DA 00065AG 00127   00143   00173   00185   00283WR
FNAME   00001DI 00015RD 00017AG 00074RD 00075AG
FO      00003DI 00006DA 00071AG 00152   00179   00293WR
FS      00003DI 00006DA 00044AG 00080   00248WR
G       00004DI 00007DA 00104=  00301WR
GC      00003DI 00006DA 00053AG 00104   00263WR
GM      00004DI 00007DA 00112=  00119=  00305WR
GMC     00003DI 00006DA 00050AG 00119   00258WR
GMS     00003DI 00006DA 00041AG 00112   00243WR
H       00004DI 00007DA 00128=  00135=  00308WR
HM      00003DI 00006DA 00062AG 00135   00160   00278WR
HO      00003DI 00006DA 00068AG 00167   00288WR
HR      00004DI 00007DA 00144=  00153=  00160=  00167=  00311WR
HS      00003DI 00006DA 00047AG 00088   00127   00143   00152   00253WR
I       00015RD 00018RD 00029RD 00032RD 00034RD 00035RD 00037RD 00039RD
        00040RD 00074RD 00078DO 00080   00083DO 00084   00088   00093DO
        00094   00097   00101DO 00102   00104   00110DO 00112   00116DO
        00117   00119   00123DO 00127   00128   00132DO 00135   00139DO
        00143   00144   00147DO 00148   00152   00157DO 00160   00163DO
        00164   00167   00171DO 00173   00176DO 00177   00179   00183DO
        00185   00189DO 00190   00192   00195WR 00202WR 00207WR 00212WR
        00214WR 00219WR 00221WR 00226WR 00228WR 00233WR 00236WR 00243WR
        00246WR 00253WR 00258WR 00263WR 00268WR 00273WR 00278WR 00283WR
        00288WR 00293WR 00296WR 00301WR 00306WR 00308WR 00311WR 00316WR
        00321WR 00326WR 00327DO 00328WR
IDEN    00194=  00195WR 00196=  00197WR 00198=  00200WR 00202WR 00203=
        00205WR 00207WR 00208=  00210WR 00212WR 00213=  00214WR 00215=
        00217WR 00219WR 00220=  00221WR 00222=  00226WR 00226WR 00227=
        00228WR 00229=  00231WR 00233WR 00234=  00236WR 00238WR 00239=
        00241WR 00243WR 00244=  00246WR 00248WR 00249=  00251WR 00253WR
        00254=  00256WR 00258WR 00259=  00261WR 00263WR 00264=  00266WR
        00268WR 00269=  00271WR 00273WR 00274=  00276WR 00278WR 00279=
        00281WR 00283WR 00284=  00286WR 00288WR 00289=  00291WR 00293WR
        00294=  00296WR 00297=  00299WR 00301WR 00302=  00304WR 00306WR
        00307=  00308WR 00309=  00311WR 00312=  00314WR 00316WR 00317=
        00319WR 00321WR 00322=  00324WR 00326WR
IERR    00041AG 00042IF 00044AG 00045IF 00047AG 00048IF 00050AG 00051IF
        00053AG 00054IF 00056AG 00057IF 00059AG 00062IF 00062AG 00063IF
        00065AG 00066IF 00068AG 00069IF 00071AG 00072IF
IFIN    00011DA 00012CM 00017AG 00018RD 00029RD 00029RD 00032RD 00034RD
        00035RD 00037RD 00038RD 00040RD 00074RD
IFOUT   00011DA 00012CM 00075AG 00195WR 00197WR 00200WR 00202WR 00205WR
        00207WR 00210WR 00212WR 00214WR 00217WR 00219WR 00221WR 00226WR
        00226WR 00228WR 00231WR 00233WR 00236WR 00238WR 00241WR 00243WR
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        00243#R 00248#R 00251WR 00253#R 00256#R 00258#R 00261WR 00263#R
        00266#R 00268#R 00271WR 00273#R 00276#R 00278#R 00281WR 00283#R
        00286#R 00288#R 00291WR 00293#R 00296#R 00299#R 00301WR 00304#R
        00306#R 00308#R 00311WR 00314#R 00316#R 00319#R 00321WR 00324#R
        00326#R 00328#R
II      00094=  00097   00102=  00104   00117=  00119   00148=  00153
        00164=  00167   00177=  00179   00190=  00192
IIN     00011DA 00012CM 00015RD
IO      00012CN
IOUT    00011DA 00012CM 00013WR 00024#R
IR1     00010DA 00206#R 00205#R 00210#R 00217WR 00224#R 00231WR 00236#R
        00241WR 00243#R 00251WR 00256#R 00261WR 00266#R 00271WR 00276#R
        00281WR 00286#R 00291WR 00299#R 00304WR 00314#R 00319#R 00324#R
        00328#R
J       00079DO 00083   00085DO 00088   00089   00095DO 00096   00097
        00103DO 00104   00111DO 00112   00118DO 00119   00124DO 00127
        00128   00133DO 00134   00135   00140DO 00143   00144   00149DO
        00152   00153   00158DO 00159   00160   00165DO 00166   00167
        00172DO 00173   00178DO 00179   00184DO 00185   00191DO 00192
        00243#R 00248#R 00253WR 00258#R 00263WR 00268#R 00273WR 00278#R
        00283WR 00288#R 00293#R 00296#R 00301WR 00306#R 00308#R 00311WR
        00316#R 00321WR 00326#R
JJ      00095=  00097   00134=  00135   00159=  00160   00166=  00167
K       00087DO 00088   00126DO 00127   00142DO 00143   00151DO 00152
L       00084=  00089
MNTOL   00002RL 00037RD 00219#R
MNU     00002RL 00029RD 00202#R
MNV     00002RL 00035RD 00214#R
MNW     00002RL 00032RD 00207#R
MNXC    00002RL 00009DA 00233#R
MNXS    00002RL 00008DA 00233#R
MNYM    00002RL 00038RD 00221WR 00228#R
MNYO    00002RL 00040RD 00220#R
MNYS    00002RL 00034RD 00212#R
MNZ     00002RL
NDIM1   00011DA 00041AG 00044AG 00047AG 00195#R
NDIM2   00011DA 00052AG 00053AG 00056AG 00059AG
NDIM3   00011DA 00062AG 00065AG 00068AG 00071AG
NU      00020RD 00022IF 00028IF 00029RD 00053AG 00099IF 00103DO 00197#R
        00199IF 00201IF 00202#R 00260IF 00262IF 00263#R 00298IF 00300IF
        00301WR
NW      00020RD 00022IF 00031IF 00032RD 00041AG 00050AG 00106IF 00111DO
        00113DO 00197#R 00204IF 00206IF 00207#R 00240IF 00242IF 00243#R
        00255IF 00257IF 00258#R 00303IF 00305IF 00306#R
NXC     00020RD 00022IF 00052AG 00053AG 00056AG 00059AG 00062AG 00068AG
        00081IF 00083DO 00091IF 00093DO 00095DO 00101DO 00114IF 00116DO
        00130IF 00133DO 00155IF 00158DO 00165DO 00190   00197#R 00235IF
        00237IF 00238#R 00255IF 00257IF 00258#R 00260IF 00262IF 00263#R
        00265IF 00267IF 00268#R 00270IF 00272IF 00273#R 00275IF 00277IF
        00278#R 00285IF 00287IF 00288#R 00295
NXS     00020RD 00022IF 00041AG 00044AG 00047AG 00076IF 00078DO 00079DO
        00084   00085DO 00094   00096   00102   00108IF 00110DO 00117
        00121IF 00124DO 00134   00137IF 00140DO 00149DO 00159   00166
        00187IF 00189DO 00197#R 00230IF 00232IF 00233#R 00240IF 00242IF
```

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```
        00243WR 00245IF 00247IF 00249WR 00250IF 00252IF 00253WR 00295
NXT     00295=  00296WR 00301WR 00306WR 00308WR 00311WR 00329WR
NYO     00020RD 00022IF 00039IF 00040RD 00068AG 00071AG 00145IF 00147DO
        00161IF 00163DO 00174IF 00176DO 00197WR 00223IF 00225IF 00228WR
        00285IF 00287IF 00288WR 00290IF 00292IF 00293WR 00310  00311WR
NYS     00020RD 00022IF 00033IF 00034RD 00036IF 00037RD 00047AG 00056AG
        00065AG 00071AG 00081IF 00087DO 00121IF 00126DO 00137IF 00142DO
        00151DO 00169IF 00172DO 00178DO 00181IF 00184DO 00187IF 00191DO
        00197WR 00209IF 00211IF 00212WR 00216IF 00218IF 00219WR 00250IF
        00252IF 00253WR 00265IF 00267IF 00268WR 00280IF 00282IF 00283WR
        00290IF 00292IF 00293WR 00313IF 00315IF 00316WR 00318IF 00320IF
        00321WR 00323IF 00325IF 00326WR
NZ      00020RD 00022IF 00035RD 00038RD 00062AG 00065AG 00123DO 00132DO
        00139DO 00148   00157DO 00164   00171DO 00177   00183DO 00197WR
        00214WR 00221WR 00228WR 00278WR 00283WR 00308WR 00310  00311WR
        00321WR
NZT     00310=  00311WR 00316WR
READ4X  00041CL 00044CL 00047CL 00050CL 00053CL 00056CL 00059CL 00062CL
        00065CL 00068CL 00071CL
R0      00010DA 00208WR 00209WR 00210WR 00217WR 00224WR 00231WR 00239WR
        00241WR 00246WR 00251WR 00256WR 00261WR 00269WR 00271WR 00276WR
        00281WR 00283WR 00291WR 00299WR 00304WR 00314WR 00319WR 00324WR
TITLE   00001DI 00018RD 00195WR
10      00013WR 00014*
100     00050*  00052GT
1000    00032GT 00329*
110     00053*  00055GT
120     00056*  00058GT
130     00059*  00061GT
140     00062*  00064GT
150     00065*  00067GT
160     00068*  00070GT
170     00071*  00073GT
180     00078DO 00079DO 00080*
190     00087DO 00088*
20      00015RD 00016*  00074RD
200     00083DO 00085DO 00089*
210     00077GT 00082GT 00090*
220     00093DO 00095DO 00097*
230     00092GT 00098*
240     00101DO 00103DO 00104*
250     00100GT 00105*
260     00110DO 00111DO 00112*
270     00109GT 00113*
280     00116DO 00118DO 00119*
290     00107GT 00115GT 00120*
30      00018RD 00019*
300     00126DO 00127*
310     00123DO 00124DO 00128*
320     00122GT 00129*
330     00132DO 00133DO 00135*
340     00131GT 00136*
350     00142DO 00143*
360     00139DO 00140DO 00144*
```

```
370     00151DO 00152*
380     00147DO 00149DO 00153*
390     00138GT 00146GT 00154*
40      00020RD 00021*
400     00157DO 00158DO 00160*
410     00163DO 00165DO 00167*
420     00156GT 00162GT 00168*
430     00171DO 00172DO 00173*
440     00176DO 00178DO 00179*
45      00024NR 00025*
450     00170GT 00175GT 00180*
460     00183DO 00184DO 00185*
470     00182GT 00186*
480     00189DO 00191DO 00192*
490     00188GT 00193*
50      00023GT 00027*
500     00327DO 00328*
60      00029RD 00030*  00032RD 00034RD 00035RD 00037RD 00038RD 00040RD
70      00041*  00043GT
80      00044*  00046GT
90      00047*  00049GT
```

```
00001        SUBROUTINE READMX(IMAX,JMAX,NROW,ARRAY,IERR)
             C     ROUTINE READ MATRIX ELEMENT OF THE FORM:
             C                I,J,VALUE
             C     CHECKS FOR DIMENSIONS OUT OF RANGE AND FORMS:
             C                ARRAY(I,J)=VALUE
00002        COMMON/IO/ IIN,IOUT,IFIN,IFOUT
00003        DIMENSION ARRAY(NROW,JMAX)
00004        READ(IFIN,10,ERR=50) I,J,VALUE
00005 10     FORMAT(2I,E)
00006        IF(I.GT.IMAX.OR.I.LT.0.OR.J.GT.JMAX.OR.J.LT.0) GO TO 30
00008        IF(I.EQ.0) GO TO 20
00010        ARRAY(I,J)=VALUE
00011        IERR=0
00012        RETURN
             C     ERRORS:   IERR=1 - I=0 INDICATING TERMINATION OF DATA FOR
             C                        THIS MATRIX
             C               IERR=2 - DIMENSIONS OUT OF RANGE
             C               IERR=3 - WRONG FORMAT ON INPUT
00013 20     IERR=1
00014        RETURN
00015 30     IERR=2
00016        WRITE(IOUT,40) I,J,VALUE
00017 40     FORMAT(5X,'DIMENSIONS OUT OF RANGE FOR ',3X,2I3,E15.6)
00018        RETURN
00019 50     IERR=3
00020        WRITE(IOUT,60)
00021 60     FORMAT(5X,'WRONG FORMAT')
00022        RETURN
00023        END
```

```
ARRAY   00001AG 00003DI 00010=
I       00004RD 00006IF 00008IF 00010   00016WR
IERR    00001AG 00011=  00013=  00015=  00019=
IFIN    00002CM 00004RD
IFOUT   00002CM
IIN     00002CM
IMAX    00001AG 00006IF
IO      00002CN
IOUT    00002CM 00016WR 00020WR
J       00004RD 00006IF 00010   00016WR
JMAX    00001AG 00003DI 00006IF
NROW    00001AG 00003DI
READMX  00001SU
VALUE   00004RD 00010   00016WR
10      00004RD 00005*
20      00009GT 00013*
30      00007GT 00015*
40      00016WR 00017*
50      00004RD 00019*
60      00020WR 00021*
```

```
      C         BLOCK2 - CONTROLLED ELEMENT ANALYSIS
      C           SETS UP A TREN FILE FOR TRANSFER FUNCTION ANALYSIS
      C           OF THE CONTROLLED ELEMENT.
00001         DIMENSION FNAME(5),TITLE(15)
      C         PROBLEM FILE INPUT MATRICES
00002         REAL MNU(5),MNN(15),MNYS(5),MNZ(15),MNYO(15),MNXC(10)
00003         DIMENSION GMC(10,15),GC(10,5),CC(10,5),FC(10,10),
     +                  HM(15,10),HO(15,15),E1(30,5)
      C         WORKING SPACE
00004         REAL MN(400),MM(25)
      C         DATA
00005         DATA IIN,IOUT,IPFIN,ITREN /5,7,20,21/
00006         DATA KO,IO,A2,A1,IPLUS,X1 /2*0,2*0.,'+',1./
      C         READ PROBLEM FILE NAME, TITLE AND TREN FILE NAME
00007         WRITE(IOUT,10)
00008 10      FORMAT(10X,'CONTROLLED ELEMENT DEFINITION - BLOCK 2',/,
     +       2X,'INPUT PROBLEM FILE NAME ? ',$)
00009         READ(IIN,20) (FNAME(I),I=1,4)
00010         CALL ASSIGN(IPFIN,FNAME)
00011         WRITE(IOUT,12)
00012 12      FORMAT(2X,'OUTPUT TREN FILE NAME ? ',$)
00013         READ(IIN,20) (FNAME(I),I=1,4)
00014         CALL ASSIGN(ITREN,FNAME)
00015         WRITE(IOUT,14)
00016 14      FORMAT(2X,'TREN TITLE (60 CHARS) : ')
00017         READ(IIN,20) (TITLE(I),I=1,15)
00018 20      FORMAT(15A4)
      C         READ THE FOLLOWING FROM THE PROBLEM FILE:
      C           DIMENSIONS  IDEN=2
      C           U MNEMONICS IDEN=3
      C           W MNEMONICS IDEN=4
      C           YS MNEMONICS IDEN=5
      C           Y MNEMONICS IDEN=9&10
      C           XC MNEMONICS IDEN=12
      C           GMC MATRIX  IDEN=15
      C           GC MATRIX   IDEN=17
      C           CC MATRIX   IDEN=18
      C           FC MATRIX   IDEN=19
      C           HM MATRIX   IDEN=20
      C           HO MATRIX   IDEN=22
      C           E1 MATRIX   IDEN=29
00019         DO 23 K=1,200
00020         READ(IPFIN,END=35) IDEN
00021         IF(IDEN.EQ.1) READ(IPFIN) IDEN,NXS,NXC,NU,NN,NZ,NYS,NYO
00023         IF(IDEN.EQ.2) READ(IPFIN) IDEN,NX,(MNU(I),I=1,NX)
00025         IF(IDEN.EQ.3) READ(IPFIN) IDEN,NX,(MNN(I),I=1,NX)
00027         IF(IDEN.EQ.5) READ(IPFIN) IDEN,NX,(MNYS(I),I=1,NX)
00029         IF(IDEN.EQ.8) READ(IPFIN) IDEN,NX,(MNYO(I),I=1,NX)
00031         IF(IDEN.EQ.9) READ(IPFIN) IDEN,NX,(MNZ(I),I=1,NX)
00033         IF(IDEN.EQ.11) READ(IPFIN) IDEN,NX,(MNXC(I),I=1,NX)
00035         IF(IDEN.EQ.15) READ(IPFIN) IDEN,NX,NY,((GMC(I,J),J=1,NZ),I=1,NX)
00037         IF(IDEN.EQ.16) READ(IPFIN) IDEN,NX,NY,((GC(I,J),J=1,NY),I=1,NX)
00039         IF(IDEN.EQ.17) READ(IPFIN) IDEN,NX,NY,((CC(I,J),J=1,NY),I=1,NX)
00041         IF(IDEN.EQ.18) READ(IPFIN) IDEN,NX,NY,((FC(I,J),J=1,NY),I=1,NX)
```

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00043          IF(IDEN.EQ.19) READ(IPFIN) IDEN,NX,NY,((HM(I,J),J=1,NY),I=1,NX)
00045          IF(IDEN.EQ.21) READ(IPFIN) IDEN,NX,NY,((HO(I,J),J=1,NY),I=1,NX)
00047          IF(IDEN.EQ.28) READ(IPFIN) IDEN,NX,NY,((E1(I,J),J=1,NY),I=1,NX)
00049 30       CONTINUE
00050 35       NY=NZ+NYO
00051          NX=NX-NXC
00052          CALL CLOSE(IPFIN)
               C                    (SI-FC   0)
               C       FORM LHS = (          ) = (NXC,NXC   NXC,NY)
               C                  ( -HM    I)   (NY,NXC     NY,NY)
               C                  ( -HO     )
00053          IF(NXC.EQ.0) GO TO 65
00055          DO 40 I=1,NXC
00056          DO 40 J=1,NXC
00057          A1=0.
00058          IF(I.EQ.J) A1=1.
00060          X=-FC(I,J)
00061          IF(A1.EQ.0..AND.X.EQ.0.) GO TO 40
00063          WRITE(ITRFN,80) I,J,A2,A1,X,K0
00064 40       CONTINUE
00065          A1=0.
00066          DO 50 I=1,NZ
00067          II=I+NXC
00068          DO 50 J=1,NXC
00069          IF(HM(I,J).EQ.0.) GO TO 50
00071          X=-HM(I,J)
00072          WRITE(ITRFN,80) II,J,A2,A1,X,K0
00073 50       CONTINUE
00074          IF(NYO.EQ.0) GO TO 65
00076          DO 60 I=1,NYO
00077          II=I+NXC+NZ
00078          DO 60 J=1,NXC
00079          IF(HO(I,J).EQ.0.) GO TO 60
00081          X=-HO(I,J)
00082          WRITE(ITRFN,80) II,J,A2,A1,X,K0
00083 60       CONTINUE
00084 65       DO 70 I=1,NY
00085          II=I+NXC
00086 70       WRITE(ITRFN,80) II,II,A2,A1,X1,K0
00087 80       FORMAT(2I,3E,I)
00088          WRITE(ITRFN,80) I0
               C                    (GC   CC   G*C)     (NXC,NU   NXC,NYS   NXC,NV)
               C       FORM RHS = (                ) = (                           )
               C                    (0    E1    0 )     (NY,NU    NY,NYS    NY,NV)
00089          IF(NXC.EQ.0) GO TO 105
00091          IF(NU.EQ.0) GO TO 95
00093          DO 90 I=1,NXC
00094          DO 90 J=1,NXC
00095          IF(GC(I,J).EQ.0.) GO TO 90
00097          X=GC(I,J)
00098          WRITE(ITRFN,80) I,J,A2,A1,X,K0
00099 90       CONTINUE
00100 95       CONTINUE
00101          IF(NYS.EQ.0) GO TO 115
```

```
00103          DO 100 I=1,NXC
00104          DO 100 J=1,NYS
00105          JJ=J+NU
00106          IF(CC(I,J).EQ.0.) GO TO 100
00108          X=CC(I,J)
00109          WRITE(ITRFN,80) I,JJ,A2,A1,X,K0
00110 100      CONTINUE
00111 105      DO 110 I=1,NY
00112          II=I+NXC
00113          DO 110 J=1,NYS
00114          JJ=J+NU
00115          IF(E1(I,J).EQ.0.) GO TO 110
00117          X=E1(I,J)
00118          WRITE(ITRFN,80) II,JJ,A2,A1,X,K0
00119 110      CONTINUE
00120 115      CONTINUE
00121          IF(NW.EQ.0.OR.NXC.EQ.0) GO TO 125
00123          DO 120 I=1,NXC
00124          DO 120 J=1,NW
00125          JJ=J+NU+NYS
00126          IF(GMC(I,J).EQ.0.) GO TO 120
00128          X=GMC(I,J)
00129          WRITE(ITRFN,80) I,JJ,A2,A1,X,K0
00130 120      CONTINUE
00131 125      WRITE(ITRFN,80) I0
               C        COMPOSE COLUMN CODES
00132          IF(NXC.EQ.0) GO TO 140
00134          DO 130 I=1,NXC
00135 130      MN(I)=MNXC(I)
00136 140      CONTINUE
00137          DO 150 I=1,NZ
00138          II=I+NXC
00139 150      MN(II)=MNZ(I)
00140          IF(NYO.EQ.0) GO TO 170
00142          DO 160 I=1,NYO
00143          II=I+NXC+NZ
00144 160      MN(II)=MNYO(I)
00145 170      CONTINUE
00146          IF(NU.EQ.0) GO TO 190
00148          DO 180 I=1,NU
00149 180      MM(I)=MNU(I)
00150 190      CONTINUE
00151          IF(NYS.EQ.0) GO TO 210
00153          DO 200 I=1,NYS
00154          II=I+NU
00155 200      MM(II)=MNYS(I)
00156 210      CONTINUE
00157          IF(NW.EQ.0) GO TO 230
00159          DO 220 I=1,NW
00160          II=I+NXS+NU
00161 220      MM(II)=MNW(I)
               C        WRITE TITLE, MATRIX DIMENSIONS AND COLUMN CODES
00162 230      WRITE(ITRFN,20) (TITLE(I),I=1,15)
00163          N=NXC+NY
```

```
00164          M=NU+NYS+NW
00165          WRITE(ITRFN,240) N,M,I0
00166 240      FORMAT(3I)
00167          IF(N.LE.18) GO TO 270
00169          WRITE(ITRFN,250) (MN(I),I=1,18),IPLUS
00170 250      FORMAT(17A4,A3,A1)
00171          IF(N.LE.36) GO TO 260
00173          WRITE(ITRFN,250) (MN(I),I=19,36),IPLUS
00174          WRITE(ITRFN,250) (MN(I),I=37,N)
00175          GO TO 280
00175 260      WRITE(ITRFN,250) (MN(I),I=19,N)
00177          GO TO 280
00178 270      WRITE(ITRFN,250) (MN(I),I=1,N)
00179 280      CONTINUE
00180          IF(M.LE.18) GO TO 290
00182          WRITE(ITRFN,250) (MM(I),I=1,18),IPLUS
00183          WRITE(ITRFN,250) (MM(I),I=19,M)
00184          GO TO 300
00185 290      WRITE(ITRFN,250) (MM(I),I=1,M)
               C          THE END
00185 300      STOP
00187          END
```

```
ASSIGN  00010CL 00014CL
A1      00006DA 00057=  00059=  00061IF 00063WR 00065=  00072WR 00082WR
        00088WR 00098WR 00109WR 00118WR 00129WR
A2      00006DA 00063WR 00072WR 00082WR 00088WR 00098WR 00109WR 00118WR
        00129WR
CC      00003DI 00040RD 00106IF 00108
CLOSE   00052CL
E1      00003DI 00048RD 00115IF 00117
FC      00003DI 00042RD 00060
FNAME   00001DI 00009RD 00010AG 00013RD 00014AG
GC      00003DI 00038RD 00095IF 00097
GMC     00003DI 00036RD 00126IF 00128
H4      00003DI 00044RD 00069IF 00071
HO      00003DI 00046RD 00079IF 00081
I       00009RD 00013RD 00017RD 00024RD 00026RD 00028RD 00030RD 00032RD
        00034RD 00036RD 00038RD 00040RD 00042RD 00044RD 00046RD 00048RD
        00055DO 00058IF 00060   00063WR 00066DO 00067   00069IF 00071
        00076DO 00077   00079IF 00081   00084DO 00085   00093DO 00095IF
        00097   00098WR 00103DO 00106IF 00108   00109WR 00111DO 00112
        00115IF 00117   00123DO 00126IF 00128   00129WR 00134DO 00135
        00137DO 00138   00139   00142DO 00143   00144   00148DO 00149
        00153DO 00154   00155   00159DO 00160   00161   00162WR 00169WR
        00173WR 00174WR 00176WR 00178WR 00182WR 00183WR 00185WR
IDEN    00020RD 00021IF 00022RD 00023IF 00024RD 00025IF 00026RD 00027IF
        00028RD 00029IF 00030RD 00031IF 00032RD 00033IF 00034RD 00035IF
        00036RD 00037IF 00038RD 00039IF 00040RD 00041IF 00042RD 00043IF
        00044RD 00045IF 00046RD 00047IF 00048RD
II      00067=  00072WR 00077=  00082WR 00085=  00088WR 00112=  00118WR
        00138=  00139   00143=  00144   00154=  00155   00160=  00161
IIN     00005DA 00009RD 00013RD 00017RD
IOUT    00005DA 00007WR 00011WR 00015WR
IPFIN   00005DA 00010AG 00020RD 00022RD 00024RD 00026RD 00028RD 00030RD
        00032RD 00034RD 00036RD 00038RD 00040RD 00042RD 00044RD 00046RD
        00048RD 00052AG
IPLUS   00006DA 00169WR 00173WR 00182WR
ITRFN   00005DA 00014AG 00063WR 00072WR 00082WR 00088WR 00093WR 00098WR
        00109WR 00118WR 00129WR 00131WR 00162WR 00165WR 00169WR 00173WR
        00174WR 00176WR 00178WR 00182WR 00183WR 00185WR
I0      00005DA 00088WR 00131WR 00165WR
J       00036RD 00038RD 00040RD 00042RD 00044RD 00046RD 00048RD 00056DO
        00058IF 00060   00063WR 00068DO 00069IF 00071   00072WR 00078DO
        00079IF 00081   00082WR 00094DO 00095IF 00097   00098WR 00104DO
        00105   00106IF 00108   00113DO 00114   00115IF 00117   00124DO
        00125   00126IF 00128
JJ      00105=  00109WR 00114=  00118WR 00125=  00129WR
K       00019DO
K0      00006DA 00063WR 00072WR 00082WR 00088WR 00098WR 00109WR 00118WR
        00129WR
M       00164=  00165WR 00180IF 00183WR 00185WR
MM      00004RL 00149=  00155=  00161=  00182WR 00183WR 00185WR
MN      00004RL 00135=  00139=  00144=  00169WR 00173WR 00174WR 00176WR
        00178WR
MNU     00002RL 00024RD 00149
MNW     00002RL 00026RD 00161
```

```
MNXC    00002RL 00034RD 00135
MNYO    00002RL 00038RD 00144
MNYS    00002RL 00028RD 00155
MNZ     00002RL 00032RD 00139
N       00163=  00165NR 00167IF 00171IF 00174NR 00175NR 00178NR
NU      00022RD 00091IF 00105   00114   00125   00146IF 00148DO 00154
        00160   00164
NV      00022RD 00051=  00121IF 00124DO 00157IF 00159DO 00164
NX      00024RD 00026RD 00028RD 00030RD 00032RD 00034RD 00036RD 00038RD
        00040RD 00042RD 00044RD 00046RD 00048RD
NXC     00022RD 00051   00053IF 00055DO 00056DO 00057   00058DO 00077
        00078DO 00085   00089IF 00093DO 00094DO 00103DO 00112   00121IF
        00123DO 00132IF 00134DO 00138   00143   00163
NXS     00022RD 00160
NY      00036RD 00038RD 00040RD 00042RD 00044RD 00046RD 00048RD 00050=
        00084DO 00111DO 00163
NYO     00022RD 00050   00074IF 00076DO 00140IF 00142DO
NYS     00022RD 00101IF 00104DO 00113DO 00125   00151IF 00153DO 00164
NZ      00022RD 00050   00066DO 00077   00137DO 00143
TITLE   00001DI 00017RD 00162NR
X       00056=  00061IF 00063NR 00071=  00072NR 00081=  00082NR 00097=
        00098NR 00108=  00109NR 00117=  00118NR 00128=  00129NR
X1      00005DA 00086NR
10      00007NR 00008*
100     00103DO 00104DO 00107GT 00110*
105     00090GT 00111*
110     00111DO 00113DO 00116GT 00119*
115     00102GT 00120*
12      00011NR 00012*
120     00123DO 00124DO 00127GT 00130*
125     00122GT 00131*
130     00134DO 00135*
14      00015NR 00016*
140     00133GT 00136*
150     00137DO 00139*
160     00142DO 00144*
170     00141GT 00145*
180     00148DO 00149*
190     00147GT 00150*
20      00009RD 00013RD 00017RD 00018*  00162NR
200     00153DO 00155*
210     00152GT 00156*
220     00159DO 00161*
230     00158GT 00162*
240     00165NR 00166*
250     00169NR 00170*  00173NR 00174NR 00175NR 00178NR 00182NR 00183NR
        00185NR
260     00172GT 00176*
270     00166GT 00178*
280     00175GT 00177GT 00179
290     00181GT 00185*
30      00019DO 00049*
300     00184GT 00186*
35      00020RD 00050*
```

```
40      00055DO 00056DO 00062GT 00064*
50      00066DO 00068DO 00070GT 00073*
60      00076DO 00078DO 00080GT 00083*
65      00054GT 00075GT 00084*
70      00084DO 00085*
80      00062NR 00072NR 00082NR 00088NR 00087*  00088NR 00093NR 00109NR
        00110NR 00129NR 00131NR
90      00093DO 00094DO 00095GT 00099*
95      00092GT 00100*
```

```
      C        BLOCK 3 - THE FILTER PROBLEM SET-UP
      C          THIS ROUTINE SETS UP THE SINGULAR OR NON-SINGULAR
      C          FILTER PROBLEM USING THE DATA GENERATED BY BLOCK 1
      C          AND ADDITIONAL INPUTS QD AND RD.
00001       DIMENSION FNAME(4),TTLNEW(5),SCALE(15)
      C        INPUT MATRIX ARRAYS
00002       DIMENSION QD(15),RD(15)
      C        PROBLEM FILE INPUT MATRIX ARRAYS
00003       REAL MNV(15),MNZ(15),MNXT(15),MNXS(5),MNXC(10)
00004       DIMENSION F(15,15),G(15,5),GM(15,15),H(15,15),IREOR(15,15)
      C        OUTPUT ARRAYS
00005       DIMENSION T1(15,15),T2(15,15),AR4(30,30)
      C        WORKING ARRAYS
00006       DIMENSION ARRAY(900),IARRAY(900),DUMMY(15,15),DUMMY2(15,15)
00007       DIMENSION XINVRT(15,15),T2I(15,15),A(15,15),ZETA(15),TZ(15,15)
      C        EQUIVALENCES
00008       EQUIVALENCE (ARRAY,IARRAY),(ARRAY,T1),(ARRAY,AR4),
     +                (ARRAY(226),T2),(ARRAY(451),T2I)
00009       EQUIVALENCE (XINVRT,A),(DUMMY2,TZ)
      C        COMMONS
00010       COMMON/IO/ IIN,IOUT
00011       COMMON/NONAME/ NDIM3
      C        INITIALIZE ARRAYS
00012       DATA F,G,GM,H,QD,RD,A,ARM,ZETA /1920*0./
      C        OTHER DATA
00013       DATA IIN,IOUT,IPFIN,IPFOUT /5,7,20,21/
00014       DATA I1,R0,I900,LASTID,NDIM3,NDIM6 /1,0.,900,31,15,30/
      C        READ PROBLEM FILE NAMES AND REGULATOR TITLE
00015       WRITE(IOUT,10)
00016 10    FORMAT(20X,'FILTER SET-UP - BLOCK 3',/,2X,
     +       'INPUT PROBLEM FILE NAME ? ',$)
00017       READ(IIN,20) (FNAME(I),I=1,4)
00018       CALL ASSIGN(IPFIN,FNAME)
00019       WRITE(IOUT,12)
00020 12    FORMAT(2X,'OUTPUT PROBLEM FILE NAME ? ',$)
00021       READ(IIN,20) (FNAME(I),I=1,4)
00022       CALL ASSIGN(IPFOUT,FNAME)
00023       WRITE(IOUT,14)
00024 14    FORMAT(2X,'PROBLEM TITLE (20 CHARS) : ',$)
00025       READ(IIN,20) (TTLNEW(I),I=1,5)
00026 20    FORMAT(5A4)
00027       WRITE(IOUT,22)
00028 22    FORMAT(2X,'AUGMENTATION CONSTANT : ',$)
00029       READ(IIN,25) ACONST
00030 25    FORMAT(E)
      C        GET THE FOLLOWING DATA FROM THE PROBLEM FILE:
      C          DIMENSIONS     IDEN=2
      C          V MNEMONICS    IDEN=6
      C          Z MNEMONICS    IDEN=10
      C          X MNEMONICS    IDEN=11&12
      C          F MATRIX       IDEN=24
      C          G MATRIX       IDEN=25
      C          GM MATRIX      IDEN=26
      C          H MATRIX       IDEN=27
```

```
00031        DO 40 K=1,200
00032        READ(IPFIN,END=42) IDEN
00033        IF(IDEN.EQ.1) READ(IPFIN) IDEN,NXS,NXC,NU,NM,NZ,NYS,NYO
00035        IF(IDEN.EQ.5) READ(IPFIN) IDEN,NX,(MNV(I),I=1,NX)
00037        IF(IDEN.EQ.9) READ(IPFIN) IDEN,NX,(MNZ(I),I=1,NX)
00039        IF(IDEN.EQ.10) READ(IPFIN) IDEN,NX,(MNXS(I),I=1,NX)
00041        IF(IDEN.EQ.11) READ(IPFIN) IDEN,NX,(MNXC(I),I=1,NX)
00043        IF(IDEN.EQ.23) READ(IPFIN) IDEN,NX,NY,((F(I,J),J=1,NY),I=1,NX)
00045        IF(IDEN.EQ.24) READ(IPFIN) IDEN,NX,NY,((G(I,J),J=1,NY),I=1,NX)
00047        IF(IDEN.EQ.25) READ(IPFIN) IDEN,NX,NY,((G4(I,J),J=1,NY),I=1,NX)
00049        IF(IDEN.EQ.26) READ(IPFIN) IDEN,NX,NY,((H(I,J),J=1,NY),I=1,NX)
00051 40     CONTINUE
      C         READ QD AND RD
00052 42     WRITE(IOUT,45)
00053 45     FORMAT(2X,'NON-ZERO DIAGONAL Q ELEMENTS : ')
00054 50     CALL READMX(NM,QD,IERR)
00055        IF(IERR.NE.1) GO TO 50
00057        WRITE(IOUT,55)
00058 55     FORMAT(2X,'NON-ZERO DIAGONAL R ELEMENTS : ')
00059 60     CALL READMX(NZ,RD,IERR)
00060        IF(IERR.NE.1) GO TO 60
      C         READ AND WRITE PROBLEM FILE, COMPOSEING NEW TITLE
00062        REWIND IPFIN
00063        CALL RENR(IPFIN,IPFOUT,TTLNEW,1000,LASTID,ARRAY,IARRAY)
00064        NXT=NXC+NXS
00065        IF(NXS.EQ.0) GO TO 64
00067        DO 62 I=1,NXS
00068 62     MNXT(I)=MNXS(I)
00069 64     CONTINUE
00070        IF(NXC.EQ.0) GO TO 68
00072        DO 66 I=1,NXC
00073        II=I+NXS
00074 66     MNXT(II)=MNXC(I)
00075 68     CONTINUE
```

```
      C        SEE THAT G, GM AND H HAVE FULL RANK
00076         DO 70 I=1,NXT
00077         DO 70 J=1,NU
00078 70      DUMMY(I,J)=G(I,J)
00079         CALL GMINV(NXT,NU,DUMMY,XINVRT,MR,0)
00080         IF(MR.NE.NU) WRITE(IOUT,80)
00082 80      FORMAT(5X,'G MATRIX DOES NOT HAVE FULL RANK')
00083         DO 90 I=1,NXT
00084         DO 90 J=1,NM
00085 90      DUMMY(I,J)=GM(I,J)
00086         CALL GMINV(NXT,NM,DUMMY,XINVRT,MR,0)
00087         IF(MR.LT.NM-NXC) WRITE(IOUT,100)
00089 100     FORMAT(5X,'GM MATRIX DOES NOT HAVE FULL RANK')
00090         DO 110 I=1,NZ
00091         DO 110 J=1,NXT
00092 110     DUMMY(I,J)=H(I,J)
00093         CALL GMINV(NZ,NXT,DUMMY,XINVRT,MR,0)
00094         IF(MR.NE.NZ) WRITE(IOUT,120)
00096 120     FORMAT(5X,'H MATRIX DOES NOT HAVE FULL RANK')
      C        HERE WE SHOULD TEST FOR THE DETECTABILITY OF (F  H),
      C        BUT WE DON'T DO THAT.  IF (F  H) IS NOT DETECTABLE,
      C        THERE WILL BE CLOSED LOOP ROOTS IN THE RIGHT-HALF PLANE.
      C        IS THIS A SINGULAR FILTERING PROBLEM?  IF SO,
      C        REORDER RD, H, MNV AND MNZ.
00097         DO 125 I=1,NZ
00098         DO 125 J=1,NZ
00099         TZ(I,J)=0.
00102 125     TZ(I,I)=1.
00101         M2P=0
00102         DO 140 I=1,NZ
00103         II=NZ-I+1
00104         IF(RD(II).NE.0.) GO TO 140
00106         M2P=M2P+1
00107         IF(I.EQ.M2P) GO TO 140
00109         DUM=RD(II)
00110         RD(II)=RD(II+1)
00111         RD(II+1)=DUM
00112         DO 130 J=1,NXT
00113         DUM=H(II,J)
00114         H(II,J)=H(II+1,J)
00115         HREOR(II,J)=H(II+1,J)
00116         H(II+1,J)=DUM
00117 130     HREOR(II+1,J)=DUM
00118         DO 135 J=1,NZ
00119         DUM=TZ(II,J)
00120         TZ(II,J)=TZ(II+1,J)
00121 135     TZ(II+1,J)=DUM
00122         DUM=MNV(II)
00123         MNV(II)=MNV(II+1)
00124         MNV(II+1)=DUM
00125         DUM=MNZ(II)
00126         MNZ(II)=MNZ(II+1)
00127         MNZ(II+1)=DUM
00128 140     CONTINUE
```

```
00129          IF(M2P.EQ.0) GO TO 700
               C     WRITE MNEMONICS AND TZ TO OUTPUT PROBLEM FILE
00131          IDEN=LASTID+1
00132          WRITE(IPFOUT) IDEN,NZ,(MNV(I),I=1,NZ)
00133          IDEN=IDEN+1
00134          WRITE(IPFOUT) IDEN,NZ,(MNZ(I),I=1,NZ)
00135          M1=NZ-M2P
00136          M2=M2P
00137          M1P=NXT-M2
               C     MAKE T1 THE IDENTITY MATRIX
00138          DO 144 I=1,NXT
00139          DO 144 J=1,NXT
00140          T1(I,J)=0.
00141 144      T1(I,I)=1.0
               C     SINGULAR FILTERING PROBLEM - REORDER STATE TO CAUSE
               C     H22 TO HAVE FULL RANK.
00142          DO 200 NCOL=1,M2P
00143          NBCOL=NXT-NCOL+1
00144          NC=NCOL
00145          DO 146 I=1,M2P
00146          II=I+M1
00147          DO 146 J=1,NCOL
00148          JB=NXT-J+1
00149          JC=NCOL-J+1
00150 146      DUMMY(I,JC)=H(II,JB)
00151          NC=NCOL
00152          CALL GMINV(M2P,NC,DUMMY,XINVRT,MR,0)
00153          IF(MR.EQ.NCOL) GO TO 200
00155          DO 160 L=1,NZ
00156          DUM=H(L,NBCOL)
00157          DO 150 M=1,NBCOL-1
00158          MBACK=NBCOL-M+1
00159 150      H(L,MBACK)=H(L,MBACK-1)
00160 160      H(L,1)=DUM
00161          DUMN=MNXT(NBCOL)
00162          DO 170 L=1,NBCOL-1
00163          LBACK=NBCOL-L+1
00164 170      MNXT(LBACK)=MNXT(LBACK-1)
00165          MNXT(1)=DUMN
00166          DO 190 L=1,NXT
00167          DUM=T1(L,NBCOL)
00168          DO 180 M=1,NBCOL-1
00169          MBACK=NBCOL-M+1
00170 180      T1(L,MBACK)=T1(L,MBACK-1)
00171 190      T1(L,1)=DUM
00172 200      CONTINUE
               C                    ( I    0 )
               C        FORM T2 = (         )
               C                    (H21  H22)
00173 210      CONTINUE
00174          DO 215 I=1,NXT
00175          DO 215 J=1,NXT
00176 215      T2(I,J)=0.
00177          IF(M1P.EQ.0) GO TO 245
```

```
00179       DO 220 I=1,M1P
00180 220   T2(I,I)=1.0
00181       DO 240 I=1,M2P
00182       II=I+M1
00183       IK=I+M1P
00184       DO 240 J=1,M1P
00185 240   T2(IK,J)=H(II,J)
00186 245   DO 250 I=1,M2P
00187       II=I+M1
00188       IK=I+M1P
00189       DO 250 J=1,M2P
00190       JJ=J+NXT-M2P
00191 250   T2(IK,JJ)=H(II,JJ)
      C        COMPUTE T=T2*T1 AND TI
00192       DO 255 I=1,NXT
00193       DO 255 J=1,NXT
00194       DUM=0.
00195       DO 253 K=1,NXT
00196 253   DUM=DUM+T2(I,K)*T1(J,K)
00197 255   DUMMY(I,J)=DUM
00198       DO 257 I=1,NXT
00199       DO 257 J=1,NXT
00200 257   T2(I,J)=DUMMY(I,J)
00201       CALL GMINV(NXT,NXT,DUMMY,T2I,MR,0)
00202       DO 258 I=1,M1P
00203 258   CALL TRANSL(MNXT,MNXT,'E','X')
00204       IDEN=IDEN+1
00205       WRITE(IPFOUT) IDEN,NXT,(MNXT(I),I=1,M1P),
          +      (MNZ(I),I=1+M1,M1+M2)
00206       IDEN=IDEN+1
00207       WRITE (IPFOUT) IDEN,NZ,NZ,((TZ(I,J),J=1,NZ),I=1,NZ)
00208       IDEN=IDEN+1
00209       WRITE(IPFOUT) IDEN,NXT,NXT,((T2(I,J),J=1,NXT),I=1,NXT)
00210       IDEN=IDEN+1
00211       WRITE(IPFOUT) IDEN,NXT,NXT,((T2I(I,J),J=1,NXT),I=1,NXT)
00212       IF(M1P.EQ.0) GO TO 645
      C        TRANSFORM F, G, GM:
      C          F=T2*F*T2I
      C          G=T2*G
      C          GM=T2*GM
00214       DO 270 I=1,NXT
00215       DO 270 J=1,NXT
00216       DUM=0.
00217       DO 260 K=1,NXT
00218 260   DUM=DUM+T2(I,K)*F(K,J)
00219 270   DUMMY(I,J)=DUM
00220       DO 290 I=1,NXT
00221       DO 290 J=1,NXT
00222       DUM=0.
00223       DO 280 K=1,NXT
00224 280   DUM=DUM+DUMMY(I,K)*T2I(K,J)
00225 290   F(I,J)=DUM
00226       DO 310 I=1,NU
00227       DO 310 J=1,NU
```

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00228         DUM=0.
00229         DO 300 K=1,NXT
00230  300    DUM=DUM+T2(I,K)*G(K,J)
00231  310    DUMMY(I,J)=DUM
00232         DO 320 I=1,NXT
00233         DO 320 J=1,NU
00234  320    G(I,J)=DUMMY(I,J)
00235         DO 340 I=1,NXT
00236         DO 340 J=1,NW
00237         DUM=0.
00238         DO 330 K=1,NXT
00239  330    DUM=DUM+T2(I,K)*GM(K,J)
00240  340    DUMMY(I,J)=DUM
00241         DO 350 I=1,NXT
00242         DO 350 J=1,NW
00243  350    GM(I,J)=DUMMY(I,J)
       C        DETERMINE THE RANK OF GM2*QD*GM2T AND IF RANK IS NOT
       C        FULL, AUGMENT.
00244         DO 410 ISQR=1,M2
00245         DO 400 I=1,ISQR
00246         II=I+M1P
00247         DO 400 J=1,ISQR
00248         JJ=J+M1P
00249         DUM=0.
00250         DO 390 K=1,NW
00251  390    DUM=DUM+GM(II,K)*GM(JJ,K)*QD(K)
00252         IF(I.EQ.J) DUM=DUM+ZETA(I)
00254  400    DUMMY(I,J)=DUM
00255         IS=ISQR
00256         CALL GMINV(IS,IS,DUMMY,A,MR,0)
00257         IF(MR.LT.ISQR) ZETA(ISQR)=ACONST
00259  410    CONTINUE
00260         DO 425 I=1,M2
00261         II=I+M1P
00262         DO 425 J=1,M2
00263         JJ=J+M1P
00264         DUM=0.
00265         DO 420 K=1,NW
00266  420    DUM=DUM+GM(II,K)*GM(JJ,K)*QD(K)
00267         IF(I.EQ.J) DUM=DUM+ZETA(I)
00269  425    DUMMY(I,J)=DUM
00270         CALL GMINV(M2,M2,DUMMY,A,MR,0)
00271         IS=0
00272         DO 428 I=1,M2
00273         IF(ZETA(I).GT.0.) IS=1
00275  428    CONTINUE
00276         IF(IS.EQ.1) WRITE(IOUT,429)
00278  429    FORMAT(5X,'GM2*QD*GM2T HAS BEEN AUGMENTED')
```

```
      C         FORM UPPER LEFT QUADRANT OF ARM:
      C          F11-GM1*QD*GM2T*(GM2*QD*GM2T)I*F21
00279           DO 440 I=1,M1P
00280           DO 440 J=1,M2
00281           JJ=J+M1P
00282           DUM=0.
00283           DO 430 K=1,NN
00284 430       DUM=DUM+GM(I,K)*GM(JJ,K)*QD(K)
00285 440       DUMMY(I,J)=DUM
00286           DO 460 I=1,M1P
00287           DO 460 J=1,M2
00288           DUM=0.
00289           DO 450 K=1,M2
00290 450       DUM=DUM+DUMMY(I,K)*A(K,J)
00291 460       DUMMY2(I,J)=DUM
00292           DO 480 I=1,M1P
00293           DO 480 J=1,M1P
00294           DUM=0.
00295           DO 470 K=1,M2
00296           KK=K+M1P
00297 470       DUM=DUM+DUMMY2(I,K)*F(KK,J)
00298 480       ARM(I,J)=F(I,J)-DUM
      C            FORM THE LOWER RIGHT QUADRANT OF ARM, WHICH IS THE NEGATIVE
      C            TRANSPOSE OF THE UPPER LEFT QUADRANT.
00299           DO 490 I=1,M1P
00300           DO 490 J=1,M1P
00301 490       ARM(I+M1P,J+M1P)=-ARM(J,I)
      C            FORM THE LOWER LEFT QUADRANT OF ARM:
      C             -H11T*R1I*H11 - F21T*(GM2*QD*GM2T)I*F21
00302           DO 510 I=1,M1P
00303           DO 510 J=1,M2
00304           DUM=0.
00305           DO 500 K=1,M2
00306           KK=K+M1P
00307 500       DUM=DUM+F(KK,I)*A(K,J)
00308 510       DUMMY(I,J)=DUM
00309           DO 525 I=1,M1P
00310           II=I+M1P
00311           DO 525 J=1,M1P
00312           DUM=0.
00313           DO 520 K=1,M2
00314           KK=K+M1P
00315 520       DUM=DUM+DUMMY(I,K)*F(KK,J)
00316 525       ARM(II,J)=-DUM
00317           IF(M1.EQ.0) GO TO 545
00319           DO 540 I=1,M1P
00320           II=I+M1P
00321           DO 540 J=1,M1P
00322           DUM=0.
00323           DO 530 K=1,M1
00324 530       DUM=DUM-H(K,I)*H(K,J)/RD(K)
00325 540       ARM(II,J)=DUM+ARM(II,J)
      C            FORM THE UPPER RIGHT QUADRANT OF ARM:
      C             -GM1*QD*GM1T + GM1*QD*GM2T*(GM2*QD*GM2T)I*GM2*QD*GM1T
```

```
00326 545    DO 560 I=1,M1P
00327        DO 550 J=1,M2
00328        JJ=I+M1P
00329        DUM=0.
00330        DO 550 K=1,NV
00331 550    DUM=DUM+GM(I,K)*GM(JJ,K)*QD(K)
00332 560    DUMMY(I,J)=DUM
00333        DO 580 I=1,M1P
00334        DO 580 J=1,M2
00335        DUM=0.
00336        DO 570 K=1,M2
00337 570    DUM=DUM+DUMMY(I,K)*A(K,J)
00338 580    DUMMY2(I,J)=DUM
00339        DO 600 I=1,M1P
00340        DO 600 J=1,NV
00341        DUM=0.
00342        DO 590 K=1,M2
00343        KK=K+M1P
00344 590    DUM=DUM+DUMMY2(I,K)*GM(KK,J)*QD(J)
00345 600    DUMMY(I,J)=DUM
00346        DO 620 I=1,M1P
00347        DO 620 J=1,M1P
00348        DUM=0.
00349        DO 610 K=1,NV
00350 610    DUM=DUM+DUMMY(I,K)*GM(J,K)
00351 620    DUMMY2(I,J)=DUM
00352        DO 640 I=1,M1P
00353        DO 640 J=1,M1P
00354        JJ=J+M1P
00355        DUM=0.
00356        DO 630 K=1,NV
00357 630    DUM=DUM+GM(I,K)*GM(I,K)*QD(K)
00358 640    ARM(I,JJ)=DUM+DUMMY2(I,J)
             C
             C     WRITE THE FOLLOWING TO THE PROBLEM FILE:
             C       F11,F12,F21,F22,G1,G2,GM1,GM2,HREOR,H11,H12,H22,QD,RD,ARM
00359        IDEN=IDEN+1
00360        WRITE(IPFOUT) IDEN,M1P,M1P,((F(I,J),J=1,M1P),I=1,M1P)
00361        IDEN=IDEN+1
00362        WRITE(IPFOUT) IDEN,M1P,M2,((F(I,J),J=M1P+1,NXT),I=1,M1P)
00363        IDEN=IDEN+1
00364        WRITE(IPFOUT) IDEN,M2,M1P,((F(I,J),J=1,M1P),I=M1P+1,NXT)
00365        IDEN=IDEN+1
00366        WRITE(IPFOUT) IDEN,M2,M2,((F(I,J),J=M1P+1,NXT),I=M1P+1,NXT)
00367        IDEN=IDEN+1
00368        WRITE(IPFOUT) IDEN,M1P,NU,((G(I,J),J=1,NU),I=1,M1P)
00369        IDEN=IDEN+1
00370        WRITE(IPFOUT) IDEN,M2,NU,((G(I,J),J=1,NU),I=M1P+1,NXT)
00371        IDEN=IDEN+1
00372        WRITE(IPFOUT) IDEN,M1P,NV,((GM(I,J),J=1,NV),I=1,M1P)
00373        IDEN=IDEN+1
00374        WRITE(IPFOUT) IDEN,M2,NV,((GM(I,J),J=1,NV),I=M1P+1,NXT)
00375        IDEN=IDEN+1
00376        NX=M1+M2P
00377        NY=M1P+M2
```


C-2

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00378       WRITE(IPFOUT) IDEN,NX,NY,((HREOR(I,J),J=1,NY),I=1,NX)
00379       IDEN=IDEN+1
00380       IF(M1.EQ.0) WRITE(IPFOUT) IDEN,I1,I1,R0
00382       IF(M1.NE.0)
           + WRITE(IPFOUT) IDEN,M1,M1P,((H(I,J),J=1,M1P),I=1,M1)
00384       IDEN=IDEN+1
00385       IF(M1.EQ.0) WRITE(IPFOUT) IDEN,I1,I1,R0
00387       IF(M1.NE.0)
           + WRITE(IPFOUT) IDEN,M1,M2,((H(I,J),J=M1P+1,NXT),I=1,M1)
00389       IDEN=IDEN+1
00390       WRITE(IPFOUT) IDEN,M2,M2,((H(I,J),J=M1P+1,NXT),I=M1+1,NZ)
00391       IDEN=IDEN+1
00392       WRITE(IPFOUT) IDEN,NN,(QD(I),I=1,NN)
00393       IDEN=IDEN+1
00394       WRITE(IPFOUT) IDEN,NZ,(RD(I),I=1,NZ)
00395       IDEN=IDEN+1
00396       NUM=M1P*2
00397       WRITE(IPFOUT) IDEN,NUM,NUM,((ARM(I,J),J=1,NUM),I=1,NUM)
00398       IDEN=IDEN+1
00399       WRITE(IPFOUT) IDEN,M2,M2,((A(I,J),J=1,M2),I=1,M2)
00400       IDEN=IDEN+1
00401       WRITE(IPFOUT) IDEN,M1,M1P,M2,M2P
00402       GO TO 900
      C        FOR R IDENTICALLY SINGULAR
00403 645   DO 655 K=1,3
00404       IDEN=IDEN+1
00405 655   WRITE(IPFOUT) IDEN,I1,I1,R0
00406       IDEN=IDEN+1
00407       WRITE(IPFOUT) IDEN,M2,M2,((F(I,J),J=1,M2),I=1,M2)
00408       IDEN=IDEN+1
00409       WRITE(IPFOUT) IDEN,I1,I1,R0
00410       IDEN=IDEN+1
00411       WRITE(IPFOUT) IDEN,M2,NU,((G(I,J),J=1,NU),I=1,M2)
00412       IDEN=IDEN+1
00413       WRITE(IPFOUT) IDEN,I1,I1,R0
00414       IDEN=IDEN+1
00415       WRITE(IPFOUT) IDEN,M2,NN,((GM(I,J),J=1,NN),I=1,M2)
00416       DO 660 K=1,3
00417       IDEN=IDEN+1
00418 660   WRITE(IPFOUT) IDEN,I1,I1,R0
00419       IDEN=IDEN+1
00420       WRITE(IPFOUT) IDEN,M2,M2,((H(I,J),J=1,M2),I=1,M2)
00421       IDEN=IDEN+1
00422       WRITE(IPFOUT) IDEN,NN,(QD(I),I=1,NN)
00423       IDEN=IDEN+1
00424       WRITE(IPFOUT) IDEN,NZ,(RD(I),I=1,NZ)
00425       IDEN=IDEN+1
00426       WRITE(IPFOUT) IDEN,I1,I1,R0
00427       IDEN=IDEN+1
00428       WRITE(IPFOUT) IDEN,I1,I1,R0
00429       IDEN=IDEN+1
00430       WRITE(IPFOUT) IDEN,M1,M1P,M2,M2P
00431       GO TO 900
```

```
      C        NON-SINGULAR FILTER
      C                          (   F      -GQGT)
      C        ASSEMBLE ARM =    (                )
      C                          (-HTRIH    -FT )
00432 700    DO 710 I=1,NXT
00433        DO 710 J=1,NXT
00434 710    ARM(I,J)=F(I,J)
00435        DO 730 I=1,NXT
00436        II=I+NXT
00437        DO 730 J=1,NXT
00438        DUM=0.
00439        DO 720 K=1,NZ
00440 720    DUM=DUM-H(K,I)*H(K,J)/RD(K)
00441 730    ARM(II,J)=DUM
00442        DO 750 I=1,NXT
00443        DO 750 J=1,NXT
00444        JJ=J+NXT
00445        DUM=0.
00446        DO 740 K=1,NU
00447 740    DUM=DUM-G(I,K)*G(J,K)*QD(K)
00448 750    ARM(I,JJ)=DUM
00449        DO 760 I=1,NXT
00450        II=I+NXT
00451        DO 760 J=1,NXT
00452        JJ=J+NXT
00453 760    ARM(II,JJ)=-F(J,I)
      C        WRITE THE FOLLOWING TO THE PROBLEM FILE:
      C          MNEMONICS,T1,T,TI,F,G,GM,H,QD,RD AND ARM
00454        DO 770 I=1,NXT
00455        DO 770 J=1,NXT
00456        DUMMY(I,J)=0.
00457 770    DUMMY(I,I)=1.0
00458        IDEN=LASTID+1
00459        WRITE(IPFOUT) IDEN,NZ,(MNV(I),I=1,NZ)
00460        IDEN=IDEN+1
00461        WRITE(IPFOUT) IDEN,NZ,(MNZ(I),I=1,NZ)
00462        IDEN=IDEN+1
00463        DO 775 I=1,NXT
00464 775    CALL TRANSL(MNXT,MNXT,'E','X')
00465        WRITE(IPFOUT) IDEN,NXT,(MNXT(I),I=1,NXT)
00466        IDEN=IDEN+1
00467        WRITE(IPFOUT) IDEN,NXT,NXT,((DUMMY(I,J),J=1,NXT),I=1,NXT)
00468        IDEN=IDEN+1
00469        WRITE(IPFOUT) IDEN,NXT,NXT,((DUMMY(I,J),J=1,NXT),I=1,NXT)
00470        IDEN=IDEN+1
00471        WRITE(IPFOUT) IDEN,NXT,NXT,((DUMMY(I,J),J=1,NXT),I=1,NXT)
00472        IDEN=IDEN+1
00473        WRITE(IPFOUT) IDEN,NXT,NXT,((F(I,J),J=1,NXT),I=1,NXT)
00474        DO 780 I=1,3
00475        IDEN=IDEN+1
00476 780    WRITE(IPFOUT) IDEN,I1,I1,R0
00477        IDEN=IDEN+1
00478        WRITE(IPFOUT) IDEN,NXT,NU,((G(I,J),J=1,NU),I=1,NXT)
00479        IDEN=IDEN+1
```

```
00480        WRITE(IPFOUT) IDEN,I1,I1,R0
00481        IDEN=IDEN+1
00482        WRITE(IPFOUT) IDEN,NXT,NN,((GM(I,J),J=1,NN),I=1,NXT)
00483        IDEN=IDEN+1
00484        WRITE(IPFOUT) IDEN,I1,I1,R0
00485        IDEN=IDEN+1
00486        WRITE(IPFOUT) IDEN,NZ,NXT,((H(I,J),J=1,NXT),I=1,NZ)
00487        IDEN=IDEN+1
00488        WRITE(IPFOUT) IDEN,NZ,NXT,((H(I,J),J=1,NXT),I=1,NZ)
00489        DO 790 I=1,2
00490        IDEN=IDEN+1
00491 790    WRITE(IPFOUT) IDEN,I1,I1,R0
00492        IDEN=IDEN+1
00493        WRITE(IPFOUT) IDEN,NN,(QD(I),I=1,NN)
00494        IDEN=IDEN+1
00495        WRITE(IPFOUT) IDEN,NZ,(RD(I),I=1,NZ)
00496        IDEN=IDEN+1
00497        NUM=2*NXT
00498        WRITE(IPFOUT) IDEN,NUM,NUM,((ARM(I,J),J=1,NUM),I=1,NUM)
00499        IDEN=IDEN+1
00500        WRITE(IPFOUT) IDEN,I1,I1,R0
00501        IDEN=IDEN+1
00502        WRITE(IPFOUT) IDEN,NZ,NXT,M2P,M2P
     C          THE END
00503 930    DO 910 I=IDEN+1,130
00504 910    WRITE(IPFOUT) I,I1,I1,R0
00505 1300   STOP
00506        END
```

A 00007DI 00009EQ 00012DA 00253AG 00270AG 00290 00307 00337
00399NR
ACONST 00029RD 00258
ARM 00005DI 00008EQ 00012DA 00293= 00301= 00315= 00325= 00359=
00397NR 00434= 00441= 00448= 00453= 00493NR
ARRAY 00006DI 00008EQ 00063AG
ASSIGN 00018CL 00022CL
DUM 00109= 00111 00113= 00116 00117 00119= 00121 00122=
00124 00125= 00127 00156= 00160 00167= 00171 00194=
00196= 00197 00210= 00218= 00219 00222= 00224= 00225
00228= 00230= 00231 00237= 00239= 00240 00249= 00251=
00253= 00254 00264= 00266= 00268= 00269 00282= 00284=
00285 00288= 00290= 00291 00294= 00297= 00298 00304=
00307= 00308 00312= 00315= 00316 00322= 00324= 00325
00329= 00331= 00332 00335= 00337= 00338 00341= 00344=
00345 00348= 00350= 00351 00355= 00357= 00358 00430=
00440= 00441 00445= 00447= 00448
DUMMY 00006DI 00078= 00079AG 00085= 00086AG 00092= 00093AG 00150=
00152AG 00197= 00200 00201AG 00219= 00224 00231= 00234
00240= 00243 00254= 00256AG 00269= 00270AG 00285= 00290
00308= 00315 00332= 00337 00345= 00350 00456= 00457=
00467NR 00469NR 00471NR
DUMMY2 00006DI 00009EQ 00291= 00297 00338= 00344 00351= 00358
DUMN 00161= 00165
F 00004DI 00012DA 00044RD 00218 00225= 00297 00298 00307
00315 00360NR 00362NR 00364NR 00366NR 00407NR 00434 00453
00473NR
FNAME 00001DI 00017RD 00018AG 00021RD 00022AG
G 00004DI 00012DA 00046RD 00078 00230 00234= 00360NR 00370NR
00411NR 00447 00478NR
GM 00004DI 00012DA 00048RD 00085 00239 00243= 00251 00266
00284 00331 00344 00350 00357 00372NR 00374NR 00415NR
00482NR
GMINV 00079CL 00085CL 00093CL 00152CL 00201CL 00256CL 00270CL
H 00004DI 00012DA 00050RD 00092 00113 00114= 00115 00116=
00150 00156 00159= 00160= 00185 00191 00324 00383NR
00398NR 00390NR 00420NR 00440 00486NR 00498NR
HREOR 00004DI 00115= 00117= 00378NR
I 00017RD 00021RD 00025RD 00036RD 00038RD 00040RD 00042RD 00044RD
00046RD 00048RD 00050RD 00067DO 00068 00072DO 00073 00074
00076DO 00078 00083DO 00085 00090DO 00092 00097DO 00099
00100 00102DO 00103 00107IF 00132NR 00134NR 00138DO 00140
00141 00145DO 00146 00150 00174DO 00176 00179DO 00180
00181DO 00182 00183 00186DO 00187 00188 00192DO 00196
00197 00198DO 00200 00202DO 00205NR 00207NR 00209NR 00211NR
00214DO 00218 00219 00220DO 00224 00225 00226DO 00230
00231 00232DO 00234 00235DO 00239 00240 00241DO 00243
00245DO 00246 00252IF 00253 00254 00260DO 00261 00267IF
00268 00269 00272DO 00273IF 00279DO 00284 00285 00286DO
00290 00291 00292DO 00297 00298 00299DO 00301 00302DO
00307 00308 00309DO 00310 00315 00319DO 00320 00324
00326DO 00331 00332 00333DO 00337 00338 00339DO 00344
00345 00346DO 00350 00351 00352DO 00357 00358 00360NR
00362NR 00364NR 00366NR 00368NR 00370NR 00372NR 00374NR 00378NR

```
        00383#R 00388#R 00390#R 00392#R 00394#R 00397#R 00399#R 00407#R
        00411#R 00415#R 00423#R 00422#R 00424#R 00432D0 00434   00435D0
        00436   00440   00442D0 00447   00448   00449D0 00450   00453
        00454D0 00456   00457   00459#R 00461#R 00463D0 00465#R 00467#R
        00469#R 00471#R 00473#R 00474D0 00478#R 00482#R 00486#R 00488#R
        00489D0 00493#R 00495#R 00498#R 00503D0 00504#R
IARRAY  000026DI 00000EQ 00063AG
IDEN    00032RD 00033IF 00034RD 00035IF 00036RD 00037IF 00038RD 00039IF
        00040RD 00041IF 00042RD 00043IF 00044RD 00045IF 00046RD 00047IF
        00048RD 00049IF 00050RD 00131=  00132#R 00133=  00134#R 00204=
        00205#R 00206=  00207#R 00208=  00209#R 00210=  00211#R 00359=
        00360#R 00361=  00362#R 00363=  00364#R 00365=  00366#R 00367=
        00368#R 00369=  00370#R 00371=  00372#R 00373=  00374#R 00375=
        00378#R 00379=  00381#R 00383#R 00384=  00386#R 00388#R 00389=
        00390#R 00391=  00392#R 00393=  00394#R 00395=  00397#R 00398=
        00399#R 00400=  00401#R 00404=  00405#R 00406=  00407#R 00408=
        00409#R 00410=  00411#R 00412=  00413#R 00414=  00415#R 00417=
        00418#R 00419=  00420#R 00421=  00422#R 00423=  00424#R 00425=
        00426#R 00427=  00428#R 00429=  00430#R 00458=  00459#R 00460=
        00461#R 00462=  00465#R 00466=  00467#R 00468=  00469#R 00470=
        00471#R 00472=  00473#R 00475=  00476#R 00477=  00478#R 00479=
        00480#R 00481=  00482#R 00483=  00484#R 00485=  00486#R 00487=
        00488#R 00490=  00491#R 00492=  00493#R 00494=  00495#R 00496=
        00498#R 00499=  00500#R 00501=  00502#R 00503D0
IERR    00054AG 00055IF 00059AG 00060IF
II      00073=  00074   00103=  00104IF 00109   00110   00111   00113
        00114   00115   00116   00117   00119   00120   00121   00122
        00123   00124   00125   00126   00127   00146=  00150   00182=
        00185   00187=  00191   00246=  00251   00261=  00266   00310=
        00316   00320=  00325   00436=  00441   00453=  00453
IIN     00010CM 00013DA 00017RD 00021RD 00025RD 00029RD
IK      00183=  00185   00183=  00191
IO      00010CN
IOUT    00010CM 00013DA 00019#R 00019#R 00023#R 00027#R 00052#R 00057#R
        00081#R 00088#R 00095#R 00277#R
IPFIN   00013DA 00018AG 00032RD 00034RD 00036RD 00038RD 00040RD 00042RD
        00044RD 00046RD 00048RD 00050RD 00052RD 00063AG
IPFOUT  00013DA 00022AG 00063AG 00132#R 00134#R 00205#R 00207#R 00209#R
        00211#R 00360#R 00362#R 00364#R 00366#R 00368#R 00374#R 00372#R
        00374#R 00376#R 00381#R 00383#R 00386#R 00388#R 00390#R 00392#R
        00394#R 00397#R 00399#R 00401#R 00405#R 00407#R 00409#R 00411#R
        00413#R 00415#R 00418#R 00420#R 00422#R 00424#R 00426#R 00428#R
        00430#R 00459#R 00461#R 00465#R 00467#R 00469#R 00471#R 00473#R
        00476#R 00478#R 00480#R 00482#R 00484#R 00486#R 00488#R 00491#R
        00493#R 00495#R 00498#R 00503#R 00502#R 00504#R
IS      00255=  00255AG 00271=  00274=  00276IF
ISQR    00244D0 00245D0 00247DQ 00255   00257IF 00259
I1      00014DA 00381#R 00386#R 00405#R 00409#R 00413#R 00418#R 00426#R
        00428#R 00476#R 00480#R 00484#R 00491#R 00502#R 00504#R
I1PP    00014DA 00063AG
J       00044RD 00046RD 00048RD 00050RD 00077D0 00078   00084D0 00085
        00091D0 00092   00098D0 00099   00112D0 00113   00114   00115
        00116   00117   00118D0 00119   00120   00121   00139D0 00140
        00147D0 00148   00149   00175D0 00176   00184D0 00185   00189D0
```

```
          001900  001930DO 001960  001970  001990DO 002000  002070WR 002090WR
          002110WR 002150DO 002180  002190  002210DO 002240  002250  002270DO
          002330  002310  002330DO 002340  002360DO 002390  002440  002420DO
          002430  002470DO 002480  002520IF 002540  002620DO 002630  002670IF
          002690  002800DO 002810  002850  002870DO 002900  002910  002930DO
          002970  002980  003000DO 003010  003030DO 003070  003080  003110DO
          003150  003160  003210DO 003240  003250  003270DO 003280  003320
          003340DO 003370  003380  003400DO 003440  003450  003470DO 003500
          003510  003530DO 003540  003570  003720WR 003740WR 003780WR 003830WR
          003860WR 003680WR 003720WR 003740WR 003780WR 003830WR 003880WR
          003900WR 003970WR 003990WR 004070WR 004110WR 004150WR 004200WR 004330DO
          004340  004370DO 004400  004410  004430DO 004440  004470  004510DO
          004520  004530  004550DO 004560  004670WR 004690WR 004710WR 004730WR
          004780WR 004820WR 004880WR 004880WR 004980WR
J3        001480= 001500
JC        001490= 001500
JJ        001900= 001910  001980= 002510  002620= 002660  002810= 002840
          003280= 003310  003540= 003580  004440= 004480  004520= 004530
K         000310DO 001950DO 001960  002170DO 002180  002230DO 002240  002290DO
          002300  002380DO 002390  002500DO 002510  002650DO 002660  002830DO
          002840  002890DO 002900  002950DO 002960  002970  003050DO 003060
          003070  003130DO 003140  003150  003230DO 003240  003300DO 003310
          003360DO 003370  003420DO 003430  003440  003490DO 003500  003560DO
          003570  004030DO 004160DO 004390DO 004400  004460DO 004470
KK        002960= 002970  003060= 003070  003140= 003150  003430= 003440
L         001550DO 001560  001590  001600  001620DO 001630  001660DO 001670
          001700  001710
LASTID    000140DA 000620AG 001310  002580
LBACK     001630= 001640
M         001570DO 001530  001680DO 001690
MBACK     001590= 001590  001690= 001700
MNV       000030RL 000360RD 001220  001230= 001240= 001320WR 004590WR
MNXC      000030RL 000420RD 000740
MNXS      000030RL 000400RD 000680
MNXT      000060RL 000580= 000740= 001610  001640= 001650= 002030AG 002050WR
          004640AG 004660WR
MNZ       000030RL 000390RD 001250  001260= 001270= 001340WR 003050WR 004610WR
MR        000790AG 000900IF 000960AG 000870IF 000930AG 000940IF 001520AG 001530IF
          002010AG 002550AG 002570IF 002700AG
M1        001350= 001460  001820  001870  002050WR 003170IF 003230DO 003760
          003980IF 003920IF 003830WR 003850IF 003870IF 003880WR 003900WR 004010WR
          004030WR
M1P       001370= 001770IF 001790DO 001830  001840DO 001880  002020DO 002050WR
          002120IF 002460  002480  002610  002630  002790DO 002810  002860DO
          002920DO 002930DO 002960  002990DO 003000DO 003010  003020DO 003060
          003090DO 003100  003110DO 003140  003190DO 003200  003210DO 003260DO
          003280  003330DO 003390DO 003430  003460DO 003470DO 003520DO 003540
          003540  003560WR 003620WR 003640WR 003660WR 003680WR 003720WR 003740WR
          003770  003830WR 003880WR 003900WR 003990WR 004010WR 004150WR 004170WR
M2        001360= 001370  002090WR 002440DO 002600DO 002620DO 002720AG 002720DO
          002800DO 002870DO 002890DO 002950DO 003030DO 003050DO 003130DO 003270DO
          003340DO 003360DO 003420DO 003620WR 003640WR 003660WR 003720WR 003740WR
          003770  003880WR 003900WR 003990WR 004010WR 004070WR 004110WR 004150WR
          004200WR 004370WR
```

```
M2P     00101=  00106=  00107IF 00129IF 00135   00136   00142DO 00145DO
        00152AG 00181DO 00186DO 00189DO 00190   00376   00401WR 00430WR
        00502WR
NBCOL   00143=  00156   00157DO 00159   00161   00162DO 00163   00167
        00168DO 00169
NC      00144=  00151=  00152AG
NCOL    00142DO 00143   00144   00147DO 00149   00151   00153IF
NDIM3   00011CM 00014DA
NDIM6   00014DA
NONAME  00011CN
NU      00034RD 00077DO 00079AG 00080IF 00227DO 00233DO 00368WR 00376WR
        00411WR 00446DO 00478WR
NUM     00396=  00397WR 00497=  00498WR
NN      00034RD 00054AG 00084DO 00086AG 00087IF 00236DO 00242DO 00250DO
        00265DO 00283DO 00330DO 00340DO 00349DO 00356DO 00372WR 00374WR
        00392WR 00415WR 00422WR 00482WR 00493WR
NX      00036RD 00039RD 00040RD 00042RD 00044RD 00046RD 00048RD 00050RD
        00376=  00378WR
NXC     00034RD 00064   00070IF 00072DO 00087IF
NXS     00034RD 00064   00065IF 00067DO 00073
NXT     00054=  00076DO 00079AG 00083DO 00086AG 00091DO 00093AG 00112DO
        00137   00138DO 00139DO 00143   00148   00166DO 00174DO 00175DO
        00190   00192DO 00193DO 00195DO 00198DO 00199DO 00201AG 00205WR
        00209WR 00211WR 00214DO 00215DO 00217DO 00220DO 00221DO 00223DO
        00226DO 00229DO 00232DO 00235DO 00238DO 00241DO 00362WR 00364WR
        00368WR 00370WR 00374WR 00380WR 00390WR 00432DO 00433DO 00435DO
        00436   00437DO 00442DO 00443DO 00444   00449DO 00450   00451DO
        00452   00454DO 00455DO 00463DO 00465WR 00467WR 00469WR 00471WR
        00473WR 00478WR 00482WR 00486WR 00489WR 00497   00502WR
NY      00044RD 00046RD 00048RD 00050RD 00377=  00378WR
NYO     00034RD
NYS     00034RD
NZ      00034RD 00059AG 00090DO 00093AG 00094IF 00097DO 00098DO 00102DO
        00103   00118DO 00132WR 00134WR 00135   00155DO 00207WR 00390WR
        00394WR 00424WR 00439DO 00459WR 00461WR 00486WR 00488WR 00495WR
        00502WR
QD      00022DI 00012DA 00054AG 00251   00266   00284   00331   00344
        00357   00392WR 00422WR 00447   00493WR
RD      00022DI 00012DA 00059AG 00104IF 00109   00110=  00111=  00324
        00394WR 00424WR 00440   00499WR
READ4X  00054CL 00059CL
RENR    00063CL
R0      00014DA 00301WR 00386WR 00435WR 00469WR 00413WR 00418WR 00426WR
        00426WR 00476WR 00482WR 00484WR 00491WR 00502WR 00504WR
SCALE   00001DI
TRANSL  00203CL 00464CL
TTLNEW  00001DI 00025RD 00053AG
TZ      00007DI 00009EQ 00099=  00100=  00119   00120=  00121=  00207WR
T1      00005DI 00008EQ 00140=  00141=  00167   00170=  00171=  00196
T2      00005DI 00008EQ 00176=  00180=  00185=  00191=  00196   00200=
        00209WR 00218   00230   00239
T2I     00007DI 00008EQ 00201AG 00211WR 00224
XINVRT  00007DI 00009EQ 00079AG 00086AG 00093AG 00152AG
ZETA    00007DI 00012DA 00253   00258=  00268   00273IF
```

```
10      00015NR 00016*
100     00089NR 00089*
1000    00505*
110     00090DO 00091DO 00092*
12      00019NR 00020*
120     00095NR 00096*
125     00097DO 00098DO 00100*
130     00112DO 00117*
135     00118DO 00121*
14      00023NR 00024*
140     00102DO 00105GT 00109GT 00128*
144     00133DO 00139DO 00141*
146     00145DO 00147DO 00150*
150     00157DO 00159*
160     00155DO 00160*
170     00162DO 00164*
180     00168DO 00170*
190     00166DO 00171*
20      00017RD 00021RD 00025RD 00026*
200     00142DO 00154GT 00172*
210     00173*
215     00174DO 00175DO 00176*
22      00027NR 00028*
220     00179DO 00180*
240     00181DO 00184DO 00185*
245     00179GT 00186*
25      00029RD 00030*
250     00186DO 00189DO 00191*
253     00195DO 00196*
255     00192DO 00193DO 00197*
257     00198DO 00199DO 00200*
258     00202DO 00203*
260     00217DO 00218*
270     00214DO 00215DO 00219*
280     00223DO 00224*
290     00220DO 00221DO 00225*
300     00229DO 00230*
310     00226DO 00227DO 00231*
320     00232DO 00233DO 00234*
330     00238DO 00239*
340     00235DO 00236DO 00240*
350     00241DO 00242DO 00243*
390     00250DO 00251*
40      00031DO 00051*
400     00245DO 00247DO 00254*
410     00244DO 00259*
42      00032RD 00052*
420     00265DO 00266*
425     00260DO 00262DO 00269*
428     00272DO 00275*
429     00277NR 00278*
430     00203DO 00234*
440     00279DO 00280DO 00285*
45      00052NR 00053*
```

```
450     00289DO 00290*
460     00285DO 00287DO 00291*
470     00295DO 00297*
480     00292DO 00293DO 00298*
490     00299DO 00300DO 00301*
50      00054*  00056GT
500     00305DO 00307*
510     00302DO 00303DO 00308*
520     00313DO 00315*
525     00309DO 00311DO 00316*
530     00323DO 00324*
540     00319DO 00321DO 00325*
545     00310GT 00326*
55      00057WR 00058*
550     00330DO 00331*
560     00326DO 00327DO 00332*
570     00336DO 00337*
580     00333DO 00334DO 00338*
590     00342DO 00344*
60      00059*  00061GT
600     00339DO 00340DO 00345*
610     00349DO 00350*
62      00067DO 00068*
620     00346DO 00347DO 00351*
630     00356DO 00357*
64      00066GT 00069*
640     00352DO 00353DO 00358*
645     00213GT 00403*
655     00403DO 00405*
66      00072DO 00074*
660     00416DO 00418*
68      00071GT 00075*
70      00076DO 00077DO 00078*
700     00130GT 00432*
710     00432DO 00433DO 00434*
720     00439DO 00440*
730     00435DO 00437DO 00441*
740     00446DO 00447*
750     00442DO 00443DO 00448*
760     00449DO 00451DO 00453*
770     00454DO 00455DO 00457*
775     00463DO 00464*
780     00474DO 00476*
790     00489DO 00491*
80      00081WR 00082*
90      00083DO 00084DO 00085*
900     00442GT 00431GT 00503*
910     00503DO 00504*
```

```
00001        SUBROUTINE READMX(IMAX,ARRAY,IERR)
             C     ROUTINE READS MATRIX ELEMENT OF THE FORM:
             C          I,VALUE
             C     CHECKS FOR DIMENSIONS OUT OF RANGE AND FORMS:
             C          ARRAY(I)=VALUE
             C
00002        COMMON/IO/ IIN,IOUT
00003        DIMENSION ARRAY(IMAX)
00004        READ(IIN,10,ERR=50) I,VALUE
00005  10    FORMAT(I,E)
00006        IF(I.GT.IMAX.OR.I.LT.0) GO TO 30
00007        IF(I.EQ.0) GO TO 20
00010        ARRAY(I)=VALUE
00011        IERR=0
00012        RETURN
             C     ERRORS:    IERR=1 - I=0 INDICATING TERMINATION OF DATA
             C                         FOR THIS MATRIX
             C                IERR=2 - DIMENSIONS OUT OF RANGE
             C                IERR=3 - WRONG FORMAT ON INPUT
             C
00013  20    IERR=1
00014        RETURN
00015  30    IERR=2
00016        WRITE(IOUT,40) I,VALUE
00017  40    FORMAT(5X,'DIMENSIONS OUT OF RANGE FOR ',3X,I3,E15.6)
00018        RETURN
00019  50    IERR=3
00020        WRITE(IOUT,60)
00021  60    FORMAT(5X,'WRONG FORMAT')
00022        RETURN
00023        END
```

RT-11 INDEX V03 CROSS REFERENCE LISTING 10-APR-79 02:03:32 PAGE 00002

```
ARRAY   00001AG 00003DI 00010=
I       00004RD 00006IF 00008IF 00010   00016NR
IERR    00001AG 00011=  00013=  00015=  00019=
IIN     00002CM 00004RD
IMAX    00001AG 00003DI 00006IF
IO      00002CN
IOUT    00002CM 00016NR 00020NR
READMX  00001SU
VALUE   00004RD 00010   00016NR
10      00004RD 00005*
20      00009GT 00013*
30      00007GT 00015*
40      00016NR 00017*
50      00004RD 00019*
60      00020NR 00021*
```

```
      C          BLOCK 4 - FILTER GAINS AND ESTIMATION ERROR
      C        . UTILIZES FILTER SET-UP (BLOCK 3) AND PERFORMS
      C          EIGENVALUE DECOMPOSITION (QR ALGORITHM) TO OBTAIN
      C          FILTER GAINS. ALSO COMPUTES RMS AND CORRELATION.
00001       DIMENSION FNAME(4),TTLNEW(5)
      C        PROBLEM FILE INPUT MATRIX ARRAYS
00002       DIMENSION F21(15,15),GM(15,15),GM2(15,15),H(15,15)
00003       DIMENSION ARM(30,30),QD(15),RD(15)
      C        OUTPUT ARRAYS
00004       COMPLEX EVAL(30),EVEC(30,30),W21(15,15)
      C        WORKING ARRAYS
00005       DIMENSION ARRAY(900),IARRAY(900),DUMMY(15,15),DUMMY2(15,15)
00006       DIMENSION A(15,15),WK(30,30),INT(30),SCALE(30),WR(30),WI(30)
00007       COMPLEX DD,CD,C(15),WA(225),W11(15,15)
      C        EQUIVALENCES
00008       EQUIVALENCE (ARM,W11),(ARM(1,16),W21)
00009       EQUIVALENCE (EVEC,DUMMY,ARRAY,GM2),(EVEC(1,16),DUMMY2,IARRAY)
00010       EQUIVALENCE (WK,WA),(C,SCALE)
      C        INITIALIZE ARRAYS
00011       DATA F21,GM,H,ARM,PX,QD,RD,SCALE,WR,WI /1920*0./
00012       DATA INT /30*0/,TTLNEW /' "" ',4*' '/
00013       DATA EVAL,EVEC /930*(0.,0.)/
      C        OTHER DATA
00014       DATA IIN,IOUT,IPFIN,IPFOUT /5,7,20,21/
00015       DATA I1,R0,IWK,I900,LASTID,NDIM3,NDIM6 /1,0.,225,900,54,15,30/
00016       DATA CD /(0.,0.)/
      C        READ PROBLEM FILE NAMES
00017       WRITE(IOUT,10)
00018 10    FORMAT(20X,'FILTER GAINS, EST ERROR - BLOCK 4',/,2X,
     +       'INPUT PROBLEM FILE NAME ? ',$)
00019       READ(IIN,20) (FNAME(I),I=1,4)
00020       CALL ASSIGN(IPFIN,FNAME)
00021       WRITE(IOUT,15)
00022 15    FORMAT(2X,'OUTPUT PROBLEM FILE NAME ? ',$)
00023       READ(IIN,20) (FNAME(I),I=1,4)
00024       CALL ASSIGN(IPFOUT,FNAME)
00025 20    FORMAT(4A4)
      C        GET THE FOLLOWING FROM THE PROBLEM FILE:
      C          DIMENSIONS  IDEN=2
      C          F21 MATRIX  IDEN=40
      C          GM1 MATRIX  IDEN=44
      C          GM2 MATRIX  IDEN=45
      C          H11 MATRIX  IDEN=47
      C          QD  MATRIX  IDEN=50
      C          RD  MATRIX  IDEN=51
      C          ARM MATRIX  IDEN=52
      C          A   MATRIX  IDEN=53
      C          DIMENSSIONS IDEN=54
00026       DO 30 K=1,200
00027       READ(IPFIN,END=40) IDEN
00028       IF(IDEN.EQ.1) READ(IPFIN) IDEN,NXS,NXC,NU,NM,NZ,NYS,NYO
00030       IF(IDEN.EQ.39) READ(IPFIN) IDEN,NX,NY,((F21(I,J),J=1,NY),I=1,NX)
00032       IF(IDEN.EQ.43) READ(IPFIN) IDEN,NX,NY,((GM(I,J),J=1,NY),I=1,NX)
00034       IF(IDEN.EQ.44) READ(IPFIN) IDEN,NX,NY,((GM2(I,J),J=1,NY),I=1,NX)
```

```
00035        IF(IDEN.EQ.46) READ(IPFIN) IDEN,NX,NY,((H(I,J),J=1,NY),I=1,NX)
00038        IF(IDEN.EQ.49) READ(IPFIN) IDEN,NX,(QD(I),I=1,NX)
00040        IF(IDEN.EQ.50) READ(IPFIN) IDEN,NX,(RD(I),I=1,NX)
00042        IF(IDEN.EQ.51) READ(IPFIN) IDEN,NX,NY,((ARM(I,J),J=1,NY),I=1,NX)
00044        IF(IDEN.EQ.52) READ(IPFIN) IDEN,NX,NY,((A(I,J),J=1,NY),I=1,NX)
00046        IF(IDEN.EQ.53) READ(IPFIN) IDEN,M1,M1P,M2,M2P
00048 30     CONTINUE
00049 40     DO 45 I=1,M2
00050        II=I+M1P
00051        DO 45 J=1,NY
00052 45     G4(II,J)=G42(I,J)
     C          READ AND WRITE PROBLEM FILE
00053        REWIND IPFIN
00054        CALL RDWR(IPFIN,IPFOUT,TTLNEW,1900,LASTID,ARRAY,IARRAY)
00055        NTOT=M1P
00056        IDEN=LASTID
00057        IF(M1P.EQ.0) GO TO 1500
     C          COMPUTE OPEN LOOP EIGENVALUES AND WRITE THEM
00059        DO 50 I=1,NTOT
00060        DO 50 J=1,NTOT
00061 50     DUMMY(I,J)=ARM(I,J)
00062        CALL EIGRF(DUMMY,NTOT,NDIM3,0,EVAL,EVEC,INT,SCALE,WR,WI,WK,IERR)
00063        IDEN=IDEN+1
00064        WRITE(IPFOUT) IDEN,NTOT,(EVAL(I),I=1,NTOT)
     C          COMPUTE CLOSED LOOP EIGENVALUES AND EIGENVECTORS
00065        CALL EIGRF(ARM,2*NTOT,NDIM6,1,EVAL,EVEC,INT,SCALE,WR,WI,WK,IERR)
00066        IF(IERR.EQ.0) GO TO 790
00068        WRITE(IOUT,780)
00069 780    FORMAT(5X,'ERROR COMPUTING CLOSED LOOP EIGENSYSTEM')
00070        GO TO 1500
     C               (W11) WITH EIGENVECTORS CORRESPONDING
     C          FORM (   ) TO EIGENVALUES WITH POSITIVE
     C               (W21) REAL PARTS.
00071 790    J=0
00072        DO 810 K=1,2*NTOT
00073        IF(REAL(EVAL(K)).LT.0.) GO TO 810
00075        IF(REAL(EVAL(K)).EQ.0.) WRITE(IOUT,795)
00077 795    FORMAT(5X,'REAL PART OF C.L. EIGENVALUE = 0.0')
00078        J=J+1
00079        EVAL(J)=-EVAL(K)
00080        DO 800 I=1,NTOT
00081        L=NTOT+I
00082        W11(J,I)=EVEC(I,K)
00083        W21(J,I)=EVEC(L,K)
00084 800    EVEC(I,J)=EVEC(I,K)
00085        IF(J.EQ.NTOT) GO TO 830
00087 810    CONTINUE
00088        WRITE(IOUT,820)
00089 820    FORMAT(5X,'ERROR IN EIGENVALUE SELECTION')
00090        GO TO 1500
     C          COMPLEX SOLUTION COV=W11*W21**-1
00091 830    CALL LEQT2C(W21,NTOT,NDIM3,W11,NTOT,NDIM3,INT,C,WK,WA,IERR)
00092        IF(IERR.EQ.0) GO TO 850
00094        WRITE(IOUT,840)
```

```
00095 840   FORMAT(5X,'ERROR IN EIGENVECTOR DECOMPOSITION')
00096       GO TO 1500
00097 850   CONTINUE
00098       DO 860 I=1,NTOT
00099       DO 860 J=1,NTOT
00100 860   DUMMY(I,J)=-REAL(W11(I,J))
      C        COMPUT NORMALIZED EIGENVECTORS
00101       DO 890 I=1,NTOT
00102       SF=0.
00103       DO 870 J=1,NTOT
00104       SFF=CABS(W21(I,J))
00105       IF(SF.GT.SFF) GO TO 870
00107       JMAX=J
00108       SF=SFF
00109 870   CONTINUE
00110       DD=W21(I,JMAX)
00111       DO 880 J=1,NTOT
00112 880   W21(I,J)=W21(I,J)/DD
00113 890   CONTINUE
      C        WRITE CLOSED LOOP EIGENVALUES, NORMALIZED
      C        EIGENVECTORS AND TRANSITION MATRIX
00114       IDEN=IDEN+1
00115       WRITE(IPFOUT) IDEN,NTOT,(EVAL(I),I=1,NTOT)
00116       IDEN=IDEN+1
00117       WRITE(IPFOUT) IDEN,NTOT,NTOT,((W21(I,J),J=1,NTOT),I=1,NTOT)
00118       IDEN=IDEN+1
00119       WRITE(IPFOUT) IDEN,NTOT,NTOT,((DUMMY(I,J),J=1,NTOT),I=1,NTOT)
      C        COMPUTE FILTER GAINS AND WRITE THEM:
      C          K11 = PX*H11T*RI
      C          K12 = (PX*P21T + G41*QD*G42T)*(G42*QD*G42T)I
00120       IF(M1.NE.0) GO TO 895
00122       IDEN=IDEN+1
00123       WRITE(IPFOUT) IDEN,I1,I1,R0
00124       GO TO 920
00125 895   DO 910 I=1,NTOT
00126       DO 910 J=1,M1
00127       DUM=0.
00128       DO 900 K=1,NTOT
00129 900   DUM=DUM+REAL(W11(I,K))*H(J,K)/RD(J)
00130 910   DUMMY(I,J)=DUM
00131       IDEN=IDEN+1
00132       WRITE(IPFOUT) IDEN,NTOT,M1,((DUMMY(I,J),J=1,M1),I=1,NTOT)
00133 920   CONTINUE
00134       IF(M2.EQ.1.AND.A(1,1).EQ.0.) GO TO 1010
00136       DO 960 I=1,NTOT
00137       DO 960 J=1,M2
00138       JJ=J+NTOT
00139       DUM=0.
00140       DO 950 K=1,NW
00141 950   DUM=DUM+GM(I,K)*GM(JJ,K)*QD(K)
00142 960   DUMMY(I,J)=DUM
00143       DO 980 I=1,NTOT
00144       DO 980 J=1,M2
00145       DUM=0.
```

```
ØØ146          DO 97Ø K=1,NTOT
ØØ147 97Ø      DUM=DUM-REAL(W11(I,K))*F21(J,K)
ØØ148 98Ø      DUMMY2(I,J)=DUM+DUMMY(I,J)
ØØ149          DO 1ØØØ I=1,NTOT
ØØ15Ø          DO 1ØØØ J=1,M2
ØØ151          DUM=Ø.
ØØ152          DO 99Ø K=1,M2
ØØ153 99Ø      DUM=DUM+DUMMY2(I,K)*A(K,J)
ØØ154 1ØØØ     DUMMY(I,J)=DUM
ØØ155          IDEN=IDEN+1
ØØ156          WRITE(IPFOUT) IDEN,NTOT,M2,((DUMMY(I,J),J=1,M2),I=1,NTOT)
ØØ157          GO TO 1Ø15
ØØ158 1Ø1Ø     IDEN=IDEN+1
ØØ159          WRITE(IPFOUT) IDEN,I1,I1,RØ
      C            GET TI
ØØ16Ø 1Ø15     LASTID=IDEN
ØØ161          REWIND IPFIN
ØØ162          DO 1Ø2Ø K=1,2ØØ
ØØ163          READ(IPFIN,END=1Ø3Ø) IDEN
ØØ164          IF(IDEN.EQ.36) READ(IPFIN) IDEN,NX,NY,((DUMMY2(I,J),J=1,NY),
              +     I=1,NX)
ØØ165 1Ø2Ø     CONTINUE
      C            TRANSFORM P - TI*P*TI'
ØØ167 1Ø3Ø     NXT=NX
ØØ168          DO 1Ø5Ø I=1,NXT
ØØ169          DO 1Ø5Ø J=1,NTOT
ØØ17Ø          DUM=Ø.
ØØ171          DO 1Ø4Ø K=1,NTOT
ØØ172 1Ø4Ø     DUM=DUM+DUMMY2(I,K)*(-REAL(W11(K,J)))
ØØ173 1Ø5Ø     DUMMY(I,J)=DUM
ØØ174          DO 1Ø7Ø I=1,NXT
ØØ175          DO 1Ø7Ø J=1,NXT
ØØ176          DUM=Ø.
ØØ177          DO 1Ø6Ø K=1,NTOT
ØØ178 1Ø6Ø     DUM=DUM+DUMMY(I,K)*DUMMY2(J,K)
ØØ179 1Ø7Ø     W11(I,J)=CMPLX(-DUM,Ø.)
      C            COMPUTE RMS AND CORRELATION
ØØ18Ø          DO 1Ø3Ø I=1,NXT
ØØ181          DUM=-REAL(W11(I,I))
ØØ182          IF(DUM.GE.Ø.) GO TO 1Ø3Ø
  '34          WRITE(IOUT,1Ø75)
  _35 1Ø75     FORMAT(5X,'FILTER RICCATI MATRIX NOT NON-NEGATIVE')
  .35 1Ø8Ø     WR(I)=SQRT(DUM)
ØØ187          DO 11ØØ I=1,NXT
ØØ188          DO 11ØØ J=1,NXT
ØØ189          IF(WR(I).EQ.Ø..OR.WR(J).EQ.Ø.) GO TO 1Ø9Ø
ØØ191          DUMMY(I,J)=-REAL(W11(I,J))/(WR(I)*WR(J))
ØØ192          GO TO 11ØØ
ØØ193 1Ø9Ø     DUMMY(I,J)=Ø.
ØØ194          DUMMY(J,I)=Ø.
ØØ195          DUMMY(I,I)=1.
ØØ196 11ØØ     CONTINUE
ØØ197          IDEN=LASTID+1
ØØ198          WRITE(IPFOUT) IDEN,NXT,(WR(I),I=1,NXT)
```

```
00199          IDEN=IDEN+1
00200          WRITE(IPFOUT) IDEN,NXT,NXT,((DUMMY(I,J),J=1,NXT),I=1,NXT)
     C            THE END
00201 1500     DO 1510 I=IDEN+1,130
00202 1510     WRITE(IPFOUT) I,I1,I1,C0
00203 2000     STOP
00204          END
```

```
A       000065DI 000145RD 000134IF 000153
ARM     000103DI 000128EQ 000111DA 000143RD 000061   000055AG
ARRAY   000105DI 000139EQ 000154AG
ASSIGN  000020CL 000024CL
C       000107CX 000130EQ 000091AG
CABS    000104                                                    ORIGINAL PAGE IS
CMPLX   000179                                                    OF POOR QUALITY
CØ      000107CX 000160DA 000202NR
DD      000107CX 000115=  000112
DUM     000127=  000129=  000130  000139=  000141=  000142  000145=  000147=
        000148   000151=  000153=  000154  000170=  000172=  000173  000176=
        000178=  000179   000181=  000182IF 000186
DUMMY   000105DI 000139EQ 000051=  000052AG 000100=  000119NR 000130=  000132NR
        000142=  000148   000154=  000156NR 000173=  000178   000191=  000193=
        000194=  000195=  000200NR
DUMMY2  000105DI 000139EQ 000148=  000153   000165RD 000172   000178
EIGRF   000062CL 000065CL
EVAL    000104CX 000113DA 000052AG 000064NR 000065AG 000073IF 000075IF 000079=
        000115NR
EVEC    000104CX 000139EQ 000113DA 000062AG 000065AG 000082   000083   000084=
FNAME   000031DI 000119RD 000020AG 000023RD 000024AG
F21     000102DI 000111DA 000031RD 000147
GM      000102DI 000111DA 000033RD 000052=  000141
G42     000102DI 000139EQ 000035RD 000052
H       000102DI 000111DA 000037RD 000129
I       000119RD 000123RD 000031RD 000033RD 000035RD 000037RD 000039RD 000041RD
        000043RD 000045RD 000049DO 000050   000052   000059DO 000061   000064NR
        000080DO 000081   000082   000083   000084   000099DO 000100   000101DO
        000104   000110   000112   000115NR 000117NR 000119NR 000125DO 000129
        000130   000132NR 000136DO 000141   000142   000143DO 000147   000148
        000149DO 000153   000154   000156NR 000165RD 000168DO 000172   000173
        000174DO 000178   000179   000182DO 000181   000186   000187DO 000189IF
        000191   000193   000194   000195   000198NR 000200NR 000201DO 000202NR
IARRAY  000105DI 000139EQ 000054AG
IDEN    000027RD 000028IF 000029RD 000030IF 000031RD 000032IF 000033RD 000034IF
        000035RD 000036IF 000037RD 000038IF 000039RD 000040IF 000041RD 000042IF
        000043RD 000044IF 000045RD 000046IF 000047RD 000056=  000063=  000064NR
        000114=  000115NR 000116=  000117NR 000118=  000119NR 000122=  000123NR
        000131=  000132NR 000155=  000156NR 000158=  000159NR 000160   000163RD
        000164IF 000165RD 000197=  000198NR 000199=  000200NR 000201DO
IERR    000062AG 000065AG 000066IF 000091AG 000092IF
II      000050=  000052
IIN     000014DA 000019RD 000023RD
INT     000026DI 000012DA 000062AG 000065AG 000091AG
IOUT    000014DA 000117NR 000121NR 000068NR 000070NR 000098NR 000094NR 000184NR
IPFIN   000014DA 000020AG 000027RD 000029RD 000031RD 000033RD 000035RD 000037RD
        000039RD 000041RD 000043RD 000045RD 000047RD 000053RD 000054AG 000161RD
        000163RD 000165RD
IPFOUT  000014DA 000024AG 000054AG 000064NR 000119NR 000117NR 000119NR 000123NR
        000132NR 000158NR 000159NR 000198NR 000200NR 000202NR
IWK     000015DA 000091AG
I1      000015DA 000123NR 000159NR 000202NR
I900    000015DA 000054AG
J       000031RD 000033RD 000035RD 000037RD 000043RD 000045RD 000051DO 000052
```

```
            00056DO 00061   00071=  00078=  00079   00082   00083   00084
            00085IF 00099DO 00100   00103DO 00104   00107   00111DO 00112
            00117WR 00119WR 00125DO 00129   00130   00132WR 00137DO 00138
            00142   00144DO 00147   00148   00150DO 00153   00154   00156WR
            00165RD 00169DO 00172   00173   00175DO 00178   00179   00188DO
            00189IF 00191   00193   00194   00200WR
JJ          00132=  00141
JMAX        00107=  00110
K           00026DO 00072DO 00073IF 00075IF 00079   00082   00083   00084
            00126DO 00129   00140DO 00141   00146DO 00147   00152DO 00153
            00162DO 00171DO 00172   00177DO 00178
L           00081=  00093
LASTID      00015DA 00054AG 00056   00160=  00197
LEQT2C      00091CL
M1          00047RD 00120IF 00126DO 00132WR
M1P         00047RD 00050   00055   00057IF
M2          00047RD 00049DO 00134IF 00137DO 00144DO 00150DO 00152DO 00156WR
M2P         00047RD
NDIM3       00015DA 00062AG 00091AG
NDIM6       00015DA 00065AG
NTOT        00055=  00059DO 00060DO 00062AG 00064WR 00065AG 00072DO 00080DO
            00081   00085IF 00091AG 00098DO 00099DO 00101DO 00103DO 00111DO
            00113WR 00117WR 00119WR 00125DO 00126DO 00132WR 00136DO 00138
            00143DO 00146DO 00149DO 00156WR 00169DO 00171DO 00177DO
NU          00029RD
NW          00029RD 00051DO 00142DO
NX          00031RD 00033RD 00035RD 00037RD 00039RD 00041RD 00043RD 00045RD
            00165RD 00167
NXC         00029RD
NXS         00029RD
NXT         00167=  00168DO 00174DO 00175DO 00180DO 00187DO 00188DO 00190WR
            00200WR
NY          00031RD 00033RD 00035RD 00037RD 00043RD 00045RD 00165RD
NYO         00029RD
NYS         00029RD
NZ          00029RD
PX          00011DA
QD          00003DI 00011DA 00039RD 00141
RD          00003DI 00011DA 00041RD 00129
REAL        00073IF 00075IF 00130   00129   00147   00172   00181   00191
REWR        00054CL
R0          00015DA 00123WR 00159WR
SCALE       00006DI 00010EQ 00011DA 00062AG 00065AG
SF          00102=  00105IF 00108=
SFF         00104=  00105IF 00108
SQRT        00186
TTLNEW      00001DI 00012DA 00054AG
WA          00007CX 00010EQ 00091AG
WI          00006DI 00011DA 00062AG 00065AG
WK          00006DI 00010EQ 00062AG 00065AG
WR          00006DI 00011DA 00062AG 00065AG 00136=  00189IF 00191   00193WR
W11         00007CX 00008EQ 00082=  00091AG 00100   00129   00147   00172
            00179=  00181   00191
W21         00004CX 00008EQ 00083=  00091AG 00104   00110   00112=  00117WR
```

```
10      00017NR 00018*
100     00149DO 00150DO 00154*
1010    00135GT 00158*
1015    00157GT 00160*
1020    00162DO 00166*
1030    00163RD 00167*
1040    00171DO 00172*
1050    00168DO 00169DO 00173*
1060    00177DO 00178*
1070    00174DO 00175DO 00179*
1075    00184NR 00185*
1080    00180DO 00183GT 00186*
1090    00190GT 00193*
1100    00187DO 00188DO 00192GT 00196*
15      00021NR 00022*
1500    00058GT 00070GT 00090GT 00096GT 00201*
1510    00201DO 00202*
20      00019RD 00023RD 00025*
2000    00203*
30      00026DO 00048*
40      00027RD 00049*
45      00049DO 00051DO 00052*
50      00059DO 00062DO 00061*
700     00068NR 00069*
790     00067GT 00071*
795     00076NR 00077*
800     00080DO 00084*
810     00072DO 00074GT 00087*
820     00083NR 00089*
830     00085GT 00091*
840     00094NR 00095*
850     00093GT 00097*
860     00098DO 00099DO 00100*
870     00103DO 00107GT 00109*
880     00111DO 00112*
890     00101DO 00113*
895     00121GT 00125*
900     00128DO 00129*
910     00125DO 00126DO 00130*
920     00124GT 00133*
950     00140DO 00141*
950     00136DO 00137DO 00142*
970     00146DO 00147*
980     00143DO 00144DO 00148*
990     00152DO 00153*
```

```
      C         BLOCK 5 - THE REGULATOR PROBLEM
      C          THIS ROUTINE COMPUTES THE REGULATOR GAINS USING THE
      C          PROBLEM FILE GENERATED IN BLOCK 1 AND ADDITIONAL
      C          INPUTS OF QRD AND RRD.
00001         DIMENSION FNAME(4),TTLNEW(5)
      C          INPUT MATRIX ARRAYS
00002         DIMENSION RRD(5),QRD(30)
      C          PROBLEM FILE INPUT MATRIX ARRAYS
00003         DIMENSION F(15,15),G(15,5),HR(15,15)
      C          OUTPUT ARRAYS
00004         DIMENSION CG(5,15),PX(15,15),ARM(30,30)
00005         COMPLEX W21(15,15),EVAL(30),EVEC(30,30)
00006         EQUIVALENCE (CG,ARM)
      C          WORKING ARRAYS
00007         DIMENSION WK(30,30),WI(30),WR(30),SCALE(30),INT(30)
00008         DIMENSION ARRAY(900),IARRAY(900)
00009         COMPLEX DD,C0,W11(15,15),C(15),WA(225)
00010         EQUIVALENCE (SCALE,C),(EVEC,WA,F),(WK,W21,HR),(ARM,W11)
00011         EQUIVALENCE (ARM,ARRAY,IARRAY)
      C          INITIALIZE ARRAYS
00012         DATA RRD,QRD,F,G,HR,CG,PX,ARM,SCALE,WR,WI/1850*0./
00013         DATA INT /30*0/
00014         DATA W21,EVAL,EVEC,DD,W11,C /1396*(0.,0.)/
      C          OTHER DATA
00015         DATA IIN,IOUT,IPFIN,IPFOUT /5,7,20,21/
00016         DATA NK,I900,LASTID,NDIM3,NDIM6 /225,900,62,15,30/
00017         DATA I1,R0,C0 /1,0.,(0.,0.)/
00018         COMMON/IO/IIN,IOUT
      C          READ PROBLEM FILE NAMES AND REGULATOR TITLE
00019         WRITE(IOUT,10)
00020 10      FORMAT(20X,'REGULATOR GAINS - BLOCK 5 ',/,2X,
             +     'INPUT PROBLEM FILE NAME ? ',$)
00021         READ(IIN,20) (FNAME(I),I=1,4)
00022         CALL ASSIGN(IPFIN,FNAME)
00023         WRITE(IOUT,12)
00024 12      FORMAT(2X,'OUTPUT PROBLEM FILE NAME ? ',$)
00025         READ(IIN,20) (FNAME(I),I=1,4)
00026         CALL ASSIGN(IPFOUT,FNAME)
00027         WRITE(IOUT,14)
00028 14      FORMAT(2X,'PROBLEM TITLE (20 CHARS) : ',$)
00029         READ(IIN,20) (TTLNEW(I),I=1,5)
00030 20      FORMAT(5A4)
      C          GET DATA FROM PROBLEM FILE:
      C             TITLE       IDEN=1
      C             DIMENSIONS  IDEN=2
      C             F MATRIX    IDEN=24
      C             G MATRIX    IDEN=25
      C             HR MATRIX   IDEN=28
00031         DO 30 K=1,31
00032         READ(IPFIN,END=40) IDEN
00033         IF(IDEN.EQ.1) READ(IPFIN) IDEN,NXS,NXC,NU,NW,NZ,NYS,NYO
00035         IF(IDEN.EQ.23) READ(IPFIN) IDEN,NX,NY,((F(I,J),J=1,NY),I=1,NX)
00037         IF(IDEN.EQ.24) READ(IPFIN) IDEN,NX,NY,((G(I,J),J=1,NY),I=1,NX)
00039         IF(IDEN.EQ.27) READ(IPFIN) IDEN,NX,NY,((HR(I,J),J=1,NY),I=1,NX)
```

```
00041 30    CONTINUE
      C        READ IPFIN, WRITE IPFOUT, COMPOSING NEW TITLE
00042 40    REWIND IPFIN
00043       CALL RENR(IPFIN,IPFOUT,TTLNEW,1900,LASTID,ARRAY,IARRAY)
      C        READ QRDAND RRD MATRICES FROM INPUT FILE
00044       WRITE(IOUT,45)
00045 45    FORMAT(2X,'NON-ZERO DIAGONAL QR ELEMENTS :')
00046 50    CALL READMX(NZ+NYO,QRD,IERR)
00047       IF(IERR.NE.1) GO TO 50
00049       WRITE(IOUT,55)
00050 55    FORMAT(2X,'NON-ZERO DIAGONAL RR ELEMENTS :')
00051 60    CALL READMX(NU,RRD,IERR)
00052       IF(IERR.NE.1) GO TO 60
      C        AT THIS POINT, A CHECK SHOULD BE PERFORMED TO SEE IF (F  G)
      C        IS STABILIZABLE.  IN THIS VERSION THIS CHECK IS NOT MADE.
      C        IF (F   G) IS NOT STABILIZABLE, IT WILL BE APPARENT FROM
      C        THE TRANSFER FUNCTIONS OF THE CLOSED LOOP SYSTEM, SINCE THERE
      C        WILL BE UNSTABLE POLES.
      C        CHECK IF RRD HAS FULL RANK
00054       DO 80 I=1,NU
00055       IF(RRD(I).NE.0.0) GO TO 80
00057       WRITE(IOUT,70)
00058 70    FORMAT(5X,'RRD DOES NOT HAVE FULL RANK')
00059       GO TO 285
00060 80    CONTINUE
      C                              (  FT      HTQH)
      C        ASSEMBLE ARM =        (               )
      C                              (GRIST     -F  )
00061       NXT=NXC+NXS
00062       DO 90 I=1,NXT
00063       DO 90 J=1,NXT
00064       ARM(I,J)=F(J,I)
00065 90    PX(I,J)=F(I,J)
00066       DO 110 I=1,NXT
00067       II=I+NXT
00068       DO 110 J=1,NXT
00069       DUM=0.0
00070       DO 100 K=1,NU
00071 100   DUM=DUM+G(I,K)*G(J,K)/RRD(K)
00072 110   ARM(II,J)=DUM
00073       DO 130 I=1,NXT
00074       DO 130 J=1,NXT
00075       JJ=J+NXT
00076       DUM=0.0
00077       DO 120 K=1,NZ+NYO
00078 120   DUM=DUM+HR(K,I)*HR(K,J)*QRD(K)
00079 130   ARM(I,JJ)=DUM
00080       DO 140 I=1,NXT
00081       II=I+NXT
00082       DO 140 J=1,NXT
00083       JJ=J+NXT
00084 140   ARM(II,JJ)=-F(I,J)
      C        WRITE QRD,RRD,AND,ARM TO PROBLEM FILE
00085       IDEN=LASTID+1
```

```
00086          NQT=NZ+NYO
00087          WRITE(IPFOUT) IDEN,NQT,(QRD(I),I=1,NQT)
00088          IDEN=IDEN+1
00089          WRITE(IPFOUT) IDEN,MU,(RRD(I),I=1,MU)
00090          IDEN=IDEN+1
00091          NXT2=2*NXT
00092          WRITE(IPFOUT) IDEN,NXT2,NXT2,((ARM(I,J),J=1,NXT2),I=1,NXT2)
               C     COMPUTE OPEN LOOP EIGENVALUES AND WRITE THEM
00093          CALL EIGRF(PX,NXT,NDIM3,0,EVAL,EVEC,INT,SCALE,WR,WI,WK,IERR)
00094          IDEN=IDEN+1
00095          WRITE(IPFOUT) IDEN,NXT,(EVAL(I),I=1,NXT)
               C     COMPUTE CLOSED LOOP EIGENVALUES AND EIGENVECTORS
00096          CALL EIGRF(ARM,2*NXT,NDIM6,1,EVAL,EVEC,INT,SCALE,WR,WI,WK,IERR)
00097          IF(IERR.EQ.0) GO TO 160
00099          WRITE(IOUT,150)
00100 150      FORMAT(5X,'ERROR COMPUTING CLOSED LOOP EIGENSYSTEM')
00101          GO TO 285
               C          (W11) WITH EIGENVECTORS CORRESPONDING TO
               C     FORM (   ) EIGENVALUES WITH POSITIVE REAL
               C          (W21) PARTS
00102 160      J=0
00103          DO 180 K=1,2*NXT
00104          IF(REAL(EVAL(K)).LT.0.0) GO TO 180
00106          IF(REAL(EVAL(K)).EQ.0.0) WRITE(IOUT,165)
00108 165      FORMAT(5X,'REAL PART OF C.L. EIGENVALUE = 0.0')
00109          J=J+1
00110          EVAL(J)=-EVAL(K)
00111          DO 170 I=1,NXT
00112          L=NXT+I
00113          W11(J,I)=EVEC(I,K)
00114          W21(J,I)=EVEC(L,K)
00115 170      EVEC(I,J)=EVEC(I,K)
00116          IF(J.EQ.NXT) GO TO 200
00118 180      CONTINUE
00119          WRITE(IOUT,190)
00120 190      FORMAT(5X,'ERROR IN EIGENVALUE SELECTION')
00121          GO TO 285
               C     COMPLEX SOLUTION COV = W11*W21**-1
00122 200      CALL LEQT2C(W21,NXT,NDIM3,W11,NXT,NDIM3,INT,C,IWK,WA,IERR)
00123          IF(IERR.EQ.0) GO TO 220
00125          WRITE(IOUT,210) IERR
00126 210      FORMAT(5X,I5,'ERROR IN EIGENVECTOR DECOMPOSITION')
00127          GO TO 285
00128 220      CONTINUE
00129          DO 230 I=1,NXT
00130          DO 230 J=1,NXT
00131 230      PX(I,J)=REAL(W11(I,J))
               C     COMPUTE NORMALIZED EIGENVECTORS
00132          DO 260 I=1,NXT
00133          SF=0.
00134          DO 240 J=1,NXT
00135          SFF=CABS(W21(I,J))
00136          IF(SF.GT.SFF) GO TO 240
00138          JMAX=J
```

```
00139         SF=SFF
00140 240     CONTINUE
00141         DD=W21(I,JMAX)
00142         DO 250 J=1,NXT
00143 250     W21(I,J)=W21(I,J)/DD
00144 260     CONTINUE
      C          COMPUTE REGULATOR GAIN MATRIX
00145         DO 280 I=1,NU
00146         DO 280 J=1,NXT
00147         DUM=0.0
00148         DO 270 K=1,NXT
00149 270     DUM=DUM+G(K,I)*PX(K,J)/RRD(I)
00150 280     CG(I,J)=DUM
      C          WRITE CLOSED LOOP EIGENVALUES AND NORMALIZED EIGENVECTORS
      C          AND TRANSITION MATRIX AND REGULATOR GAIN MATRIX
00151         IDEN=IDEN+1
00152         WRITE(IPFOUT) IDEN,NXT,(EVAL(I),I=1,NXT)
00153         IDEN=IDEN+1
00154         WRITE(IPFOUT) IDEN,NXT,NXT,((W21(I,J),J=1,NXT),I=1,NXT)
00155         IDEN=IDEN+1
00156         WRITE(IPFOUT) IDEN,NXT,NXT,((PX(I,J),J=1,NXT),I=1,NXT)
00157         IDEN=IDEN+1
00158         WRITE(IPFOUT) IDEN,NU,NXT,((CG(I,J),J=1,NXT),I=1,NU)
      C          THE END
00159 285     DO 290 I=IDEN+1,130
00160 290     WRITE(IPFOUT) I,I1,I1,C0
00161 1000    STOP
00162         END
```

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```
ARM     00004DI 00006EQ 00010EQ 00011EQ 00012DA 00064=  00072=  00079=
        00084=  00092WR 00096AG
ARRAY   00038DI 00011EQ 00043AG
ASSIGN  00022CL 00026CL
C       00009CX 00010EQ 00014DA 00122AG
CABS    00135
CG      00004DI 00006EQ 00012DA 00150=  00158WR
CO      00009CX 00017DA 00160WR
DD      00009CX 00014DA 00141=  00143
DUM     00069=  00071=  00072   00076=  00078=  00079   00147=  00149=
        00150
EIGRF   00093CL 00096CL
EVAL    00005CX 00014DA 00093AG 00095WR 00096AG 00104IF 00106IF 00110=
        00152WR
EVEC    00005CX 00010EQ 00014DA 00093AG 00096AG 00113   00114   00115=
F       00003DI 00010EQ 00012DA 00036RD 00064   00065   00084
FNAME   00001DI 00021RD 00022AG 00025RD 00026AG
G       00003DI 00012DA 00038RD 00071   00149
HR      00003DI 00010EQ 00012DA 00042RD 00078
I       00021RD 00025RD 00029RD 00036RD 00038RD 00040RD 00054DO 00055IF
        00062DO 00064   00065   00066DO 00067   00071   00073DO 00078
        00079   00080DO 00081   00084   00087WR 00089WR 00092WR 00095WR
        00111DO 00112   00113   00114   00115   00129DO 00131   00132DO
        00135   00141   00143   00145DO 00149   00150   00152WR 00154WR
        00156WR 00158WR 00159DO 00160WR
IARRAY  00003DI 00011EQ 00043AG
IDEN    00032RD 00033IF 00034RD 00035IF 00036RD 00037IF 00038RD 00039IF
        00040RD 00085=  00087WR 00088=  00089WR 00090=  00092WR 00094=
        00095WR 00151=  00152WR 00153=  00154WR 00155=  00156WR 00157=
        00158WR 00159DO
IERR    00046AG 00047IF 00051AG 00052IF 00093AG 00096AG 00097IF 00122AG
        00123IF 00129WR
II      00067=  00072   00081=  00084
IIN     00015DA 00018CM 00021RD 00025RD 00029RD
INT     00007DI 00013DA 00093AG 00096AG 00122AG
IO      00018CN
IOUT    00015DA 00018CM 00019WR 00023WR 00027WR 00044WR 00049WR 00057WR
        00099WR 00107WR 00119WR 00125WR
IPFIN   00015DA 00022AG 00032RD 00034RD 00036RD 00038RD 00040RD 00042RD
        00043AG
IPFOUT  00015DA 00026AG 00043AG 00087WR 00089WR 00092WR 00095WR 00152WR
        00154WR 00156WR 00158WR 00160WR
IWK     00016DA 00122AG
I1      00017DA 00160WR
I900    00016DA 00043AG
J       00036RD 00038RD 00040RD 00063DO 00064   00065   00068DO 00071
        00072   00074DO 00075   00078   00092DO 00093   00084   00092WR
        00102=  00109=  00110   00113   00114   00115   00116IF 00136DO
        00131   00134DO 00135   00138   00142DO 00143   00146DO 00149
        00150   00154WR 00156WR 00158WR
JJ      00075=  00079   00083=  00084
JMAX    00138=  00141
K       00031DO 00070DO 00071   00077DO 00078   00103DO 00104IF 00106IF
        00110   00113   00114   00115   00148DO 00149
```

```
L       00112=  00114
LASTID  00016DA 00043AG 00085
LEQT2C  00122CL
NDIM3   00016DA 00093AG 00122AG
NDIM6   00016DA 00096AG
NQT     00086=  00087NR
NU      00034RD 00051AG 00054DO 00073DO 00089NR 00145DO 00158NR
NW      00034RD
NX      00036RD 00038RD 00042RD
NXC     00034RD 00061
NXG     00034RD 00051
NXT     00051=  00052DO 00063DO 00066DO 00067   00068DO 00073DO 00074DO
        00075   00080DO 00081   00082DO 00083   00091   00093AG 00095NR
        00096AG 00103DO 00111DO 00112   00116IF 00122AG 00129DO 00130DO
        00132DO 00134DO 00142DO 00146DO 00148DO 00152NR 00154NR 00156NR
        00158NR
NXT2    00091=  00092NR
NY      00036RD 00038RD 00040RD
NYO     00034RD 00046AG 00077DO 00086
NYS     00034RD
NZ      00034RD 00046AG 00077DO 00086
PX      00004DI 00012DA 00065=  00093AG 00131=  00149   00158NR
QRD     00002DI 00012DA 00046AG 00078   00087NR
READMX  00046CL 00051CL
REAL    00104IF 00106IF 00131
RENR    00043CL
RRD     00002DI 00012DA 00051AG 00055IF 00071   00089NR 00149
RØ      00017DA
SCALE   00007DI 00010EQ 00012DA 00093AG 00096AG
SF      00133=  00136IF 00139=
SFF     00135=  00136IF 00139
TTLNEW  00001DI 00029RD 00043AG
WA      00009CX 00010EQ 00122AG
WI      00007DI 00012DA 00093AG 00096AG
WK      00007DI 00010EQ 00093AG 00096AG
WR      00007DI 00012DA 00093AG 00096AG
W11     00009CX 00010EQ 00014DA 00113=  00122AG 00131
W21     00005CX 00010EQ 00014DA 00114=  00122AG 00135   00141   00143=
        00154NR
10      00019NR 00020*
100     00027DO 00071*
1000    00161*
110     00066DO 00068DO 00072*
12      00023NR 00024*
120     00077DO 00078*
130     00073DO 00074DO 00079*
14      00027NR 00028*
140     00080DO 00082DO 00084*
150     00099NR 00100*
160     00098GT 00102*
165     00127NR 00108*
170     00111DO 00115*
180     00103DO 00105GT 00118*
190     00119NR 00120*
```

```
20      00021RD 00025RD 00029RD 00030*
200     00117GT 00122*
210     00129MR 00126*
220     00124GT 00128*
230     00129DO 00130DO 00131*
240     00134DO 00137GT 00140*
250     00142DO 00143*
260     00132DO 00144*
270     00148DO 00149*
280     00145DO 00146DO 00150*
285     00059GT 00101GT 00121GT 00127GT 00159*
290     00159DO 00160*
30      00031DO 00041*
40      00032RD 00042*
45      00244MR 00245*
50      00043*  00340GT
55      00049MR 00050*
60      00051*  00053GT
70      00057MR 00058*
80      00054DO 00056GT 00060*
90      00062DO 00063DO 00065*
```

```
00001        SUBROUTINE READMX(IMAX,ARRAY,IERR)
             C     ROUTINE READS MATRIX ELEMENT OF THE FORM:
             C           I,VALUE
             C     CHECKS FOR DIMENSIONS OUT OF RANGE AND FORMS:
             C           ARRAY(I)=VALUE
00002        COMMON/IO/ IIN,IOUT
00003        DIMENSION ARRAY(IMAX)
00004        READ(IIN,10,ERR=50) I,VALUE
00005  10    FORMAT(I,E)
00006        IF(I.GT.IMAX.OR.I.LT.0) GO TO 30
00008        IF(I.EQ.0) GO TO 20
00010        ARRAY(I)=VALUE
00011        IERR=0
00012        RETURN
             C     ERRORS:   IERR=1 - I=0 INDICATING TERMINATION OF DATA FOR
             C                        THIS MATRIX
             C               IERR=2 - DIMENSIONS OUT OF RANGE
             C               IERR=3 - WRONG FORMAT ON INPUT
00013  20    IERR=1
00014        RETURN
00015  30    IERR=2
00016        WRITE(IOUT,40) I,VALUE
00017  40    FORMAT(5X,'DIMENSIONS OUT OF RANGE FOR ',3X,I3,E15.6)
00018        RETURN
00019  50    IERR=3
00020        WRITE(IOUT,60)
00021  60    FORMAT(5X,'WRONG FORMAT')
00022        RETURN
00023        END
```

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```
ARRAY   000001AG 00003DI 00010=
I       000004RD 00006IF 00008IF 00010   00010NR
IERR    000001AG 00011=  00013=  00015=  00019=
IIN     000002CM 000004RD
IMAX    000001AG 000003DI 000006IF
IO      000002CN
IOUT    000002CM 00010NR 00020NR
READMX  000031SU
VALUE   000004RD 00010   00010NR
1$      000004RD 00005*
2$      000009GT 00013*
3$      000007GT 00015*
4$      00010NR  00017*
5$      000004RD 00019*
6$      00020NR  00021*
```

```
      C         BLOCK 6 - SENSITIVITY CALCULATIONS
      C          THIS ROUTINE READS THE CLOSED LOOP EIGENVALUES AND
      C          EIGENVECTORS, THE REGULATOR GAINS , THE F AND G
      C          MATRICES FROM THE PROBLEM FILE AND COMPUTES THE
      C          NORMALIZED SENSITIVITIES W.R.T. F, G, AND K FOR
      C          EACH EIGENVALUE.
00001         DIMENSION FNAME(4),TTLNEW(5)
      C          INPUT MATRICES
00002         DIMENSION F(15,15),G(15,5),CG(5,15)
00003         COMPLEX EVAL(15),EVEC(15,15)
      C          OUTPUT MATRICES
00004         COMPLEX SIII(15,15)
      C          WORKING STORAGE
00005         COMPLEX DD,WA(225),W21I(15,15),C(15)
00006         DIMENSION ARRAY(900),IARRAY(900)
00007         DIMENSION IPVT(15)
00008         EQUIVALENCE (ARRAY,IARRAY),(ARRAY,WA),(ARRAY(451),W21I)
      C          INITIALIZE
00009         DATA IPVT /15*0/
00010         DATA F,G,CG /450*0./
00011         DATA EVAL,EVEC,SIII,WA,W21I,C /930*(0.,0.)/
      C          OTHER DATA
00012         DATA IIN,IOUT,IPFIN,IPFOUT /5,7,20,21,/
00013         DATA NDIM3,LASTID,I225,I900 /15,70,225,900/
00014         COMPLEX CO
00015         DATA I1,CO /1,(0.,0.)/
      C          READ PROBLEM FILE NAME AND NEW TITLE
00016         WRITE(IOUT,10)
00017 10      FORMAT(20X,'SENSITIVITY - BLOCK 6 ',/,2X,
             +       'INPUT PROBLEM FILE NAME ? ',$)
00018         READ(IIN,20) (FNAME(I),I=1,4)
00019         CALL ASSIGN(IPFIN,FNAME)
00020         WRITE(IOUT,12)
00021 12      FORMAT(2X,'OUTPUT PROBLEM FILE NAME ? ',$)
00022         READ(IIN,20) (FNAME(I),I=1,4)
00023         CALL ASSIGN(IPFOUT,FNAME)
00024         WRITE(IOUT,14)
00025 14      FORMAT(2X,'PROBLEM TITLE (20 CHARS) : ',$)
00026         READ(IIN,20) (TTLNEW(I),I=1,5)
00027 20      FORMAT(5A4)
      C          READ IPFIN, WRITE IPFOUT, COMPOSING NEW TITLE
00028         CALL REWR(IPFIN,IPFOUT,TTLNEW,I900,LASTID,ARRAY,IARRAY)
00029         REWIND IPFIN
      C          READ THE FOLLOWING FROM THE PROBLEM FILE:
      C            DIMENSIONS - IDEN=2
      C            F MATRIX   - IDEN=24
      C            G MATRIX   - IDEN=25
      C            CL EVALS   - IDEN=67
      C            CL EVECS   - IDEN=68
      C            REG GAINS  - IDEN=70
00030         DO 30 K=1,LASTID
00031         READ(IPFIN,IND=35) IDEN
00032         IF(IDEN.EQ.1) READ(IPFIN) IDEN,NXS,NXC,NU,NW,NZ,NYS,NYO
00034         IF(IDEN.EQ.23) READ(IPFIN) IDEN,NX,NY,((F(I,J),J=1,NY),I=1,NX)
```

```
00036          IF(IDEN.EQ.21) READ(IPFIN) IDEN,NX,NY,((G(I,J),J=1,NY),I=1,NX)
00039          IF(IDEN.EQ.66) READ(IPFIN) IDEN,NX,(EVAL(I),I=1,NX)
00040          IF(IDEN.EQ.67) READ(IPFIN) IDEN,NX,NY,((EVEC(I,J),J=1,NY),I=1,NX)
00042          IF(IDEN.EQ.69) READ(IPFIN) IDEN,NX,NY,((CG(I,J),J=1,NY),I=1,NX)
00044 30       CONTINUE
00045 35       NXT=NXS+NXC
00046          IDEN=LASTID
          C       GET LEFT EIGENVALUES FROM EVEC
          C       RIGHT EIGENVALUES - ROWS OF EVEC
          C       LEFT EIGENVALUES - COLUMNS FOR W21I
00047          DO 40 I=1,NXT
00048 40       W21I(I,I)=1.0
00049          CALL LEQT2C(EVEC,NXT,NDIM3,W21I,NXT,NDIM3,IPVT,C,I225,WA,IERR)
00050          IF(IERR.EQ.0) GO TO 60
00052          WRITE(IOUT,50)
00053 50       FORMAT(5X,'ERROR INVERTING EIGENVECTOR MATRIX')
00054          GO TO 1000
00055 60       CONTINUE
          C       CALCULATE SENSITIVITIES
00056          DO 150 I=1,NXT
00057          AIM=AIMAG(EVAL(I))
00058          IF(AIM) 150,70,90
          C       ZERO OUT COMPLEX ROUND-OFF ERROR
00059 70       CONTINUE
00060          DO 80 J=1,NXT
00061 80       W21I(J,I)=CMPLX(REAL(W21I(J,I)),0.)
00062 90       CONTINUE
          C       NORMALIZED SENSITIVITY W.R.T. F
00063          DO 100 J=1,NXT
00064          DO 100 K=1,NXT
00065 100      SIII(J,K)=W21I(J,I)*EVEC(I,K)*F(J,K)/EVAL(I)
00066          IDEN=IDEN+1
00067          WRITE(IPFOUT) IDEN,NXT,NXT,((SIII(II,JJ),JJ=1,NXT),II=1,NXT)
          C       NORMALIZED SENSITIVITY W.R.T. G
00068          DO 120 J=1,NXT
00069          DO 120 K=1,NU
00070          DD=0.
00071          DO 110 L=1,NXT
00072 110      DD=DD+W21I(J,I)*EVEC(I,L)*CG(K,L)
00073 120      SIII(J,K)=DD*G(J,K)/EVAL(I)
00074          IDEN=IDEN+1
00075          WRITE(IPFOUT) IDEN,NXT,NU,((SIII(II,JJ),JJ=1,NU),II=1,NXT)
          C       NORMALIZED SENSITIVITY W.R.T. K
00076          DO 140 J=1,NU
00077          DO 140 K=1,NXT
00078          DD=0.
00079          DO 130 L=1,NXT
00080 130      DD=DD+G(L,J)*W21I(L,I)*EVEC(I,K)
00081 140      SIII(J,K)=DD*CG(J,K)/EVAL(I)
00082          IDEN=IDEN+1
00083          WRITE(IPFOUT)IDEN,NU,NXT,((SIII(II,JJ),JJ=1,NXT),II=1,NU)
00084 150      CONTINUE
00085          DO 160 I=IDEN+1,130
00086 160      WRITE(IPFOUT) I,II,II,C3
```

```
      C         THE END
00087 1000      STOP
00088           END
```

```
AIM     0057=  0058IF
AIMAG   0057
ARRAY   0006DI 0008EQ 0028AG
ASSIGN  0019CL 0023CL
C       0005CX 0011DA 0049AG
CG      0002DI 0010DA 0043RD 0072   0081
CMPLX   0061
C0      0014CX 0015DA 0089NR
DD      0005CX 0070=  0072=  0073   0078=  0080=  0081
EVAL    0003CX 0011DA 0039RD 0057   0065   0073   0081
EVEC    0003CX 0011DA 0041RD 0049AG 0065   0072   0080
F       0002DI 0016DA 0035RD 0065
FNAME   0001DI 0018RD 0019AG 0022RD 0023AG
G       0002DI 0014DA 0037RD 0073   0080
I       0018RD 0022RD 0026RD 0035RD 0037RD 0039RD 0041RD 0043RD
        0047DO 0048   0056DO 0057   0061   0065   0072   0073
        0080   0081   0085DO 0089NR
IARRAY  0006DI 0063EQ 0029AG
IDEN    0031RD 0032IF 0033RD 0034IF 0035RD 0036IF 0037RD 0038IF
        0039RD 0043IF 0041RD 0042IF 0043RD 0046=  0056=  0067NR
        0074=  0075NR 0082=  0083NR 0085DO
IERR    0049AG 0050IF
II      0067NR 0075NR 0083NR
IIN     0012DA 0018RD 0022RD 0026RD
IOUT    0012DA 0016NR 0020NR 0024NR 0052NR
IPFIN   0012DA 0019AG 0028AG 0029RW 0031RD 0033RD 0035RD 0037RD
        0039RD 0041RD 0043RD
IPFOUT  0012DA 0023AG 0028AG 0067NR 0075NR 0083NR 0089NR
IPVT    0007DI 0009DA 0049AG
I1      0015DA 0089NR
I225    0013DA 0049AG
I900    0013DA 0029AG
J       0035RD 0037RD 0041RD 0043RD 0052DO 0061   0063DO 0065
        0069DO 0072   0073   0076DO 0080   0081
JJ      0067NR 0075NR 0083NR
K       0063DO 0064DO 0065   0069DO 0072   0073   0077DO 0080
        0081
L       0071DO 0072   0079DO 0080
LASTID  0013DA 0028AG 0030DO 0046
LEQT2C  0049CL
NDIM3   0013DA 0049AG
NU      0033RD 0069DO 0075NR 0077DO 0083NR
NN      0033RD
NX      0035RD 0037RD 0039RD 0041RD 0043RD
NXC     0033RD 0045
NXS     0033RD 0045
NXT     0045=  0047DO 0049AG 0056DO 0062DO 0063DO 0064DO 0067NR
        0068DO 0071DO 0075NR 0077DO 0079DO 0083NR
NY      0035RD 0037RD 0041RD 0043RD
NYO     0033RD
NYS     0033RD
NZ      0033RD
REAL    0061
RETR    0028CL
```

```
SIII    00004CX 00011DA 00065=  00067#R 00073=  00075#R 00081=  00083#R
TTLNEW  00001DI 00026RD 00028AG
WA      00005CX 00008EQ 00011DA 00049AG
W2II    00005CX 00008EQ 00011DA 00048=  00049AG 00061=  00065   00072
        00080
10      00019#R 00017*
100     00063DO 00064DO 00065*
1000    00054GT 00087*
110     00071DO 00072*
12      00023#R 00021*
120     00068DO 00069DO 00073*
130     00079DO 00080*
14      00024#R 00025*
140     00076DO 00077DO 00081*
150     00056DO 00056IF 00084*
160     00085DO 00086*
20      00018RD 00022RD 00026RD 00027*
30      00033DO 00044*
35      00031RD 00045*
40      00047DO 00048*
50      00052#R 00053*
60      00051GT 00055*
70      00058IF 00059*
80      00060DO 00061*
90      00058IF 00052*
```

```
      C          BLOCK 7 - CONTROLLER
      C          THIS ROUTINE SETS UP THE CONTROLLER EQUATIONS USING
      C          THE FILTER AND REGULATOR SOLUTIONS COMPUTED
      C          PREVIOUSLY.
00001       DIMENSION FNAME(4),TTLNEW(5)
      C        INPUT MATRIX ARRAYS
00002       DIMENSION F(15,15),G(15,5),GM(15,15),H(15,15),TZ(15,15),
     +           XK(15,15),C(5,15),TI(15,15),F12(15,15),F21(15,15),
     +           F22(15,15),G2(15,5),H2(15,15),XK2(15,15)
      C        OUTPUT MATRIX ARRAYS
00003       DIMENSION AF(15,15),BF(15,15),CF(5,15),DF(5,15)
      C        WORKING ARRAYS
00004       DIMENSION DUMMY(15,15),DUMMY2(15,15),ARRAY(900),IARRAY(900),
     +           A(30,30)
      C        EQUIVALENCES
00005       EQUIVALENCE (A,ARRAY,IARRAY,XK),(A(16,2),TI),(A(1,16),TZ),
     +           (A(16,23),DUMMY2,H2),(AF,F12),(BF,F21),(CF,G2),
     +           (DUMMY,F22),(XK2,DF)
      C        DATA
00006       DATA IIN,IOUT,IPFIN,IPFOUT /5,7,20,21/
00007       DATA I900,LASTID,I1,R0 /900,115,1,0./
      C        READ INPUT AND OUTPUT PROBLEM FILE NAMES AND TITLE
00008       WRITE(IOUT,10)
00009 10    FORMAT(20X,'CONTROLLER - BLOCK 7',/,2X,
     +     'INPUT PROBLEM FILE NAME ? ',$)
00010       READ(IIN,20) (FNAME(I),I=1,4)
00011       CALL ASSIGN(IPFIN,FNAME)
00012       WRITE(IOUT,12)
00013 12    FORMAT(2X,'OUTPUT PROBLEM FILE NAME ? ',$)
00014       READ(IIN,20) (FNAME(I),I=1,4)
00015       CALL ASSIGN(IPFOUT,FNAME)
00016       WRITE(IOUT,14)
00017 14    FORMAT(2X,'PROBLEM TITLE (20 CHARS) : ',$)
00018       READ(IIN,20) (TTLNEW(I),I=1,5)
00019 20    FORMAT(5A4)
      C        READ AND WRITE PROBLEM FILE, COMPOSING TITLE
00020       CALL REWR(IPFIN,IPFOUT,TTLNEW,I900,LASTID,ARRAY,IARRAY)
00021       REWIND IPFIN
      C        GET THE FOLLOWING FROM THE PROBLEM FILE:
      C          DIMENSIONS  IDEN=2
      C          TZ MATRIX   IDEN=35
      C          TI MATRIX   IDEN=37
      C          F MATRIX    IDEN=38,39,40,41
      C          G MATRIX    IDEN=42,43
      C          H MATRIX    IDEN=47,48
      C          DIMENSIONS  IDEN=54
      C          K MATRIX    IDEN=59,60
      C          C MATRIX    IDEN=70
00022       DO 30 K=1,200
00023       READ(IPFIN,END=40) IDEN
00024       IF(IDEN.EQ.1) READ(IPFIN) IDEN,NXS,NXC,NU,NW,NZ,NYS,NYO
00026       IF(IDEN.EQ.34) READ(IPFIN) IDEN,NX,NY,((TZ(I,J),J=1,NY),I=1,NX)
00028       IF(IDEN.EQ.36) READ(IPFIN) IDEN,NX,NY,((TI(I,J),J=1,NY),I=1,NX)
00030       IF(IDEN.EQ.37) READ(IPFIN) IDEN,NX,NY,((F(I,J),J=1,NY),I=1,NX)
```

```
00032          IF(IDEN.EQ.38) READ(IPFIN) IDEN,NX,NY,((F12(I,J),J=1,NY),I=1,NX)
00034          IF(IDEN.EQ.39) READ(IPFIN) IDEN,NX,NY,((F21(I,J),J=1,NY),I=1,NX)
00036          IF(IDEN.EQ.40) READ(IPFIN) IDEN,NX,NY,((F22(I,J),J=1,NY),I=1,NX)
00038          IF(IDEN.EQ.41) READ(IPFIN) IDEN,NX,NY,((G(I,J),J=1,NY),I=1,NX)
00040          IF(IDEN.EQ.42) READ(IPFIN) IDEN,NX,NY,((G2(I,J),J=1,NY),I=1,NX)
00042          IF(IDEN.EQ.46) READ(IPFIN) IDEN,NX,NY,((H(I,J),J=1,NY),I=1,NX)
00044          IF(IDEN.EQ.47) READ(IPFIN) IDEN,NX,NY,((H2(I,J),J=1,NY),I=1,NX)
00046          IF(IDEN.EQ.53) READ(IPFIN) IDEN,M1,M1P,M2,M2P
00048          IF(IDEN.EQ.58) READ(IPFIN) IDEN,NX,NY,((XK(I,J),J=1,NY),I=1,NX)
00050          IF(IDEN.EQ.59) READ(IPFIN) IDEN,NX,NY,((XK2(I,J),J=1,NY),I=1,NX)
00052          IF(IDEN.EQ.69) READ(IPFIN) IDEN,NCX,NCY,((C(I,J),J=1,NCY),I=1,NCX)
00054 30       CONTINUE
00055 40       REWIND IPFIN
               C      COMPOSE F,G,H AND K
00056          IF(M1P.EQ.0) GO TO 60
00058          IF(M2.EQ.0) GO TO 85
00060          DO 50 I=1,M1P
00061          DO 50 J=1,M2
00062          JJ=J+M1P
00063          F(I,JJ)=F12(I,J)
00064 50       F(JJ,I)=F21(J,I)
00065          DO 55 I=1,M1P
00066          DO 55 J=1,M2
00067          JJ=J+M1
00068 55       XK(I,JJ)=XK2(I,J)
00069 60       DO 70 I=1,M2
00070          II=I+M1P
00071          DO 70 J=1,M2
00072          JJ=J+M1P
00073 70       F(II,JJ)=F22(I,J)
00074          DO 75 I=1,M2
00075          II=I+M1P
00076          DO 75 J=1,NU
00077 75       G(II,J)=G2(I,J)
00078          IF(M1.EQ.0) GO TO 85
00080          DO 80 I=1,M1
00081          DO 80 J=1,M2
00082          JJ=J+M1P
00083 80       H(I,JJ)=H2(I,J)
00084 85       CONTINUE
00085          NV=NYS
00086          NXT=NXC+NXS
00087          IF(M1P.EQ.0) GO TO 440
00089          IF(NCX.NE.1.OR.NCY.NE.1) GO TO 95
00091          DO 90 I=1,NU
00092          DO 90 J=1,NXT
00093 90       C(I,J)=0.
               C      COMPUTE AF = (F11-K12*F21-K11*H11-(G1-K12*G2)*C*TI)
00094 95       DO 110 I=1,M1P
00095          DO 110 J=1,M1P
00096          DUM=0.
00097          IF(M1.EQ.0) GO TO 110
00099          DO 100 K=1,M1
00100 100      DUM=DUM+XK(I,K)*H(K,J)
```

```
00101 110   AF(I,J)=F(I,J)-DUM
00102       IF(M2.EQ.0) GO TO 200
00104 115   DO 130 I=1,M1P
00105       DO 130 J=1,M1P
00106       DUM=0.
00107       DO 120 K=1,M2
00108       KK=K+M1
00109       KF=K+M1P
00110 120   DUM=DUM+XK(I,KK)*F(KF,J)
00111 130   AF(I,J)=AF(I,J)-DUM
00112       IF(NU.EQ.0) GO TO 200
00114       DO 150 I=1,M1P
00115       DO 150 J=1,NU
00116       DUM=0.
00117       DO 140 K=1,M2
00118       KK=K+M1
00119       KG=K+M1P
00120 140   DUM=DUM+XK(I,KK)*G(KG,J)
00121 150   DUMMY(I,J)=G(I,J)-DUM
00122       DO 170 I=1,M1P
00123       DO 170 J=1,NXT
00124       DUM=0.
00125       DO 160 K=1,NU
00126 160   DUM=DUM+DUMMY(I,K)*C(K,J)
00127 170   DUMMY2(I,J)=DUM
00128       DO 190 I=1,M1P
00129       DO 190 J=1,M1P
00130       DUM=0.
00131       DO 180 K=1,NXT
00132 180   DUM=DUM+DUMMY2(I,K)*TI(K,J)
00133 190   AF(I,J)=AF(I,J)-DUM
00134 200   CONTINUE
      C        COMPUTE BF = (K11   (F11-K12*F21-K11*H11)*K12+F12-K12*F22
      C                              -K11*H12-(G1-K12*G2)*C*TI*K12  )*TZ
00135       IF(M1.EQ.0) GO TO 215
00137       DO 210 I=1,M1P
00138       DO 210 J=1,M1
00139 210   BF(I,J)=XK(I,J)
00140       IF(M2.EQ.0) GO TO 380
00142 215   DO 240 I=1,M1P
00143       DO 240 J=1,M1P
00144       DUM=0.
00145       DO 220 K=1,M2
00146       KK=K+M1
00147       KF=K+M1P
00148 220   DUM=DUM+XK(I,KK)*F(KF,J)
00149       DUMMY(I,J)=F(I,J)-DUM
00150       DUM=0.
00151       IF(M1.EQ.0) GO TO 240
00153       DO 230 K=1,M1
00154 230   DUM=DUM+XK(I,K)*H(K,J)
00155 240   DUMMY(I,J)=DUMMY(I,J)-DUM
00156       DO 260 I=1,M1P
00157       DO 260 J=1,M2
```

```
00158          JJ=J+M1
00159          JF=J+M1P
00160          DUM=0.
00161          DO 250 K=1,M1P
00162 250      DUM=DUM+DUMMY(I,K)*XK(K,JJ)
00163 260      BF(I,JJ)=F(I,JF)+DUM
00164          DO 290 I=1,M1P
00165          DO 290 J=1,M2
00166          JJ=J+M1
00167          JF=J+M1P
00168          DUM=0.
00169          DO 270 K=1,M2
00170          KK=K+M1
00171          KF=K+M1P
00172 270      DUM=DUM+XK(I,KK)*F(KF,JF)
00173          BF(I,JJ)=BF(I,JJ)-DUM
00174          DUM=0.
00175          IF(M1.EQ.0) GO TO 290
00177          DO 280 K=1,M1
00178 280      DUM=DUM+XK(I,K)*H(K,JF)
00179 290      BF(I,JJ)=BF(I,JJ)-DUM
00180          IF(NU.EQ.0) GO TO 380
00182          DO 310 I=1,M1P
00183          DO 310 J=1,NU
00184          DUM=0.
00185          DO 300 K=1,M2
00186          KK=K+M1
00187          KG=K+M1P
00188 300      DUM=DUM+XK(I,KK)*G(KG,J)
00189 310      DUMMY(I,J)=G(I,J)-DUM
00190          DO 330 I=1,M1P
00191          DO 330 J=1,NXT
00192          DUM=0.
00193          DO 320 K=1,NU
00194 320      DUM=DUM+DUMMY(I,K)*C(K,J)
00195 330      DUMMY2(I,J)=DUM
00196          DO 350 I=1,M1P
00197          DO 350 J=1,NXT
00198          DUM=0.
00199          DO 340 K=1,NXT
00200 340      DUM=DUM+DUMMY2(I,K)*TI(K,J)
00201 350      DUMMY(I,J)=DUM
00202          DO 355 I=1,NXT
00203          DO 355 J=1,NZ
00204 355      DUMMY2(I,J)=0.
00205          DO 360 I=1,M1P
00206          DO 360 J=1,M2
00207          JJ=J+M1
00208 360      DUMMY2(I,JJ)=XK(I,JJ)
00209          DO 365 I=1,M2
00210          II=I+M1P
00211          III=I+M1
00212 365      DUMMY2(II,III)=1.
00213          DO 375 I=1,M1P
```

```
00214          DO 375 J=1,NZ
00215          DUM=0.
00216          DO 370 K=1,NXT
00217 370      DUM=DUM+DUMMY(I,K)*DUMMY2(K,J)
00218 375      BF(I,J)=BF(I,J)-DUM
00219 380      DO 400 I=1,M1P
00220          DO 400 J=1,NZ
00221          DUM=0.
00222          DO 390 K=1,NZ
00223 390      DUM=DUM+BF(I,K)*TZ(K,J)
00224 400      DUMMY(I,J)=DUM
00225          DO 410 I=1,M1P
00226          DO 410 J=1,NZ
00227 410      BF(I,J)=DUMMY(I,J)
       C          COMPUTE CF = -C*TI
00228          IF(NU.EQ.0) GO TO 510
00230          DO 430 I=1,NU
00231          DO 430 J=1,M1P
00232          DUM=0.
00233          DO 420 K=1,NXT
00234 420      DUM=DUM+C(I,K)*TI(K,J)
00235 430      CF(I,J)=-DUM
       C          COMPUTE DF = -C*TI*K12*TZ
00236 440      DO 460 I=1,NU
00237          DO 460 J=1,NXT
00238          DU1=0.
00239          DO 450 K=1,NXT
00240 450      DU1=DU1+C(I,K)*TI(K,J)
00241 460      DUMMY(I,J)=-DUM
00242          DO 470 I=1,NXT
00243          DO 470 J=1,NZ
00244 470      DUMMY2(I,J)=0.
00245          IF(M2.EQ.0) GO TO 485
00247          IF(M1P.EQ.0) GO TO 482
00249          DO 480 I=1,M1P
00250          DO 480,J=1,M2
00251          JJ=J+M1
00252 480      DUMMY2(I,JJ)=XK(I,JJ)
00253 482      DO 484 I=1,M2
00254          II=I+M1P
00255          IJ=I+M1
00256 484      DUMMY2(II,IJ)=1.
00257 485      DO 487 I=1,NU
00258          DO 487 J=1,NZ
00259          DUM=0.
00260          DO 486 K=1,NXT
00261 486      DUM=DUM+DUMMY(I,K)*DUMMY2(K,J)
00262 487      DF(I,J)=DUM
00263          DO 495 I=1,NU
00264          DO 495 J=1,NZ
00265          DUM=0.
00266          DO 490 K=1,NZ
00267 490      DUM=DU1+DF(I,K)*TZ(K,J)
00268 495      DUMMY(I,J)=DU1
```

```
00269          DO 500 I=1,MU
00270          DO 500 J=1,NZ
00271  500     DF(I,J)=DUMMY(I,J)
       C          WRITE AF,BF,CF,AND DF
00272  510     IDEN=LASTID+1
00273          IF(M1P.EQ.0) WRITE(IPFOUT) IDEN,I1,I1,R0
00275          IF(M1P.NE.0) WRITE(IPFOUT)
              +    IDEN,M1P,M1P,((AF(I,J),J=1,M1P),I=1,M1P)
00277          IDEN=IDEN+1
00278          IF(M1P.EQ.0) WRITE(IPFOUT) IDEN,I1,I1,R0
00280          IF(M1P.NE.0) WRITE(IPFOUT)
              +  IDEN,M1P,NZ,((BF(I,J),J=1,NZ),I=1,M1P)
00282          IDEN=IDEN+1
00283          IF(M1P.EQ.0.OR.MU.EQ.0) WRITE(IPFOUT) IDEN,I1,I1,R0
00285          IF(M1P.NE.0.AND.MU.NE.0) WRITE(IPFOUT)
              +  IDEN,MU,M1P,((CF(I,J),J=1,M1P),I=1,MU)
00287          IDEN=IDEN+1
00288          IF(MU.EQ.0) WRITE(IPFOUT) IDEN,I1,I1,R0
00290          IF(MU.NE.0) WRITE(IPFOUT)
              +  IDEN,MU,NZ,((DF(I,J),J=1,NZ),I=1,MU)
00292          LASTID=IDEN
       C          READ THE FOLLOWING FROM THE PROBLEM FILE:
       C            F MATRIX    IDEN=24
       C            G MATRIX    IDEN=25
       C            GM MATRIX   IDEN=26
       C            H MATRIX    IDEN=27
00293          DO 520 K=1,200
00294          READ(IPFIN,END=530) IDEN
00295          IF(IDEN.EQ.23) READ(IPFIN) IDEN,NX,NY,((F(I,J),J=1,NY),I=1,NX)
00297          IF(IDEN.EQ.24) READ(IPFIN) IDEN,NX,NY,((G(I,J),J=1,NY),I=1,NX)
00299          IF(IDEN.EQ.25) READ(IPFIN) IDEN,NX,NY,((GM(I,J),J=1,NY),I=1,NX)
00301          IF(IDEN.EQ.26) READ(IPFIN) IDEN,NX,NY,((H(I,J),J=1,NY),I=1,NX)
00303  520     CONTINUE
00304  530     CALL CLOSE(IPFIN)
00305          IDEN=LASTID
       C                          (F+G*DF*H     G*CF)
       C            COMPUTE A =   (                 )
       C                          (  BF*H        AF )
00306          DO 535 I=1,NXT+M1P
00307          DO 535 J=1,NXT+M1P
00308  535     A(I,J)=0.
00309          DO 540 I=1,NXT
00310          DO 540 J=1,NXT
00311  540     A(I,J)=F(I,J)
00312          IF(MU.EQ.0) GO TO 590
00314          DO 560 I=1,NXT
00315          DO 560 J=1,NZ
00316          DUM=0.
00317          DO 550 K=1,MU
00318  550     DUM=DUM+G(I,K)*DF(K,J)
00319  560     DUMMY(I,J)=DUM
00320          DO 580 I=1,NXT
00321          DO 580 J=1,NXT
00322          DUM=0.
```

```
00323         DO 570 K=1,NZ
00324  570    DUM=DUM+DUMMY(I,K)*H(K,J)
00325  580    A(I,J)=A(I,J)+DUM
00326  590    CONTINUE
00327         IF(M1P.EQ.0) GO TO 660
00329         DO 610 I=1,M1P
00330         II=I+NXT
00331         DO 610 J=1,NXT
00332         DUM=0.
00333         DO 600 K=1,NZ
00334  600    DUM=DUM+BF(I,K)*H(K,J)
00335  610    A(II,J)=DUM
00336         IF(NU.EQ.0) GO TO 640
00338         DO 630 I=1,NXT
00339         DO 630 J=1,M1P
00340         JJ=J+NXT
00341         DUM=0.
00342         DO 620 K=1,NU
00343  620    DUM=DUM+G(I,K)*CF(K,J)
00344  630    A(I,JJ)=DUM
00345  640    DO 650 I=1,M1P
00346         II=I+NXT
00347         DO 650 J=1,M1P
00348         JJ=J+NXT
00349  650    A(II,JJ)=AF(I,J)
00350  660    IDEN=IDEN+1
00351         NTOT=NXT+M1P
00352         WRITE(IPFOUT) IDEN,NTOT,NTOT,((A(I,J),J=1,NTOT),I=1,NTOT)
00353         DO 700 I=IDEN+1,130
00354  700    WRITE(IPFOUT) I,II,II,R0
      C          THE END
00355         STOP
00356         END
```

A 00004DI 00005EQ 00033= 00311= 00325= 00335= 00344= 00349= 00352NR
AF 00003DI 00005EQ 00101= 00111= 00133= 00276NR 00349
ARRAY 00004DI 00005EQ 00020AG
ASSIGN 00011CL 00015CL
BY 00003DI 00005EQ 00139= 00163= 00173= 00179= 00218= 00223 00227= 00281NR 00334
C 00002DI 00053RD 00093= 00126 00194 00234 00240
CF 00003DI 00005EQ 00235= 00286NR 00343
CLOSE 00004CL
DF 00003DI 00005EQ 00252= 00267 00271= 00291NR 00310
DU1 00096= 00100= 00101 00106= 00110= 00111 00116= 00120= 00121 00124= 00126= 00127 00130= 00132= 00133 00144= 00148= 00149 00150= 00154= 00155 00160= 00162= 00163 00168= 00172= 00173 00174= 00178= 00179 00184= 00188= 00189 00192= 00194= 00195 00198= 00202= 00201 00215= 00217= 00218 00221= 00223= 00224 00232= 00234= 00235 00239= 00240= 00241 00259= 00261= 00262 00265= 00267= 00268 00316= 00318= 00319 00322= 00324= 00325 00332= 00334= 00335 00341= 00343= 00344
DUMMY 00004DI 00005EQ 00121= 00125 00149= 00155= 00162 00189= 00194 00201= 00217 00224= 00227 00241= 00261 00268= 00271 00319= 00324
DUMMY2 00004DI 00005EQ 00127= 00132 00195= 00200 00204= 00208= 00212= 00217 00244= 00252= 00255= 00261
F 00002DI 00031RD 00053= 00054= 00073= 00101 00110 00148 00149 00163 00172 00296RD 00311
FNAME 00021DI 00010RD 00011AG 00014RD 00015AG
F12 00002DI 00005EQ 00033RD 00063
F21 00002DI 00005EQ 00035RD 00064
F22 00002DI 00005EQ 00037RD 00073
G 00002DI 00039RD 00077= 00124 00121 00183 00189 00298RD 00310 00343
G1 00002DI 00034RD
G2 00002DI 00005EQ 00041RD 00077
H 00002DI 00043RD 00083= 00100 00154 00178 00302RD 00324 00334
H2 00002DI 00005EQ 00045RD 00083
I 00010RD 00014RD 00018RD 00027RD 00029RD 00031RD 00033RD 00035RD 00037RD 00039RD 00041RD 00043RD 00045RD 00049RD 00051RD 00053RD 00055DD 00063 00064 00065DD 00068 00069DD 00072 00073 00074DD 00075 00077 00082DD 00083 00091DD 00093 00094DD 00100 00101 00104DD 00110 00111 00114DD 00120 00121 00123DD 00126 00127 00128DD 00132 00135 00137DD 00139 00142DD 00148 00149 00154 00155 00159DD 00162 00163 00164DD 00172 00173 00178 00179 00182DD 00188 00189 00190DD 00194 00195 00196DD 00200 00201 00202DD 00204 00205DD 00208 00209DD 00210 00211 00213DD 00217 00218 00219DD 00223 00224 00225DD 00227 00230DD 00234 00235 00236DD 00240 00241 00242DD 00244 00249DD 00252 00253DD 00254 00255 00257DD 00261 00262 00263DD 00267 00268 00269DD 00271 00276NR 00281NR 00283NR 00291NR 00296RD 00298RD 00302RD 00302RD 00306DD 00308 00311 00314DD 00318 00319 00320DD 00324 00325 00329DD 00330 00334 00338DD

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         00343   00344   00345DO 00346   00349   00352WR 00353DO 00354WR
IARRAY   00004DI 00005EQ 00020AG
IDEN     00023RD 00024IF 00025RD 00026IF 00027RD 00028IF 00029RD 00030IF
         00031RD 00032IF 00033RD 00034IF 00035RD 00036IF 00037RD 00038IF
         00039RD 00040IF 00041RD 00042IF 00043RD 00044IF 00045RD 00046IF
         00047RD 00048IF 00049RD 00050IF 00051RD 00052IF 00053RD 00272=
         00274WR 00276WR 00277=  00279WR 00281WR 00282=  00284WR 00286WR
         00287=  00289WR 00291WR 00292   00294RD 00295IF 00296RD 00297IF
         00298RD 00299IF 00300RD 00301IF 00302RD 00305=  00350=  00352WR
         00353DO
II       00070=  00073   00075=  00077   00210=  00212   00254=  00255
         00330=  00335   00346=  00349
III      00211=  00212
IIN      00003DA 00010RD 00014RD 00018RD
IJ       00255=  00256
IOUT     00003DA 00008WR 00012WR 00016WR
IPFIN    00005DA 00011AG 00020AG 00021RW 00023RD 00025RD 00027RD 00029RD
         00031RD 00033RD 00035RD 00037RD 00039RD 00041RD 00043RD 00045RD
         00047RD 00049RD 00051RD 00053RD 00055RW 00294RD 00296RD 00298RD
         00300RD 00302RD 00304AG
IPFOUT   00006DA 00015AG 00020AG 00274WR 00276WR 00279WR 00281WR 00284WR
         00286WR 00289WR 00291WR 00352WR 00354WR
I1       00027DA 00274WR 00279WR 00284WR 00289WR 00354WR
I900     00027DA 00020AG
J        00027RD 00029RD 00031RD 00033RD 00035RD 00037RD 00039RD 00041RD
         00043RD 00045RD 00049RD 00051RD 00053RD 00061DO 00062   00063
         00064   00066DO 00067   00068   00071DO 00072   00073   00076DO
         00077   00081DO 00082   00083   00092DO 00093   00095DO 00100
         00101   00105DO 00110   00111   00115DO 00120   00121   00123DO
         00126   00127   00129DO 00132   00133   00135DO 00139   00142DO
         00143   00149   00154   00155   00157DO 00158   00159   00165DO
         00166   00167   00183DO 00188   00189   00191DO 00194   00195
         00197DO 00200   00201   00203DO 00204   00205DO 00207   00214DO
         00217   00218   00222DO 00223   00224   00225DO 00227   00231DO
         00234   00235   00237DO 00240   00241   00243DO 00244   00250DO
         00251   00259DO 00261   00262   00264DO 00267   00268   00270DO
         00271   00276WR 00281WR 00286WR 00291WR 00296RD 00298RD 00300RD
         00302RD 00307DO 00308   00310DO 00311   00315DO 00318   00319
         00321DO 00324   00325   00331DO 00334   00335   00339DO 00340
         00343   00347DO 00348   00349   00352WR
JF       00159=  00163   00167=  00172   00178
JJ       00062=  00063   00064   00067=  00068   00072=  00073   00082=
         00083   00158=  00162   00163   00165=  00173   00179   00207=
         00208   00251=  00252   00340=  00344   00348=  00349
K        00022DO 00099DO 00100   00107DO 00108   00109   00117DO 00118
         00119   00125DO 00126   00131DO 00132   00145DO 00146   00147
         00153DO 00154   00161DO 00162   00169DO 00170   00171   00177DO
         00178   00185DO 00186   00187   00193DO 00194   00199DO 00200
         00216DO 00217   00222DO 00223   00233DO 00234   00239DO 00240
         00260DO 00261   00266DO 00267   00293DO 00317DO 00318   00323DO
         00324   00333DO 00334   00342DO 00343
KF       00109=  00110   00147=  00148   00171=  00172
KG       00119=  00120   00187=  00188
KK       00108=  00110   00118=  00120   00146=  00148   00170=  00172
```

```
            000186=  000188
LASTID      000007DA 0002JAG 000272   000292=  000305
M1          000047RD 000067  000078IF 000083DO 000097IF 000099DO 000103  000110
            000135IF 000139DO 000146  000151IF 000153DO 000159  000166  000170
            000175IF 000177DO 000186  000207  000211  000231  000255
M1P         000047RD 000056IF 000063DO 000062  000065DO 000070  000072  000075
            000082   000087IF 000094DO 000095DO 000104DO 000105DO 000109  000114DO
            000119   000122DO 000126DO 000129DO 000137DO 000142DO 000143DO 000147
            000150DO 000159   000161DO 000164DO 000167   000171   000182DO 000187
            000190DO 000196DO 000205DO 000210   000213DO 000219DO 000225DO 000231DO
            000247IF 000249DO 000254   000273IF 000275IF 000279NR 000281F 000286IF
            000281NR 000283IF 000285IF 000286NR 000306DO 000307DO 000327IF 000329DO
            000339DO 000345DO 000347DO 000351
M2          000047RD 000058IF 000061DO 000066DO 000069DO 000071DO 000074DO 000081DO
            000102IF 000107DO 000117DO 000140IF 000145DO 000157DO 000165DO 000169DO
            000185DO 000206DO 000209DO 000245IF 000250DO 000253DO
M2P         000047RD
NCX         000053RD 000089IF
NCY         000053RD 000089IF
NTOT        000351=  000352NR
NU          000025RD 000076DO 000091DO 000112IF 000115DO 000125DO 000180IF 000183DO
            000193DO 000220IF 000230DO 000236DO 000257DO 000263DO 000269DO 000283IF
            000285IF 000286NR 000288IF 000290IF 000291NR 000312IF 000317DO 000336IF
            000342DO
NV          000025RD 000085=
NX          000027RD 000029RD 000031RD 000033RD 000035RD 000037RD 000039RD 000041RD
            000043RD 000045RD 000049RD 000051RD 000296RD 000298RD 000300RD 000302RD
NXC         000025RD 000086
NXS         000025RD 000086
NXT         000095=  000092DO 000123DO 000131DO 000191DO 000197DO 000199DO 000202DO
            000216DO 000233DO 000237DO 000239DO 000242DO 000260DO 000306DO 000307DO
            000309DO 000310DO 000314DO 000320DO 000321DO 000324   000331DO 000339DO
            000340   000346   000348   000351
NY          000027RD 000029RD 000031RD 000033RD 000035RD 000037RD 000039RD 000041RD
            000043RD 000045RD 000049RD 000051RD 000295RD 000298RD 000304RD 000302RD
NYC         000025RD
NYS         000025RD 000085
NZ          000025RD 000203DO 000214DO 000220DO 000222DO 000228DO 000243DO 000250DO
            000264DO 000266DO 000270DO 000281NR 000291NR 000315DO 000323DO 000333DO
RENR        000202CL
R0          000047DA 000274NR 000279NR 000294NR 000289NR 000354NR
TI          000042DI 000035EQ 000029RD 000132   000200   000234   000240
TTLNEW      000041DI 000019RD 0002JAG
TZ          000042DI 000035EQ 000027RD 000223   000267
XR          000042DI 000035EQ 000049RD 000050=  000120   000110   000120   000139
            000148   000154   000162   000172   000178   000108   000208   000252
XR2         000202DI 000035EQ 000051RD 000063
10          000035NR 000029*
100         000099DO 000100*
110         000094DO 000095DO 000098GT 000101*
115         000104*
12          000112NR 000113*
120         000107DO 000110*
130         000104DO 000105DO 000111*
```

```
14      00013NR 00017*
140     00117DO 00120*
150     00114DO 00115DO 00121*
160     00125DO 00126*
170     00122DO 00123DO 00127*
180     00131DO 00132*
190     00128DO 00129DO 00133*
20      00013RD 00014RD 00018RD 00019*
200     00103GT 00113GT 00134*
210     00137DO 00138DO 00139*
215     00139GT 00142*
220     00145DO 00148*
230     00153DO 00154*
240     00142DO 00143DO 00152GT 00155*
250     00161DO 00162*
260     00156DO 00157DO 00163*
270     00169DO 00172*
280     00177DO 00178*
290     00164DO 00165DO 00179GT 00179*
30      00022DO 00454*
300     00185DO 00188*
310     00182DO 00183DO 00189*
320     00193DO 00194*
330     00196DO 00191DO 00195*
340     00199DO 00200*
350     00196DO 00197DO 00201*
355     00202DO 00203DO 00204*
360     00205DO 00206DO 00208*
365     00209DO 00212*
370     00216DO 00217*
375     00213DO 00214DO 00218*
380     00141GT 00181GT 00219*
390     00222DO 00223*
40      00023RD 00055*
400     00219DO 00220DO 00224*
410     00225DO 00226DO 00227*
420     00233DO 00234*
430     00230DO 00231DO 00235*
440     00088GT 00236*
450     00239DO 00240*
460     00236DO 00237DO 00241*
470     00242DO 00243DO 00244*
480     00249DO 00250DO 00252*
482     00240GT 00253*
484     00253DO 00256*
485     00246GT 00257*
486     00260DO 00261*
487     00257DO 00258DO 00262*
490     00264DO 00267*
495     00263DO 00264DO 00268*
50      00056DO 00061DO 00064*
500     00269DO 00270DO 00271*
510     00229GT 00272*
520     00293DO 00303*
```

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530     003294RD 003304*
535     003305DO 003307DO 003308*
540     003309DO 003310DO 003311*
55      003065DO 003066DO 003068*
550     003317DO 003318*
560     003314DO 003315DO 003319*
570     003323DO 003324*
580     003320DO 003321DO 003325*
590     003313GT 003326*
60      003057GT 003269*
600     003333DO 003334*
610     003329DO 003331DO 003335*
620     003342DO 003343*
630     003339DO 003339DO 003344*
640     003337GT 003345*
650     003345DO 003347DO 003349*
660     003328GT 003350*
70      003069DO 003071DO 003073*
700     003353DO 003354*
75      003074DO 003076DO 003077*
80      003080DO 003081DO 003083*
85      003059GT 003079GT 003084*
90      003091DO 003092DO 003093*
95      003090GT 003094*
```

```
      C         BLOCK 8 - CONTROLLER ANALYSIS
      C           THIS ROUTINE SETS UP THE TREN FILE TO ALLOW TRANSFER
      C           FUNCTION ANALYSIS OF THE CONTROLLER
00001         DIMENSION FNAME(4),TITLE(15)
      C         INPUT MATRIX ARRAYS
00002         REAL MNU(5),MNZ(15),MNXT(15)
00003         DIMENSION F(15,15),G(15,5),H(15,15),TI(15,15),XX(15,15),C(5,15)
00004         DIMENSION F12(15,15),F21(15,15),F22(15,15),G2(15,5),H2(15,15),
     +                  XX2(15,15)
      C         WORKING SPACE
00005         REAL DUMMY(15,15),DUMMY2(15,15),MN(20)
00006         EQUIVALENCE (F21,DUMMY),(F12,DUMMY2)
      C         DATA
00007         DATA IIN,IOUT,IPFIN,ITREN /5,7,20,21/
00008         DATA A1,A2,K0,IPLUS,X1 /0.,0.,0,'+',1./
      C         READ FILE NAMES AND TITLE
00009         WRITE(IOUT,10)
00010 10      FORMAT(23X,'CONTROLLER DEFINITION - BLOCK 8',/,2X,
     +         'INPUT PROBLEM FILE NAME ? ',$)
00011         READ(IIN,20) (FNAME(I),I=1,4)
00012         CALL ASSIGN(IPFIN,FNAME)
00013         WRITE(IOUT,12)
00014 12      FORMAT(2X,'OUTPUT TREN FILE NAME ? ',$)
00015         READ(IIN,20) (FNAME(I),I=1,4)
00016         CALL ASSIGN(ITREN,FNAME)
00017         WRITE(IOUT,14)
00018 14      FORMAT(2X,'TREN TITLE (60 CHARS) :')
00019         READ(IIN,20) (TITLE(I),I=1,15)
00020 20      FORMAT(15A4)
      C         READ THE FOLLOWING FROM THE PROBLEM FILE:
      C           DIMENSIONS  IDEN=2
      C           U MNEMONICS IDEN=3
      C           Z MNEMONICS IDEN=33
      C           X MNEMONICS IDEN=34
      C           TI MATRIX   IDEN=37
      C           F MATRIX    IDEN=38,39,40,41
      C           G MATRIX    IDEN=42,43
      C           H MATRIX    IDEN=47,48
      C           DIMENSIONS  IDEN=54
      C           K MATRIX    IDEN=59,60
      C           C MATRIX    IDEN=70
00021         DO 30 K=1,200
00022         READ(IPFIN,END=40) IDEN
00023         IF(IDEN.EQ.1) READ(IPFIN) IDEN,NXS,NXC,NU,NW,NZ,NYS,NYO
00025         IF(IDEN.EQ.2) READ(IPFIN) IDEN,NX,(MNU(I),I=1,NX)
00027         IF(IDEN.EQ.32) READ(IPFIN) IDEN,NX,(MNZ(I),I=1,NX)
00029         IF(IDEN.EQ.33) READ(IPFIN) IDEN,NX,(MNXT(I),I=1,NX)
00031         IF(IDEN.EQ.36) READ(IPFIN) IDEN,NX,NY,((TI(I,J),J=1,NY),I=1,NX)
00033         IF(IDEN.EQ.37) READ(IPFIN) IDEN,NX,NY,((F(I,J),J=1,NY),I=1,NX)
00035         IF(IDEN.EQ.38) READ(IPFIN) IDEN,NX,NY,((F12(I,J),J=1,NY),I=1,NX)
00037         IF(IDEN.EQ.39) READ(IPFIN) IDEN,NX,NY,((F21(I,J),J=1,NY),I=1,NX)
00039         IF(IDEN.EQ.40) READ(IPFIN) IDEN,NX,NY,((F22(I,J),J=1,NY),I=1,NX)
00041         IF(IDEN.EQ.41) READ(IPFIN) IDEN,NX,NY,((G(I,J),J=1,NY),I=1,NX)
00043         IF(IDEN.EQ.42) READ(IPFIN) IDEN,NX,NY,((G2(I,J),J=1,NY),I=1,NX)
```

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00045        IF(IDEN.EQ.46) READ(IPFIN) IDEN,NX,NY,((H(I,J),J=1,NY),I=1,NX)
00047        IF(IDEN.EQ.47) READ(IPFIN) IDEN,NX,NY,((H2(I,J),J=1,NY),I=1,NX)
00049        IF(IDEN.EQ.53) READ(IPFIN) IDEN,M1,M1P,M2,M2P
00051        IF(IDEN.EQ.58) READ(IPFIN) IDEN,NX,NY,((XK(I,J),J=1,NY),I=1,NX)
00053        IF(IDEN.EQ.59) READ(IPFIN) IDEN,NX,NY,((XK2(I,J),J=1,NY),I=1,NX)
00055        IF(IDEN.EQ.69) READ(IPFIN) IDEN,NX,NY,((C(I,J),J=1,NY),I=1,NX)
00057 30     CONTINUE
00058 40     NXT=NXC+NXS
00059        CALL CLOSE(IPFIN)
     C          COMPOSE F,G,H AND XK MATRICES
00060        IF(M1P.EQ.0) GO TO 50
00062        IF(M2.EQ.0) GO TO 85
00064        DO 50 I=1,M1P
00065        DO 50 J=1,M2
00066        JJ=J+M1P
00067        F(I,JJ)=F12(I,J)
00068 50     F(JJ,I)=F21(J,I)
00069 60     DO 70 I=1,M2
00070        II=I+M1P
00071        DO 70 J=1,M2
00072        JJ=J+M1P
00073 70     F(II,JJ)=F22(I,J)
00074        DO 75 I=1,M2
00075        II=I+M1P
00076        DO 75 J=1,NU
00077 75     G(II,J)=G2(I,J)
00078        DO 80 I=1,M1P
00079        DO 80 J=1,M2
00080        JJ=J+M1
00081        H(I,JJ)=H2(I,J)
00082 80     XK(I,JJ)=XK2(I,J)
00083 85     CONTINUE
00084        IF(M1P.EQ.0.AND.NU.NE.0) GO TO 185
00086        IF(M1P.EQ.0.AND.NU.EQ.0) GO TO 195
     C                    (SI-F11+K12*F21+K11*H11      -G1+K12*G2)
     C       WRITE AF = (                                        )
     C                    (          C*TI                   I     )
00088        DO 130 I=1,M1P
00089        DO 130 J=1,M1P
00090        DUM=0.
00091        IF(M1.EQ.0) GO TO 95
00093        DO 90 K=1,M1
00094 90     DUM=DUM+XK(I,K)*H(K,J)
00095 95     DUMMY(I,J)=-F(I,J)+DUM
00096        IF(M2.EQ.0) GO TO 110
00098        DUM=0.
00099        DO 100 K=1,M2
00100        KK=K+M1
00101        KF=K+M1P
00102 100    DUM=DUM+XK(I,KK)*F(KF,J)
00103        DUMMY(I,J)=DUMMY(I,J)+DUM
00104 110    A1=0.
00105        IF(I.EQ.J) A1=1.0
00107        IF(A1.EQ.0..AND.DUMMY(I,J).EQ.0.) GO TO 130
```

```
00109          WRITE(ITRFN,120) I,J,A2,A1,DUMMY(I,J),K0
00110 120      FORMAT(2I,3F,I)
00111 130      CONTINUE
00112          A1=0.
00113          IF(NU.EQ.0) GO TO 195
00115          DO 150 I=1,NU
00116          II=I+M1P
00117          DO 150 J=1,M1P
00118          DUM=0.
00119          DO 140 K=1,NXT
00120 140      DUM=DUM+C(I,K)*TI(K,J)
00121          IF(DUM.EQ.0.) GO TO 150
00123          WRITE(ITRFN,120) II,J,A2,A1,DUM,K0
00124 150      CONTINUE
00125          DO 180 I=1,M1P
00126          DO 180 J=1,NU
00127          JJ=J+M1P
00128          DUM=0.
00129          IF(M2.EQ.0) GO TO 170
00131          DO 160 K=1,M2
00132          KK=K+M1
00133          KG=K+M1P
00134 160      DUM=DUM+XK(I,KK)*G(KG,J)
00135 170      DUMMY(I,J)=-G(I,J)+DUM
00136          IF(DUMMY(I,J).EQ.0.) GO TO 180
00138          WRITE(ITRFN,120) I,JJ,A2,A1,DUMMY(I,J),K0
00139 180      CONTINUE
00140 195      DO 190 I=1,NU
00141          II=I+M1P
00142          DO 190 J=1,NU
00143          JJ=J+M1P
00144          IF(I.NE.J) GO TO 190
00146          WRITE(ITRFN,120) II,JJ,A2,A1,X1,K0
00147 190      CONTINUE
00148 195      WRITE(ITRFN,120) K0
               C                    (K11    (F11-K12*F21-K11*H11)*K12+F12-K12*F22-K11*H12)
               C       WRITE BF = (                                                        )
               C                    ( 0                    C*TI*K12                     )
00149          IF(M1.EQ.0) GO TO 205
00151          IF(M1P.EQ.0) GO TO 275
00153          DO 200 I=1,M1P
00154          DO 200 J=1,M1
00155          IF(XK(I,J).EQ.0.) GO TO 200
00157          WRITE(ITRFN,120) I,J,A2,A1,XK(I,J),K0
00158 200      CONTINUE
00159          IF(M2.EQ.0) GO TO 320
00161 205      DO 230 I=1,M1P
00162          DO 230 J=1,M1P
00163          DUM=0.
00164          DO 210 K=1,M2
00165          KK=K+M1
00166          KF=K+M1P
00167 210      DUM=DUM+XK(I,KK)*F(KF,J)
00168          DUMMY(I,J)=F(I,J)-DUM
```

```
00169          DUM=0.
00170          IF(M1.EQ.0) GO TO 230
00172          DO 220 K=1,M1
00173 220      DUM=DUM+XK(I,K)*H(K,J)
00174 230      DUMMY(I,J)=DUMMY(I,J)-DUM
00175          DO 245 I=1,M1P
00176          DO 245 J=1,M2
00177          JJ=J+M1
00178          JF=J+M1P
00179          DUM=0.
00180          DO 240 K=1,M1P
00181 240      DUM=DUM+DUMMY(I,K)*XK(K,JJ)
00182 245      DUMMY2(I,J)=F(I,JF)+DUM
00183          DO 265 I=1,M1P
00184          DO 265 J=1,M2
00185          JJ=J+M1
00186          JF=J+M1P
00187          DUM=0.
00188          DO 250 K=1,M2
00189          KK=K+M1
00190          KF=K+M1P
00191 250      DUM=DUM+XK(I,KK)*F(KF,JF)
00192          DUMMY2(I,J)=DUMMY2(I,J)-DUM
00193          DUM=0.
00194          IF(M1.EQ.0) GO TO 265
00196          DO 260 K=1,M1
00197 260      DUM=DUM+XK(I,K)*H(K,JF)
00198 265      DUMMY2(I,J)=DUMMY2(I,J)-DUM
00199          DO 270 I=1,M1P
00200          DO 270 J=1,M2
00201          JJ=J+M1
00202          IF(DUMMY2(I,J).EQ.0.) GO TO 270
00204          WRITE(ITRFN,120) I,JJ,M2,M1,DUMMY2(I,J),K0
00205 270      CONTINUE
00206 275      CONTINUE
00207          IF(NU.EQ.0) GO TO 320
00209          DO 290 I=1,NU
00210          DO 290 J=1,NXT
00211          DUM=0.
00212          DO 280 K=1,NXT
00213 280      DUM=DUM-C(I,K)*TI(K,J)
00214 290      DUMMY(I,J)=DUM
00215          DO 292 I=1,NXT
00216          DO 292 J=1,M2
00217 292      DUMMY2(I,J)=0.
00218          IF(M1P.EQ.0) GO TO 295
00220          DO 294 I=1,M1P
00221          DO 294 J=1,M2
00222          JJ=J+M1
00223 294      DUMMY2(I,J)=XK(I,JJ)
00224 295      DO 296 I=1,M2
00225          II=I+M1P
00226 296      DUMMY2(II,I)=1.
00227          DO 310 I=1,NU
```

```
00228          II=I+M1P
00229          DO 310 J=1,M2
00230          JJ=J+M1
00231          DUM=0.
00232          DO 300 K=1,NXT
00233          DUM=DUM+DUMMY(I,K)*DUMMY2(K,J)
00234 300      CONTINUE
00235          IF(DUM.EQ.0.) GO TO 310
00237          WRITE(ITRFN,120) II,JJ,A2,A1,DUM,K0
00238 310      CONTINUE
00239 320      WRITE(ITRFN,120) K0
       C          WRITE TITLE,DIMENSIONS AND MATRIX CODES
00240          WRITE(ITRFN,20) (TITLE(I),I=1,15)
00241          NX=M1P+NU
00242          NY=M1+M2
00243          WRITE(ITRFN,330) NX,NY,K0
00244 330      FORMAT(3I)
00245          IF(M1P.EQ.0) GO TO 345
00247          DO 340 I=1,M1P
00248 340      MN(I)=MNXT(I)
00249 345      CONTINUE
00250          IF(NU.EQ.0) GO TO 355
00252          DO 350 I=1,NU
00253          II=I+M1P
00254 350      MN(II)=MNU(I)
00255 355      CONTINUE
00256          IF(NX.LE.18) GO TO 370
00258          WRITE(ITRFN,360) (MN(I),I=1,18),IPLUS
00259 360      FORMAT(17A4,A3,A1)
00260          ISTART=19
00261          GO TO 380
00262 370      ISTART=1
00263 380      WRITE(ITRFN,360) (MN(I),I=ISTART,NX)
00264          WRITE(ITRFN,350) (MNZ(I),I=1,NY)
       C          THE END
00265          STOP
00266          END
```

ASSIGN 00012CL 00016CL
A1 00008DA 00104= 00106= 00107IF 00109NR 00112= 00123NR 00138NR
00146NR 00157NR 00204NR 00237NR
A2 00008DA 00109NR 00123NR 00138NR 00146NR 00157NR 00204NR 00237NR
C 00003DI 00056RD 00120 00213
CLOSE 00059CL
DUM 00090= 00094= 00095 00098= 00102= 00103 00118= 00120=
00121IF 00123NR 00128= 00134= 00135 00163= 00167= 00168
00169= 00173= 00174 00179= 00181= 00182 00187= 00191=
00192 00193= 00197= 00198 00211= 00213= 00214 00231=
00233= 00235IF 00237NR
DUMMY 00005RL 00006EQ 00095= 00103= 00107IF 00109NR 00135= 00136IF
00138NR 00160= 00174= 00181 00214= 00233
DUMMY2 00005RL 00006EQ 00182= 00192= 00198= 00202IF 00204NR 00217=
00223= 00226= 00233
F 00003DI 00034RD 00067= 00068= 00073= 00095 00102 00167
00168 00182 00191
FNAME 00031DI 00111RD 00012AG 00015RD 00016AG
F12 00004DI 00006EQ 00036RD 00067
F21 00004DI 00006EQ 00038RD 00068
F22 00004DI 00040RD 00073
G 00003DI 00042RD 00077= 00134 00135
G2 00004DI 00044RD 00077
H 00003DI 00046RD 00081= 00094 00173 00197
H2 00004DI 00048RD 00081
I 00011RD 00015RD 00019RD 00026RD 00028RD 00030RD 00032RD 00034RD
00036RD 00038RD 00042RD 00042RD 00044RD 00046RD 00048RD 00052RD
00054RD 00056RD 00064DO 00067 00068 00069DO 00070 00073
00074DO 00075 00077 00078DO 00081 00082 00088DO 00094
00095 00102 00103 00105IF 00107IF 00109NR 00115DO 00116
00120 00125DO 00134 00135 00136IF 00138NR 00140DO 00141
00144IF 00153DO 00155IF 00157NR 00161DO 00167 00168 00173
00174 00175DO 00181 00182 00183DO 00191 00192 00197
00198 00199DO 00202IF 00204NR 00209DO 00213 00214 00215DO
00217 00220DO 00223 00224DO 00225 00226 00227DO 00228
00233 00240NR 00247DO 00248 00252DO 00253 00254 00256NR
00262NR 00264NR
IDEN 00022RD 00023IF 00024RD 00025IF 00026RD 00027IF 00028RD 00029IF
00030RD 00031IF 00032RD 00033IF 00034RD 00035IF 00036RD 00037IF
00038RD 00039IF 00040RD 00041IF 00042RD 00043IF 00044RD 00045IF
00046RD 00047IF 00048RD 00049IF 00050RD 00051IF 00052RD 00053IF
00054RD 00055IF 00056RD
II 00070= 00073 00075= 00077 00116= 00123NR 00141= 00146NR
00225= 00226 00228= 00237NR 00253= 00254
IIN 00007DA 00011RD 00015RD 00019RD
IOUT 00007DA 00009NR 00013NR 00017NR
IPFIN 00007DA 00012AG 00022RD 00024RD 00026RD 00028RD 00030RD 00032RD
00034RD 00036RD 00038RD 00040RD 00042RD 00044RD 00046RD 00048RD
00050RD 00052RD 00054RD 00056RD 00059AG
IPLUS 00008DA 00258NR
ISTART 00260= 00262= 00263NR
ITRFN 00007DA 00016AG 00109NR 00123NR 00138NR 00146NR 00146NR 00157NR
00204NR 00237NR 00239NR 00244NR 00243NR 00258NR 00263NR 00264NR
J 00032RD 00034RD 00036RD 00038RD 00040RD 00042RD 00044RD 00046RD

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```
         00048RD 00052RD 00054RD 00056RD 00065DO 00066   00067   00068
         00071DO 00072   00073   00076DO 00077   00079DO 00080   00081
         00082   00089DO 00094   00095   00102   00103   00105IF 00107IF
         00109WR 00117DO 00120   00123WR 00126DO 00127   00134   00135
         00136IF 00138WR 00142DO 00143   00144IF 00154DO 00155IF 00157WR
         00162DO 00167   00168   00173   00174   00176DO 00177   00178
         00182   00184DO 00185   00186   00192   00198   00200DO 00201
         00202IF 00204WR 00210DO 00213   00214   00216DO 00217   00221DO
         00222   00223   00229DO 00230   00233
JF       00178=  00182   00186=  00191   00197
JJ       00056=  00057   00068   00072=  00073   00080=  00081   00082
         00127=  00138WR 00143=  00146WR 00177=  00181   00185=  00201=
         00204WR 00222=  00223   00230=  00237WR
K        00021DO 00093DO 00094   00099DO 00100   00101   00119DO 00120
         00131DO 00132   00133   00164DO 00165   00166   00172DO 00173
         00180DO 00181   00188DO 00189   00190   00196DO 00197   00212DO
         00213   00232DO 00233
KF       00101=  00102   00166=  00167   00190=  00191
KG       00133=  00134
KK       00100=  00102   00132=  00134   00165=  00167   00189=  00191
KU       00008DA 00109WR 00123WR 00138WR 00146WR 00148WR 00157WR 00204WR
         00237WR 00239WR 00243WR
MN       00005RL 00248=  00254=  00258WR 00263WR
MNU      00002RL 00026RD 00254
MNXT     00002RL 00030RD 00248
MNZ      00002RL 00028RD 00254WR
M1       00050RD 00030   00091IF 00093DO 00100   00132   00149IF 00154DO
         00165   00170IF 00172DO 00177   00185   00189   00194IF 00196DO
         00201   00222   00230   00242
M1P      00050RD 00060IF 00064DO 00066   00070   00072   00075   00073DO
         00084IF 00086IF 00088DO 00089DO 00101   00116   00117DO 00125DO
         00127   00133   00141   00143   00151IF 00153DO 00161DO 00162DO
         00166   00175DO 00178   00180DO 00183DO 00186   00190   00199DO
         00218IF 00220DO 00225   00226   00241   00245IF 00247DO 00253
M2       00050RD 00062IF 00065DO 00069DO 00071DO 00074DO 00079DO 00096IF
         00099DO 00129IF 00131DO 00159IF 00164DO 00176DO 00184DO 00188DO
         00220DO 00216DO 00221DO 00224DO 00229DO 00242
M2P      00056RD
MU       00024RD 00076DO 00084IF 00086IF 00113IF 00115DO 00126DO 00140DO
         00142DO 00207IF 00209DO 00227DO 00241   00250IF 00252DO
MM       00024RD
MX       00026RD 00028RD 00030RD 00032RD 00034RD 00036RD 00038RD 00040RD
         00042RD 00044RD 00046RD 00048RD 00052RD 00054RD 00056RD 00241=
         00243WR 00256IF 00263WR
MXC      00024RD 00058
MXS      00024RD 00058
MXT      00058=  00119DO 00210DO 00212DO 00215DO 00232DO
MY       00032RD 00034RD 00036RD 00038RD 00040RD 00042RD 00044RD 00046RD
         00048RD 00052RD 00054RD 00056RD 00242=  00243WR 00264WR
MYO      00024RD
MYS      00024RD
MZ       00024RD
TI       00003DI 00032RD 00120   00213
TITLE    00001DI 00019RD 00242WR
```

```
XK      000003DI 000052RD 000082=  000094   000102   000134   000155IF 000157NR
        000167   000173   000181   000191   000197   000223
XK2     000004DI 000054RD 000082
X1      000038DA 000143NR
10      000039NR 000310*
100     000099DO 000102*
110     000097GT 000104*
12      000113NR 000114*
120     000139NR 000110*  000123NR 000138NR 000146NR 000148NR 000157NR 000204WR
        000237NR 000239NR
130     000088DO 000089DO 000108GT 000111*
14      000117NR 000118*
140     000119DO 000120*
150     000115DO 000117DO 000122GT 000124*
160     000131DO 000134*
170     000133GT 000135*
180     000125DO 000126DO 000137GT 000139*
185     000085GT 000140*
190     000143DO 000142DO 000145GT 000147*
195     000087GT 000114GT 000148*
20      000011RD 000015RD 000019RD 000020*  000240NR
200     000153DO 000154DO 000156GT 000158*
205     000156GT 000161*
210     000164DO 000167*
220     000172DO 000173*
230     000161DO 000162DO 000171GT 000174*
240     000180DO 000181*
245     000175DO 000176DO 000182*
250     000188DO 000191*
260     000196DO 000197*
265     000183DO 000184DO 000195GT 000198*
270     000199DO 000200DO 000203GT 000205*
275     000152GT 000206*
280     000212DO 000213*
290     000209DO 000210DO 000214*
292     000215DO 000216DO 000217*
294     000222DO 000221DO 000223*
295     000219GT 000224*
296     000224DO 000226*
30      000021DO 000057*
300     000232DO 000234*
310     000227DO 000229DO 000235GT 000238*
320     000216GT 000200GT 000239*
330     000243NR 000244*
340     000247DO 000240*
345     000246GT 000249*
350     000252DO 000254*
355     000251GT 000255*
360     000250NR 000259*  000263NR 000264NR
370     000257GT 000262*
380     000261GT 000263*
40      000022RD 000058*
50      000064DO 000065DO 000068*
60      000061GT 000069*
```

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```
70      00069DO 00071DO 00073*
75      00074DO 00076DO 00077*
80      00078DO 00079DO 00082*
85      00063GT 00083*
90      00093DO 00094*
95      00092GT 00095*
```

```
      C         BLOCK 9 - CLOSED LOOP SYSTEM ANALYSIS
      C           COMPUTES TREN FILE FROM PROBLEM FILE AND IM INPUT
      C           FOR CLOSED LOOP SYSTEM TRANSFER ANALYSIS.
00001         DIMENSION FNAME(4),TITLE(15)
      C           INPUT MATRIX ARRAYS
00002         REAL MNY(15),MNTS(5),MNV(15),MNTOL(5),MNYO(15),MNZ(15),
     +        MNXC(10),MNXT(15)
00003         DIMENSION GMC(10,15),CC(10,5),CC(10,5),FC(10,10),IM(15,10),
     +                FM(15,5),FD(15,10),E1(30,5),AF(15,15),BF(15,15),
     +                CF(5,15),DF(5,15),XIM(15)
      C           WORKING SPACE
00004         REAL WSN(55),WM4(48)
00005         DIMENSION DUMMY(15,15),DUMMY2(15,15)
      C           DATA
00006         DATA IIN,IOUT,IPFIN,ITREN /5,7,20,21/
00007         DATA A2,A1,K0,X1,IP /0.,0.,0,1.,'+'/
      C           READ FILENAMES, TITLE AND IM MATRIX
00008         WRITE(IOUT,10)
00009 10      FORMAT(1X,'CLOSED LOOP SYSTEM DEFINITION - BLOCK 9',/,2X,
     +        'INPUT PROBLEM FILE NAME ? ',$)
00010         READ(IIN,20) (FNAME(I),I=1,4)
00011         CALL ASSIGN(IPFIN,FNAME)
00012         WRITE(IOUT,12)
00013 12      FORMAT(2X,'OUTPUT TREN FILE NAME ? ',$)
00014         READ(IIN,20) (FNAME(I),I=1,4)
00015         CALL ASSIGN(ITREN,FNAME)
00016         WRITE(IOUT,14)
00017 14      FORMAT(2X,'TREN TITLE (60 CHARS) : ')
00018         READ(IIN,20) (TITLE(I),I=1,15)
00019 20      FORMAT(15A4)
00020         WRITE(IOUT,25)
00021 25      FORMAT(2X,'IM DIAGONAL ELEMENTS (NZ-OF-THEM) : ')
00022         READ(IIN,30) (XIM(I),I=1,15)
00023 30      FORMAT(15E)
      C           READ THE FOLLOWING FROM THE PROBLEM FILE:
      C             DIMENSIONS  IDEN=2
      C             N MNEMONICS IDEN=4
      C            TS MNEMONICS IDEN=5
      C             V MNEMONICS IDEN=6
      C           TOL MNEMONICS IDEN=7
      C            YO MNEMONICS IDEN=9
      C             Z MNEMONICS IDEN=10
      C            XC MNEMONICS IDEN=12
      C             G/C MATRIX  IDEN=16
      C             CC MATRIX   IDEN=17
      C             CC MATRIX   IDEN=18
      C             FC MATRIX   IDEN=19
      C             IM MATRIX   IDEN=20
      C             FM MATRIX   IDEN=21
      C             FD MATRIX   IDEN=22
      C             E1 MATRIX   IDEN=29
      C            XT MNEMONICS IDEN=34
      C             DIMENSIONS  IDEN=54
      C             AF MATRIX   IDEN=116
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      C          BF MATRIX   IDEN=117
      C          CF MATRIX   IDEN=118
      C          DF MATRIX   IDEN=119
00024          DO 40 K=1,200
00025          READ(IPFIN,END=45) IDEN
00026          IF(IDEN.EQ.1) READ(IPFIN) IDEN,NXS,NXC,NU,NV,NZ,NYS,NYO
00028          IF(IDEN.EQ.3) READ(IPFIN) IDEN,NX,(MNN(I),I=1,NX)
00030          IF(IDEN.EQ.4) READ(IPFIN) IDEN,NX,(MNTS(I),I=1,NX)
00032          IF(IDEN.EQ.5) READ(IPFIN) IDEN,NX,(MNV(I),I=1,NX)
00034          IF(IDEN.EQ.6) READ(IPFIN) IDEN,NX,(MNTOL(I),I=1,NX)
00036          IF(IDEN.EQ.8) READ(IPFIN) IDEN,NX,(MNYO(I),I=1,NX)
00038          IF(IDEN.EQ.9) READ(IPFIN) IDEN,NX,(MNZ(I),I=1,NX)
00040          IF(IDEN.EQ.11) READ(IPFIN) IDEN,NX,(MNXC(I),I=1,NX)
00042          IF(IDEN.EQ.15) READ(IPFIN) IDEN,NX,NY,((GMC(I,J),J=1,NZ),I=1,NX)
00044          IF(IDEN.EQ.16) READ(IPFIN) IDEN,NX,NY,((GC(I,J),J=1,NY),I=1,NX)
00046          IF(IDEN.EQ.17) READ(IPFIN) IDEN,NX,NY,((CC(I,J),J=1,NY),I=1,NX)
00048          IF(IDEN.EQ.18) READ(IPFIN) IDEN,NX,NY,((FC(I,J),J=1,NY),I=1,NX)
00050          IF(IDEN.EQ.19) READ(IPFIN) IDEN,NX,NY,((TM(I,J),J=1,NY),I=1,NX)
00052          IF(IDEN.EQ.20) READ(IPFIN) IDEN,NX,NY,((FM(I,J),J=1,NY),I=1,NX)
00054          IF(IDEN.EQ.21) READ(IPFIN) IDEN,NX,NY,((HO(I,J),J=1,NY),I=1,NX)
00056          IF(IDEN.EQ.22) READ(IPFIN) IDEN,NX,NY,((EI(I,J),J=1,NY),I=1,NX)
00058          IF(IDEN.EQ.33) READ(IPFIN) IDEN,NX,(MNXT(I),I=1,NX)
00060          IF(IDEN.EQ.53) READ(IPFIN) IDEN,M1,M1P,M2,M2P
00062          IF(IDEN.EQ.115) READ(IPFIN) IDEN,NX,NY,((AF(I,J),J=1,NY),I=1,NX)
00064          IF(IDEN.EQ.116) READ(IPFIN) IDEN,NX,NY,((BF(I,J),J=1,NY),I=1,NX)
00066          IF(IDEN.EQ.117) READ(IPFIN) IDEN,NX,NY,((CF(I,J),J=1,NY),I=1,NX)
00068          IF(IDEN.EQ.118) READ(IPFIN) IDEN,NX,NY,((DF(I,J),J=1,NY),I=1,NX)
00070 40     CONTINUE
00071 45     M=M+NXC
00072          CALL CLOSE(IPFIN)
      C                      (SI-ACC    -ACF     0)
      C        WRITE AS = ( -AFC   SI-AFF     0)
      C                      ( -HTF      0       I)
00073          IF(NXC.EQ.0) GO TO 230
00075          DO 100 I=1,NXC
00076          DO 100 J=1,NXC
00077          DUMMY(I,J)=-FC(I,J)
00078          IF(M2.EQ.0.OR.NU.EQ.0) GO TO 90
00080          DO 60 K=1,M1+M2
00081          DUM=0.
00082          DO 50 L=1,NU
00083 50       DUM=DUM+GC(I,L)*DF(L,K)
00084 60       DUMMY2(I,K)=DUM
00085          DUM=0.
00086          DO 70 K=1,M1+M2
00087 70       DUM=DUM+DUMMY2(I,K)*HM(K,J)*XIM(K)
00088          DUMMY(I,J)=DUMMY(I,J)-DUM
00089 80       A1=0.
00090          IF(I.EQ.J) A1=1.0
00092          IF(A1.EQ.0..AND.DUMMY(I,J).EQ.0.) GO TO 100
00094          WRITE(ITREN,90) I,J,A2,A1,DUMMY(I,J),K0
00095 90       FORMAT(2I,3E,I)
00096 100    CONTINUE
00097          IF(M1P.EQ.0) GO TO 175
```

```
00099          A1=0.
00100          DO 170 I=1,M1P
00101          II=I+NXC
00102          DO 170 J=1,NXC
00103          DUM=0.
00104          DO 160 K=1,M1+M2
00105 160      DUM=DUM-BF(I,K)*TM(K,J)*XIM(K)
00106          IF(DUM.EQ.0.) GO TO 170
00107          WRITE(ITRFN,90) II,J,A2,A1,DUM,K0
00109 170      CONTINUE
00110 175      DO 190 I=1,NZ
00111          II=I+NXC+M1P
00112          DO 180 J=1,NXC
00113          DUM=-TM(I,J)
00114          IF(DUM.EQ.0.) GO TO 180
00116          WRITE(ITRFN,90) II,J,A2,A1,DUM,K0
00117 180      CONTINUE
00118          IF(NYO.EQ.0) GO TO 200
00120          DO 190 I=1,NYO
00121          II=I+NXC+M1P+NZ
00122          DO 190 J=1,NXC
00123          DUM=-HO(I,J)
00124          IF(DUM.EQ.0.) GO TO 190
00126          WRITE(ITRFN,90) II,J,A2,A1,DUM,K0
00127 190      CONTINUE
00128 200      CONTINUE
00129          IF(M1P.EQ.0) GO TO 245
00131          IF(NU.EQ.0) GO TO 230
00133          DO 220 I=1,NXC
00134          DO 220 J=1,M1P
00135          JJ=J+NXC
00136          DUM=0.
00137          DO 210 K=1,NU
00138 210      DUM=DUM-GC(I,K)*CF(K,J)
00139          IF(DUM.EQ.0.) GO TO 220
00141          WRITE(ITRFN,90) I,JJ,A2,A1,DUM,K0
00142 220      CONTINUE
00143 230      DO 240 I=1,M1P
00144          II=I+NXC
00145          DO 240 J=1,M1P
00146          JJ=J+NXC
00147          A1=0.
00148          IF(I.EQ.J) A1=1.0
00150          DUM=-AI(I,J)
00151          IF(A1.EQ.0..AND.DUM.EQ.0.) GO TO 240
00153          WRITE(ITRFN,90) II,JJ,A2,A1,DUM,K0
00154 240      CONTINUE
00155 245      A1=0.
00156          DO 250 I=1,NZ+NYO
00157          II=I+NXC+M1P
00159 250      WRITE(ITRFN,90) II,II,A2,A1,XI,K0
00159          WRITE(ITRFN,90) K0
               C                    (BCS   BCV   BCL   G4C)
               C       WRITE BS = (BFS   BFV   BFL    0 )
```

```
C                       (E1      0       0       0 )
            IF(NXC.EQ.0) GO TO 310
            IF(NYS.EQ.0) GO TO 350
            DO 300 I=1,NXC
            DO 300 J=1,NYS
            IF(M2.EQ.0.OR.NU.EQ.0) GO TO 290
            DO 270 K=1,M1+M2
            DUM=0.
            DO 260 L=1,NU
      260   DUM=DUM+GC(I,L)*DF(L,K)
      270   DUMMY2(I,K)=DUM
            DUM=0.
            DO 280 K=1,M1+M2
      280   DUM=DUM+DUMMY2(I,K)*FM(K,J)*XIM(K)
      290   DUMMY(I,J)=CC(I,J)+DUM
            IF(DUMMY(I,J).EQ.0.) GO TO 300
            WRITE(ITRFN,90) I,J,A2,A1,DUMMY(I,J),K0
      300   CONTINUE
      310   CONTINUE
            IF(M1P.EQ.0) GO TO 335
            DO 330 I=1,M1P
            II=I+NXC
            DO 330 J=1,NYS
            DUM=0.
            DO 320 K=1,M1+M2
      320   DUM=DUM+BF(I,K)*FM(K,J)*XIM(K)
            IF(DUM.EQ.0.) GO TO 330
            WRITE(ITRFN,90) II,J,A2,A1,DUM,K0
      330   CONTINUE
      335   DO 340 I=1,NZ+NYO
            II=I+NXC+M1P
            DO 340 J=1,NYS
            IF(E1(I,J).EQ.0.) GO TO 340
            WRITE(ITRFN,90) II,J,A2,A1,E1(I,J),K0
      340   CONTINUE
      350   CONTINUE
            IF(NXC.EQ.0.OR.NU.EQ.0.OR.M2.EQ.0) GO TO 380
            DO 370 I=1,NXC
            DO 370 J=1,M1+M2
            JJ=J+NYS
            DUM=0.
            DO 360 K=1,NU
      360   DUM=DUM+GC(I,K)*DF(K,J)
            IF(DUM.EQ.0.) GO TO 370
            WRITE(ITRFN,90) I,JJ,A2,A1,DUM,K0
      370   CONTINUE
            IF(M1P.EQ.0) GO TO 395
      380   DO 390 I=1,M1P
            II=I+NXC
            DO 390 J=1,M1+M2
            JJ=J+NYS
            IF(BF(I,J).EQ.0.) GO TO 390
            WRITE(ITRFN,90) II,JJ,A2,A1,BF(I,J),K0
      390   CONTINUE
```

```
00224 395   CONTINUE
00225       IF(NYS.EQ.0) GO TO 470
00227       IF(NXC.EQ.0.OR.NU.EQ.0.OR.M2.EQ.0) GO TO 440
00229       DO 410 I=1,NXC
00230       DO 410 J=1,M1+M2
00231       DUM=0.
00232       DO 400 K=1,NU
00233 400   DUM=DUM+GC(I,K)*DF(K,J)
00234 410   DUMMY(I,J)=DUM
00235       DO 430 I=1,NXC
00236       DO 430 J=1,NYS
00237       JJ=J+NYS+M1+M2
00238       DUM=0.
00239       DO 420 K=1,M1+M2
00240 420   DUM=DUM+DUMMY(I,K)*BM(K,J)
00241       IF(DUM.EQ.0.) GO TO 430
00243       WRITE(ITRFN,90) I,JJ,A2,A1,DUM,K0
00244 430   CONTINUE
00245       IF(M1P.EQ.0) GO TO 470
00247 440   DO 460 I=1,M1P
00248       II=I+NXC
00249       DO 460 J=1,NYS
00250       JJ=J+NYS+M1+M2
00251       DUM=0.
00252       DO 450 K=1,M1+M2
00253 450   DUM=DUM+BF(I,K)*BM(K,J)
00254       IF(DUM.EQ.0.) GO TO 460
00256       WRITE(ITRFN,90) II,JJ,A2,A1,DUM,K0
00257 460   CONTINUE
00258 470   CONTINUE
00259       IF(NU.EQ.0.OR.NXC.EQ.0) GO TO 490
00261       DO 480 I=1,NXC
00262       DO 480 J=1,NU
00263       JJ=I+2*NYS+M1+M2
00264       IF(GMC(I,J).EQ.0.) GO TO 480
00265       WRITE(ITRFN,90) I,JJ,A2,A1,GMC(I,J),K0
00267 480   CONTINUE
00268 490   WRITE(ITRFN,90) K0
      C        WRITE TITLE, DIMENSIONS AND COLUMN CODES
00269       WRITE(ITRFN,20) (TITLE(I),I=1,15)
00270       NX=NXC+M1P+NZ+NYO
00271       NY=2*NYS+M1+M2+NU
00272       WRITE(ITRFN,500) NX,NY,K0
00273 500   FORMAT(3I)
00274       IF(NXC.EQ.0) GO TO 520
00276       DO 510 I=1,NXC
00277 510   ANN(I)=ANXC(I)
00278 520   CONTINUE
00279       IF(M1P.EQ.0) GO TO 540
00281       DO 530 I=1,M1P
00282       II=I+NXC
00283 530   ANN(II)=ANXT(I)
00284 540   CONTINUE
00285       DO 550 I=1,NZ
```

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```
00286          II=I+NXC+M1P
00287 550      MNN(II)=MNZ(I)
00288          IF(NYO.EQ.0) GO TO 570
00290          DO 560 I=1,NYO
00291          II=I+NXC+M1P+NZ
00292 560      MNN(II)=MNYO(I)
00293 570      CONTINUE
00294          IF(NYS.EQ.0) GO TO 590
00296          DO 580 I=1,NYS
00297 580      MNM(I)=MNYS(I)
00298 590      DO 600 I=1,NZ
00299          II=I+NYS
00300 600      MNM(II)=MNV(I)
00301          IF(NYS.EQ.0) GO TO 620
00303          DO 610 I=1,NYS
00304          II=I+NYS+NZ
00305 610      MNM(II)=MNTOL(I)
00306 620      CONTINUE
00307          IF(NN.EQ.0) GO TO 640
00309          DO 630 I=1,NN
00310          II=I+2*NYS+NZ
00311 630      MNM(II)=MNN(I)
00312 640      CONTINUE
00313          IF(NX.LE.18) GO TO 670
00315          WRITE(ITRFN,650) (MNN(I),I=1,18),IP
00316 650      FORMAT(17A4,A3,A1)
00317          IF(NX.LE.36) GO TO 660
00319          WRITE(ITRFN,650) (MNN(I),I=19,36),IP
00320          ISTART=37
00321          GO TO 680
00322 660      ISTART=19
00323          GO TO 680
00324 670      ISTART=1
00325 680      WRITE(ITRFN,650) (MNN(I),I=ISTART,NX)
00326          IF(NY.LE.18) GO TO 700
00328          WRITE(ITRFN,650) (MNM(I),I=1,18),IP
00329          IF(NY.LE.36) GO TO 690
00331          WRITE(ITRFN,650) (MNM(I),I=19,36),IP
00332          ISTART=37
00333          GO TO 710
00334 690      ISTART=19
00335          GO TO 710
00336 700      ISTART=1
00337 710      WRITE(ITRFN,650) (MNM(I),I=ISTART,NY)
               C          THE END
00338          STOP
00339          END
```

```
AF      00003DI 00063RD 00150
ASSIGN  00011CL 00015CL
A1      00007DA 00089=  00091=  00092IF 00094NR 00099=  00108NR 00116NR
        00120NR 00141NR 00147=  00149=  00151IF 00153NR 00155=  00158NR
        00179NR 00192NR 00199NR 00212NR 00222NR 00243NR 00256NR 00266NR
A2      00007DA 00094NR 00108NR 00116NR 00120NR 00141NR 00153NR 00158NR
        00179NR 00192NR 00199NR 00212NR 00222NR 00243NR 00256NR 00266NR
BF      00003DI 00065RD 00105   00189   00220IF 00222NR 00253
CC      00003DI 00047RD 00176
CF      00003DI 00067RD 00138
CLOSE   00072CL
DF      00003DI 00059RD 00083   00171   00209   00233
DUM     00081=  00083=  00084   00085=  00087=  00088   00103=  00105=
        00106IF 00108NR 00113=  00114IF 00116NR 00123=  00124IF 00126NR
        00136=  00138=  00139IF 00141NR 00150=  00151IF 00153NR 00169=
        00171=  00172   00173=  00175=  00176   00187=  00189=  00194IF
        00192NR 00207=  00209=  00210IF 00212NR 00231=  00233=  00234
        00238=  00240=  00241IF 00243NR 00251=  00253=  00254IF 00256NR
DUMMY   00005DI 00077=  00083=  00092IF 00094NR 00176=  00177IF 00179NR
        00234=  00240
DUMMY2  00005DI 00084=  00087   00172=  00175
E1      00003DI 00057RD 00197IF 00199NR
FC      00003DI 00049RD 00077
FM      00003DI 00053RD 00175   00189   00240   00253
FNAME   00001DI 00010RD 00011AG 00014RD 00015AG
GC      00003DI 00045RD 00083   00138   00171   00209   00233
GMC     00003DI 00043RD 00264IF 00266NR
IM      00003DI 00051RD 00087   00105   00113
IO      00003DI 00055RD 00123
I       00016RD 00014RD 00018RD 00022RD 00029RD 00031RD 00033RD 00035RD
        00037RD 00039RD 00041RD 00043RD 00045RD 00047RD 00049RD 00051RD
        00053RD 00055RD 00057RD 00059RD 00063RD 00065RD 00067RD 00069RD
        00075DO 00077   00083   00084   00087   00088   00090IF 00092IF
        00094NR 00103DO 00101   00105   00110DO 00111   00113   00120DO
        00121   00123   00133DO 00138   00141NR 00143DO 00144   00148IF
        00150   00156DO 00157   00164DO 00171   00172   00175   00176
        00177IF 00179NR 00184DO 00185   00189   00194DO 00195   00197IF
        00199NR 00204DO 00209   00212NR 00216DO 00217   00220IF 00222NR
        00229DO 00233   00234   00235DO 00240   00243NR 00247DO 00248
        00253   00261DO 00264IF 00266NR 00269NR 00276DO 00277   00281DO
        00282   00283   00285DO 00286   00287   00290DO 00291   00292
        00296DO 00297   00298DO 00299   00300   00303DO 00304   00305
        00309DO 00310   00311   00315NR 00319NR 00325NR 00328NR 00331NR
        00337NR
IDEN    00025RD 00026IF 00027RD 00028IF 00029RD 00030IF 00031RD 00032IF
        00033RD 00034IF 00035RD 00036IF 00037RD 00038IF 00039RD 00040IF
        00041RD 00042IF 00043RD 00044IF 00045RD 00046IF 00047RD 00048IF
        00049RD 00050IF 00051RD 00052IF 00053RD 00054IF 00055RD 00056IF
        00057RD 00058IF 00059RD 00060IF 00061RD 00062IF 00063RD 00064IF
        00065RD 00066IF 00067RD 00068IF 00069RD
II      00101=  00108NR 00111=  00116NR 00121=  00120NR 00144=  00153NR
        00157=  00158NR 00105=  00192NR 00195=  00199NR 00217=  00222NR
        00248=  00256NR 00282=  00283   00286=  00287   00291=  00292
        00299=  00300   00304=  00305   00310=  00311
```

IIN 00006DA 00010RD 00014RD 00018RD 00022RD
IOUT 00006DA 00006WR 00012WR 00016WR 00020WR
IP 00007DA 00315WR 00319WR 00328WR 00331WR
IPFIN 00006DA 00011AG 00025RD 00027RD 00029RD 00031RD 00033RD 00035RD
00037RD 00039RD 00041RD 00043RD 00045RD 00047RD 00049RD 00051RD
00053RD 00055RD 00057RD 00059RD 00061RD 00063RD 00065RD 00067RD
00069RD 00072AG
ISTART 00320= 00322= 00324= 00325WR 00332= 00334= 00336= 00337WR
ITRFN 00006DA 00015AG 00094WR 00108WR 00116WR 00126WR 00141WR 00153WR
00158WR 00159WR 00179WR 00192WR 00196WR 00212WR 00222WR 00243WR
00250WR 00259WR 00269WR 00269WR 00272WR 00315WR 00319WR 00325WR
00328WR 00331WR 00337WR
J 00043RD 00045RD 00047RD 00049RD 00051RD 00053RD 00055RD 00057RD
00063RD 00065RD 00067RD 00069RD 00076DO 00077 00087 00088
00090IF 00092IF 00094WR 00102DO 00105 00108WR 00112DO 00113
00116WR 00122DO 00123 00129WR 00134DO 00135 00138 00145DO
00146 00148IF 00150 00165DO 00175 00176 00177IF 00179WR
00186DO 00189 00192WR 00196DO 00197IF 00199WR 00205DO 00206
00209 00218DO 00219 00220IF 00222WR 00234DO 00233 00234
00236DO 00237 00240 00249DO 00250 00253 00262DO 00263
00264IF 00268WR
JJ 00135= 00141WR 00146= 00153WR 00206= 00212WR 00219= 00222WR
00237= 00243WR 00250= 00259WR 00263= 00268WR
K 00024DO 00084DO 00083 00084 00086DO 00087 00104DO 00105
00137DO 00138 00168DO 00171 00172 00174DO 00175 00188DO
00189 00208DO 00209 00232DO 00233 00239DO 00240 00252DO
00253
KJ 00007DA 00094WR 00108WR 00116WR 00126WR 00141WR 00153WR 00158WR
00159WR 00179WR 00192WR 00199WR 00212WR 00222WR 00243WR 00259WR
00268WR 00268WR 00272WR
L 00082DO 00083 00170DO 00171
MM 00004RL 00297= 00300= 00305= 00311= 00328WR 00331WR 00337WR
MN 00024RL 00277= 00283= 00287= 00292= 00319WR 00319WR 00325WR
MNTOL 00002RL 00035RD 00305
MNTS 00002RL 00031RD 00297
MNV 00002RL 00033RD 00300
MNW 00002RL 00029RD 00311
MNXC 00002RL 00041RD 00277
MNXT 00002RL 00059RD 00283
MNYO 00002RL 00037RD 00292
MNZ 00002RL 00039RD 00287
M1 00051RD 00080DO 00086DO 00104DO 00168DO 00174DO 00188DO 00205DO
00218DO 00233DO 00237 00239DO 00252 00252DO 00263 00271
M1P 00051RD 00097IF 00100DO 00111 00121 00129IF 00134DO 00143DO
00149DO 00157 00182IF 00184DO 00195 00214IF 00216DO 00245IF
00247DO 00270 00279IF 00281DO 00286 00291
M2 00051RD 00078IF 00080DO 00086DO 00104DO 00166IF 00168DO 00174DO
00188DO 00202IF 00205DO 00218DO 00227IF 00230DO 00237 00239DO
00250 00252DO 00263 00271
M2P 00051RD
NU 00027RD 00078IF 00082DO 00131IF 00137DO 00166IF 00170DO 00202IF
00208DO 00227IF 00232DO
NV 00027RD 00071= 00259IF 00262DO 00271 00307IF 00309DO
NX 00029RD 00031RD 00033RD 00035RD 00037RD 00039RD 00041RD 00043RD

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        00045RD 00047RD 00049RD 00051RD 00053RD 00055RD 00057RD 00059RD
        00063RD 00065RD 00067RD 00069RD 00270=  00272WR 00313IF 00317IF
        00325WR
NXC     00027RD 00071   00073IF 00075DO 00076DO 00101   00102DO 00111
        00112DO 00121   00122DO 00133DO 00135   00144   00146   00157
        00160IF 00164DO 00165   00195   00202IF 00204DO 00217   00227IF
        00229DO 00235DO 00248   00259IF 00261DO 00270   00274IF 00276DO
        00282   00286   00291
NXS     00027RD
NY      00043RD 00045RD 00047RD 00049RD 00051RD 00053RD 00055RD 00057RD
        00063RD 00065RD 00067RD 00069RD 00271=  00272WR 00326IF 00329IF
        00337WR
NYO     00027RD 00118IF 00120DO 00156DO 00194DO 00270   00288IF 00290DO
NYS     00027RD 00162IF 00165DO 00186DO 00196DO 00206   00219   00225IF
        00236DO 00237   00249DO 00250   00263   00271   00294IF 00296DO
        00299   00301IF 00303DO 00304   00310
NZ      00027RD 00110DO 00121   00156DO 00194DO 00270   00235DO 00291
        00298DO 00304   00310
TITLE   00001DI 00018RD 00269WR
XIM     00003DI 00022RD 00087   00105   00175   00189
XI      00007DA 00158WR
10      00008WR 00009*
100     00075DO 00076DO 00093GT 00096*
12      00012WR 00013*
14      00018WR 00017*
160     00104DO 00105*
170     00100DO 00102DO 00107GT 00109*
175     00099GT 00110*
180     00110DO 00112DO 00115GT 00117*
190     00120DO 00122DO 00125GT 00127*
20      00010RD 00014RD 00018RD 00019*  00269WR
200     00119GT 00120*
210     00137DO 00138*
220     00133DO 00134DO 00140GT 00142*
230     00074GT 00132GT 00143*
240     00143DO 00145DO 00152GT 00154*
245     00130GT 00155*
25      00022WR 00021*
250     00156DO 00158*
260     00170DO 00171*
270     00168DO 00172*
280     00174DO 00175*
290     00167GT 00176*
30      00022RD 00023*
300     00164DO 00165DO 00173GT 00180*
310     00161GT 00181*
320     00188DO 00189*
330     00184DO 00186DO 00191GT 00193*
335     00183GT 00194*
340     00194DO 00196DO 00199GT 00200*
350     00163GT 00201*
360     00209DO 00209*
370     00204DO 00205DO 00211GT 00213*
380     00200GT 00216*
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```
390     00216DO 00218DO 00221GT 00223*
395     00215GT 00224*
40      00024DO 00070*
400     00232DO 00233*
410     00229DO 00230DO 00234*
420     00239DO 00240*
430     00235DO 00236DO 00242GT 00244*
440     00220GT 00247*
45      00025RD 00071*
450     00252DO 00253*
460     00247DO 00249DO 00255GT 00257*
470     00226GT 00246GT 00258*
480     00261DO 00262DO 00265GT 00267*
490     00266GT 00268*
50      00082DO 00083*
500     00272WR 00273*
510     00276DO 00277*
520     00275GT 00278*
530     00281DO 00283*
540     00286GT 00284*
550     00285DO 00287*
560     00290DO 00292*
570     00289GT 00293*
580     00296DO 00297*
590     00295GT 00298*
60      00087DO 00084*
600     00299DO 00300*
610     00303DO 00305*
620     00302GT 00306*
630     00309DO 00311*
640     00308GT 00312*
650     00315WR 00316*  00319WR 00325WR 00326WR 00331WR 00337WR
660     00318GT 00322*
670     00314GT 00324*
680     00321GT 00323* 00325*
690     00330GT 00334*
70      00086DO 00087*
700     00327GT 00335*
710     00333GT 00335GT 00337*
80      00079GT 00089*
90      00094WR 00095*  00109WR 00113WR 00120WR 00141WR 00153WR 00158WR
        00159WR 00179WR 00192WR 00199WR 00212WR 00222WR 00243WR 00253WR
        00263WR 00268WR
```

```
      C       BLOCK 10 - CLOSED LOOP SYSTEM PERFORMANCE ANALYSIS
00001         DIMENSION FNAME(4),TTLNEW(5)
      C          INPUT MATRIX ARRAYS
00002         DIMENSION GM(15,15),QD(5),A(30,30),TZ(15,15),RD(15),
     +                BF(15,15),HR(30,15),DF(5,15),H(15,15),CF(5,15)
      C          OUTPUT MATRIX ARRAYS
00003         DIMENSION CV(30,30),CM(30,30),COVYU(35,35)
      C          WORKING SPACE
00004         DIMENSION DUMMY(35,35),ARRAY(900),IARRAY(900),QM(30,30),
     +                QV(30,30),E(30,30),XF(30,30),TR(35),YU(35,30),
     +                SCALE(30)
      C          EQUIVALENCES
00005         EQUIVALENCE (YU,A,ARRAY,IARRAY),(COVYU,XF),(COVYU(26,26),TZ),
     +                (COVYU(1,32),DF),(QV,QM),(DUMMY,E,HR),(H,BF),
     +                (TZ,CF),(GM,XF),(SCALE,RD)
00006         COMMON/NONAME/ NDIM
      C          DATA
00007         DATA IIN,IOUT,IPFIN,IPFOUT /5,7,20,21/
00008         DATA LASTID,TTLNEW,II,RP,I900 /120,' "" ',4*' ',1,0.,900/
      C          READ FILE NAMES
00009         WRITE(IOUT,10)
00010 10      FORMAT(2X,'STOCHASTIC PERFORMANCE ANALYSIS - BLOCK 10',
     +       /,2X,'INPUT PROBLEM FILE NAME ? ',$)
00011         READ(IIN,20) (FNAME(I),I=1,4)
00012         CALL ASSIGN(IPFIN,FNAME)
00013         WRITE(IOUT,12)
00014 12      FORMAT(2X,'OUTPUT PROBLEM FILE NAME ? ',$)
00015         READ(IIN,20) (FNAME(I),I=1,4)
00016         CALL ASSIGN(IPFOUT,FNAME)
00017 20      FORMAT(5A4)
      C          READ AND WRITE PROBLEM FILE
00018         CALL RENR(IPFIN,IPFOUT,TTLNEW,I900,LASTID,ARRAY,IARRAY)
00019         REWIND IPFIN
      C          READ THE FOLLOWING FROM THE PROBLEM FILE:
      C            DIMENSIONS   IDEN=2
      C            GM MATRIX    IDEN=25
      C            TZ MATRIX    IDEN=35
      C            QD VECTOR    IDEN=50
      C            RD VECTOR    IDEN=51
      C            DIMENSIONS   IDEN=54
      C            BF MATRIX    IDEN=117
      C            A MATRIX     IDEN=120
00020         DO 30 K=1,200
00021         READ(IPFIN,END=40) IDEN
00022         IF(IDEN.EQ.1) READ(IPFIN) IDEN,NXS,NXC,NU,NM,NZ,NYS,NYO
00024         IF(IDEN.EQ.25) READ(IPFIN) IDEN,NX,NY,((GM(I,J),J=1,NY),I=1,NX)
00026         IF(IDEN.EQ.34) READ(IPFIN) IDEN,NX,NY,((TZ(I,J),J=1,NY),I=1,NX)
00028         IF(IDEN.EQ.49) READ(IPFIN) IDEN,NX,(QD(I),I=1,NX)
00030         IF(IDEN.EQ.50) READ(IPFIN) IDEN,NX,(RD(I),I=1,NX)
00032         IF(IDEN.EQ.53) READ(IPFIN) IDEN,M1,M1P,M2,M2P
00034         IF(IDEN.EQ.116) READ(IPFIN) IDEN,NX,NY,((BF(I,J),J=1,NY),I=1,NX)
00036         IF(IDEN.EQ.119) READ(IPFIN) IDEN,NX,NY,((A(I,J),J=1,NY),I=1,NX)
00038 30      CONTINUE
00039 40      REWIND IPFIN
```

```
00040          NXT=NXS+NXC
00041          NW=NW-NXC
00042          NTOT=NXT+M1P
00043          IDEN=LASTID
               C                          (GM)
               C     COMPOSE QW = (  ) QD (GMT  0), SOLVE FOR CW AND WRITE
               C                          (0 )
00044          DO 670 I=1,NTOT
00045          DO 670 J=1,NTOT
00046 670      QW(I,J)=0.
00047          IF(NW.EQ.0) GO TO 700
00049          DO 690 I=1,NXT
00050          DO 690 J=1,NXT
00051          DUM=0.
00052          DO 680 K=1,NW
00053 680      DUM=DUM+GM(I,K)*GM(J,K)*QD(K)
00054 690      QW(I,J)=DUM
00055          NDIM=30
00056          CALL LINEQ1(NDIM,NTOT,A,QW,CW,E,XF,TR,SCALE)
00057 700      IDEN=IDEN+1
00058          IF(NW.EQ.0) GO TO 705
00060          WRITE(IPFOUT) IDEN,NTOT,NTOT,((CW(I,J),J=1,NTOT),I=1,NTOT)
00061          DO 704 I=1,NTOT
00062 704      TR(I)=SQRT(CW(I,I))
00063          IDEN=IDEN+1
00064          WRITE(IPFOUT) IDEN,NTOT,(TR(I),I=1,NTOT)
00065          GO TO 708
00066 705      WRITE(IPFOUT) IDEN,I1,I1,R2
00067          IDEN=IDEN+1
00068          WRITE(IPFOUT) IDEN,I1,R0
               C                          (0 )
               C       COMPOSE QV =  (  ) TZI*RD*TZIT (J  BFT), SOLVE FOR CV AND WRITE
               C                          (BF)
00069 708      DO 710 I=1,NTOT
00070          DO 710 J=1,NTOT
00071 710      QV(I,J)=0.
00072          IF(M1.EQ.0) GO TO 800
00074          DO 720 I=1,NZ
00075          DO 720 J=1,NZ
00076 720      DUMMY(I,J)=TZ(I,J)
00077          NDIM=35
00078          CALL GMINV(NZ,NZ,DUMMY,TZ,WR,J)
00079          DO 740 I=1,NZ
00080          DO 740 J=1,NZ
00081          DUM=0.
00082          DO 730 K=1,NZ
00083 730      DUM=DUM+TZ(I,K)*TZ(J,K)*RD(K)
00084 740      DUMMY(I,J)=DUM
00085          DO 750 I=1,NZ
00086          DO 750 J=1,NZ
00087 750      TZ(I,J)=DUMMY(I,J)
00088          DO 770 I=1,M1P
00089          DO 770 J=1,NZ
00090          DUM=0.
```

```
00091          DO 760 K=1,NZ
00092  760     DUM=DUM+BF(I,K)*TZ(K,J)
00093  770     DUMMY(I,J)=DUM
00094          DO 790 I=1,M1P
00095          II=I+NXT
00096          DO 790 J=1,M1P
00097          JJ=J+NXT
00098          DUM=0.
00099          DO 780 K=1,NZ
00100  780     DUM=DUM+DUMMY(I,K)*BF(J,K)
00101  790     QV(II,JJ)=DUM
00102  800     NDIM=30
00103          CALL LINEQ1(NDIM,NTOT,A,QV,CV,E,XF,TR,SCALE)
00104          IDEN=IDEN+1
00105          WRITE(IPFOUT) IDEN,NTOT,NTOT,((CV(I,J),J=1,NTOT),I=1,NTOT)
00106          DO 804 I=1,NTOT
00107  804     TR(I)=SQRT(CV(I,I))
00108          IDEN=IDEN+1
00109          WRITE(IPFOUT) IDEN,NTOT,(TR(I),I=1,NTOT)
       C          WRITE COV=CV+CV
00110          IDEN=IDEN+1
00111          DO 810 I=1,NTOT
00112          DO 810 J=1,NTOT
00113          IF(NV.EQ.0.AND.M1P.NE.0) CV(I,J)=CV(I,J)
00115          IF(NV.NE.0.AND.M1P.EQ.0) CV(I,J)=CV(I,J)
00117          IF(NV.EQ.0.AND.M1P.EQ.0) GO TO 815
00119          IF(NV.NE.0.AND.M1P.NE.0) CV(I,J)=CV(I,J)+CV(I,J)
00121  810     CONTINUE
00122          WRITE(IPFOUT) IDEN,NTOT,NTOT,((CV(I,J),J=1,NTOT),I=1,NTOT)
00123          DO 812 I=1,NTOT
00124  812     TR(I)=SQRT(CV(I,I))
00125          IDEN=IDEN+1
00126          WRITE(IPFOUT) IDEN,NTOT,(TR(I),I=1,NTOT)
00127          GO TO 818
00128  815     WRITE(IPFOUT) IDEN,II,II,R0
00129          IDEN=IDEN+1
00130          WRITE(IPFOUT) IDEN,II,R0
00131  818     CONTINUE
00132          LASTID=IDEN
       C          READ THE FOLLOWING FROM THE PROBLEM FILE:
       C            H MATRIX   IDEN=27
       C            HR MATRIX  IDEN=28
       C            CF MATRIX  IDEN=117
       C            DF MATRIX  IDEN=119
00133          DO 819 K=1,200
00134          READ(IPFIN,END=820) IDEN
00135          IF(IDEN.EQ.26) READ(IPFIN) IDEN,NX,NY,((H(I,J),J=1,NY),I=1,NX)
00137          IF(IDEN.EQ.27) READ(IPFIN) IDEN,NX,NY,((HR(I,J),J=1,NY),I=1,NX)
00139          IF(IDEN.EQ.117) READ(IPFIN) IDEN,NX,NY,((CF(I,J),J=1,NY),I=1,NX)
00141          IF(IDEN.EQ.118) READ(IPFIN) IDEN,NX,NY,((DF(I,J),J=1,NY),I=1,NX)
00143  819     CONTINUE
00144  820     IDEN=LASTID
       C                        ( HR    0)
       C          FORM YU = (          )
```

```
      C                    (DF*H  CF)
00145          DO 825 I=1,NZ+NYO+NU
00146          DO 825 J=1,NXT+M1P
00147  825     YU(I,J)=0.
00148          DO 830 I=1,NZ+NYO
00149          DO 830 J=1,NXT
00150          YU(I,J)=HR(I,J)
00151  830     IF(NU.EQ.0) GO TO 870
00153          DO 850 I=1,NU
00154          II=I+NZ+NYO
00155          DO 850 J=1,NXT
00156          DUM=0.
00157          DO 840 K=1,NZ
00158  840     DUM=DUM+DF(I,K)*H(K,J)
00159  850     YU(II,J)=DUM
00160          IF(M1P.EQ.0) GO TO 870
00162          DO 860 I=1,NU
00163          II=I+NZ+NYO
00164          DO 860 J=1,M1P
00165          JJ=J+NXT
00166  860     YU(II,JJ)=CF(I,J)
      C          COMPUTE COVYU = YU*(CV+CV)*YUT AND WRITE
00167  870     DO 890 I=1,NZ+NYO+NU
00168          DO 890 J=1,NXT+M1P
00169          DUM=0.
00170          DO 880 K=1,NXT+M1P
00171  880     DUM=DUM+YU(I,K)*CV(K,J)
00172  890     DUMMY(I,J)=DUM
00173          DO 910 I=1,NZ+NYO+NU
00174          DO 910 J=1,NZ+NYO+NU
00175          DUM=0.
00176          DO 900 K=1,NXT+M1P
00177  900     DUM=DUM+DUMMY(I,K)*YU(J,K)
00178  910     COVYU(I,J)=DUM
00179          IDEN=IDEN+1
00180          NTOT=NZ+NYO+NU
00181          WRITE(IPFOUT) IDEN,NTOT,NTOT,((COVYU(I,J),J=1,NTOT),I=1,NTOT)
00182          DO 920 I=1,NTOT
00183          TR(I)=0.
00184          IF(COVYU(I,I).GT.0.) TR(I)=SQRT(COVYU(I,I))
00185  920     CONTINUE
00187          IDEN=IDEN+1
00188          WRITE(IPFOUT) IDEN,NTOT,(TR(I),I=1,NTOT)
00189          DO 940 I=1,NTOT
00190          DO 940 J=1,NTOT
00191          IF(TR(I).EQ.0.) GO TO 930
00193          COVYU(I,J)=COVYU(I,J)/(TR(I)*TR(J))
00194          GO TO 940
00195  930     COVYU(I,J)=0.
00196          COVYU(J,I)=0.
00197          COVYU(I,I)=1.
00198  940     CONTINUE
00199          IDEN=IDEN+1
00200          WRITE(IPFOUT) IDEN,NTOT,NTOT,((COVYU(I,J),J=1,NTOT),I=1,NTOT)
```

```
0001        DO 950 I=IDEN+1,130
0002 950    WRITE(IPFOUT) IDEN,I1,I1,R0
     C        THE END
0003        STOP
0004        END
```

```
A        00002DI 00005EQ 00037RD 00056AG 00103AG
ARRAY    00004DI 00005EQ 00018AG
ASSIGN   00012CL 00016CL
BF       00002DI 00005EQ 00035RD 00092   00100
CF       00002DI 00005EQ 00140RD 00166
CONVU    00003DI 00005EQ 00178=  00181WR 00184IF 00185   00193=  00195=
         00196=  00197=  00200WR
CV       00003DI 00103AG 00109WR 00107   00114=  00116=  00120=  00122WR
         00124   00171
CW       00003DI 00056AG 00060WR 00062   00116   00120
DF       00002DI 00005EQ 00142RD 00152
DUM      00051=  00053=  00054   00081=  00083=  00084   00091=  00092=
         00093   00099=  00100=  00101   00156=  00158=  00159   00169=
         00171=  00172   00175=  00177=  00178
DUMMY    00004DI 00005EQ 00075=  00078AG 00084=  00087   00093=  00100
         00172=  00177
E        00004DI 00005EQ 00056AG 00103AG
FNAME    00001DI 00011RD 00012AG 00015RD 00016AG
G4       00002DI 00005EQ 00025RD 00053
GAINV    00070CL
H        00002DI 00005EQ 00139RD 00159
HR       00002DI 00005EQ 00139RD 00150
I        00011RD 00015RD 00025RD 00027RD 00029RD 00031RD 00035RD 00037RD
         00044DO 00046   00049DO 00053   00054   00056WR 00061DO 00062
         00064WR 00069DO 00071   00074DO 00076   00079DO 00083   00084
         00085DO 00087   00089DO 00092   00093   00094DO 00095   00100
         00108WR 00110DO 00107   00109WR 00111DO 00114   00116   00120
         00122WR 00123DO 00124   00129WR 00136RD 00138RD 00140RD 00142RD
         00145DO 00147   00148DO 00150   00153DO 00154   00159   00162DO
         00163   00166   00167DO 00171   00172   00173DO 00177   00178
         00181WR 00182DO 00183   00184IF 00185   00188WR 00189DO 00191IF
         00193   00195   00196   00197   00200WR 00201DO
IARRAY   00004DI 00005EQ 00019AG
IDEN     00021RD 00022IF 00023RD 00024IF 00025RD 00026IF 00027RD 00028IF
         00029RD 00030IF 00031RD 00032IF 00033RD 00034IF 00035RD 00036IF
         00037RD 00043=  00057=  00060WR 00063=  00064WR 00065WR 00067=
         00069WR 00104=  00105WR 00108=  00109WR 00110=  00122WR 00125=
         00128WR 00129WR 00129=  00130WR 00132   00134RD 00135IF 00136RD
         00137IF 00139RD 00139IF 00140RD 00141IF 00142RD 00144=  00179=
         00180WR 00187=  00188WR 00199=  00200WR 00201DO 00202WR
II       00095=  00101   00154=  00159   00163=  00166
IIN      00007DA 00011RD 00015RD
IOUT     00007DA 00009WR 00013WR
IPFIN    00007DA 00012AG 00018AG 00019RD 00021RD 00023RD 00025RD 00027RD
         00029RD 00031RD 00033RD 00035RD 00037RD 00039RD 00136RD 00138RD
         00138RD 00140RD 00142RD
IPFOUT   00007DA 00017AG 00018AG 00055WR 00056WR 00060WR 00105WR 00109WR
         00109WR 00122WR 00129WR 00120WR 00130WR 00181WR 00188WR 00200WR
         00202WR
I1       00002DA 00055WR 00059WR 00128WR 00130WR 00202WR
I900     00003DA 00019AG
J        00025RD 00027RD 00035RD 00037RD 00045DO 00046   00050DO 00053
         00054   00056WR 00070DO 00071   00075DO 00076   00080DO 00083
         00084   00085DO 00087   00089DO 00092   00093   00095DO 00097
```

```
         00100   00105WR 00112DO 00114   00116   00120   00122WR 00136RD
         00138RD 00140RD 00142RD 00146DO 00147   00149DO 00150   00155DO
         00158   00159   00164DO 00165   00166   00168DO 00171   00172
         00174DO 00177   00178   00181WR 00190DO 00193   00195   00196
         00220WR
JJ       00097=  00101   00165=  00166
K        00020DO 00052DO 00053   00082DO 00083   00091DO 00092   00099DO
         00100   00133DO 00157DO 00158   00170DO 00171   00176DO 00177
LASTID   00008DA 00018AG 00043   00132=  00144
LINEQI   00056CL 00103CL
MR       00070AG
M1       00033RD 00072IF
M1P      00033RD 00042   00088DO 00094DO 00096DO 00113IF 00115IF 00117IF
         00119IF 00145DO 00160IF 00164DO 00168DO 00170DO 00176DO
M2       00033RD
M2P      00033RD
NDIM     00005CM 00055=  00055AG 00077=  00102=  00103AG
NONAME   00005CN
NTOT     00042=  00044DO 00045DO 00056AG 00056WR 00061DO 00064WR 00069DO
         00070DO 00103AG 00105WR 00106DO 00109WR 00111DO 00112DO 00122WR
         00123DO 00123WR 00180=  00181WR 00182DO 00188WR 00189DO 00190DO
         00220WR
NU       00023RD 00145DO 00151IF 00153DO 00162DO 00167DO 00173DO 00174DO
         00180
NW       00023RD 00041=  00047IF 00052DO 00058IF 00113IF 00115IF 00117IF
         00119IF
NX       00025RD 00027RD 00029RD 00031RD 00035RD 00037RD 00136RD 00138RD
         00140RD 00142RD
NXC      00023RD 00040   00041
NXS      00023RD 00040
NXT      00040=  00042   00049DO 00050DO 00095   00097   00146DO 00149DO
         00155DO 00165   00168DO 00170DO 00176DO
NY       00025RD 00027RD 00035RD 00037RD 00136RD 00138RD 00140RD 00142RD
NYO      00023RD 00145DO 00148DO 00154   00163   00167DO 00173DO 00174DO
         00180
NYS      00023RD
NZ       00023RD 00074DO 00075DO 00078AG 00079DO 00080DO 00082DO 00085DO
         00086DO 00089DO 00091DO 00099DO 00145DO 00148DO 00154   00157DO
         00163   00167DO 00173DO 00174DO 00180
QD       00002DI 00029RD 00053
QV       00004DI 00005EQ 00071=  00101=  00103AG
QW       00004DI 00005EQ 00046=  00054=  00056AG
RD       00002DI 00005EQ 00031RD 00093
RDWR     00010CL
RO       00008DA 00053WR 00058WR 00128WR 00130WR 00202WR
SCALE    00004DI 00005EQ 00056AG 00103AG
SQRT     00052   00107   00124   00185
TR       00004DI 00056AG 00052=  00054WR 00103AG 00107=  00109WR 00124=
         00128WR 00183=  00185=  00188WR 00191IF 00193
TTLNEW   00001DI 00008DA 00018AG
TZ       00002DI 00005EQ 00027RD 00076   00078AG 00083   00087=  00092
XF       00004DI 00005EQ 00056AG 00103AG
YU       00004DI 00005EQ 00147=  00150=  00159=  00166=  00171   00177
IJ       00009WR 00010*
```

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12      00013NR 00014*
20      00011RD 00015RD 00017*
30      00020DO 00038*
40      00021RD 00039*
670     00044DO 00045DO 00046*
680     00052DO 00053*
690     00049DO 00050DO 00054*
700     00040GT 00057*
704     00061DO 00062*
705     00059GT 00066*
708     00068GT 00069*
710     00039DO 00073DO 00071*
720     00074DO 00075DO 00076*
730     00082DO 00083*
740     00079DO 00088DO 00084*
750     00085DO 00086DO 00087*
760     00091DO 00092*
770     00088DO 00089DO 00093*
780     00099DO 00103*
790     00094DO 00096DO 00101*
800     00073GT 00102*
804     00106DO 00107*
810     00111DO 00112DO 00121*
812     00123DO 00124*
815     00118GT 00128*
818     00127GT 00131*
819     00133DO 00143*
820     00134RD 00144*
825     00145DO 00146DO 00147*
830     00149DO 00148DO 00151*
840     00157DO 00158*
850     00153DO 00155DO 00159*
860     00162DO 00164DO 00166*
870     00152GT 00160GT 00167*
880     00170DO 00171*
890     00156DO 00169DO 00172*
900     00176DO 00177*
910     00173DO 00174DO 00178*
920     00182DO 00186*
930     00192GT 00195*
940     00169DO 00190DO 00194GT 00198*
950     00201DO 00202*
```

```
      C        ROUTINE TO READ PROBLEM FILE AND FORMAT
      C        THE DATA FOR HARD COPY
00001         DIMENSION RARRAY(35,35),CARRAY(35,15),CLABEL(35),RLABEL(35)
00002         COMPLEX CMPRAY(15,15),BARRAY(15)
00003         REAL*8 DBLANK,XDATE(2),XTIME
00004         COMMON/IO/ IIN,IKB
00005         DATA BLANK /' '/,DBLANK /' '/
00006         DATA IIN,IOUT,IFIN,IFOUT /5,7,20,21/
      C        GET FILENAME FOR PROBLEM FILE
00007         NDIM=35
00008         IKB=24
00009         CALL ASSIGN(IKB,'KB:/C')
      C       CALL DATE(XDATE)
      C       CALL TIME(XTIME)
      C       WRITE(IKB,5) (XDATE(I),I=1,2),XTIME
      C5      FORMAT(20X,A8,A1,5X,A8,/)
      C       REWIND IKB
00010         WRITE(IOUT,10)
00011 10      FORMAT(5X,'PROBLEM FILE NAME ? ',$)
00012         READ(IIN,20) (CLABEL(I),I=1,4)
00013 20      FORMAT(4A4)
00014         CALL ASSIGN(IFIN,CLABEL)
00015         DO 25 K=1,200
00016         READ(IFIN,END=26) IDEN
00017         IF(IDEN.EQ.1) READ(IFIN) IDEN,NXS,NXC,NU,NW,NZ,NYS,NYO
00019         IF(IDEN.EQ.53) READ(IFIN) IDEN,M1,M1P,M2,M2P
00021 25      CONTINUE
00022 26      REWIND IFIN
00023         NXT=NXS+NXC
00024         NZT=NZ+NYO
      C        GET INDICES OF ELEMENTS TO BE LISTED
00025         WRITE(IOUT,30)
00026 30      FORMAT(5X,'INPUT INDEX OF EACH ELEMENT TO BE LISTED',/,
     +    5X,'ONE PER LINE - LAST INDEX SHOULD BE 0')
00027 40      READ(IIN,50) IX
00028 50      FORMAT(I3)
00029         IF(IX.EQ.0) GO TO 3000
      C        FORMAT THE LISTING
00031         REWIND IFIN
00032         GO TO (65,70,90,90,90,90,90,90,90,90,90,90,100,120,140,160,
     +  180,200,220,240,260,280,300,320,340,360,380,400,420,440,460,
     +  90,90,90,480,500,500,540,560,580,600,620,640,660,680,700,
     +  720,740,760,780,800,820,840,80,900,900,920,940,960,980,
     +  1000,1020,1040,1060,1080,1100,1100,1140,1160,1180,1200,
     +  1220,1240,1200,1220,1240,1200,1220,1240,1200,1220,1240,1200,
     +  1220,1240,1200,1220,1240,1200,1220,1240,1200,1220,1240,1200,
     +  1220,1240,1200,1220,1240,1200,1220,1240,1200,1220,1240,1200,
     +  1220,1240,1200,1220,1240,1200,1220,1240,1260,1280,1300,1320,
     +  1340,1340,1360,1340,1360,1340,1360,1380,1400,1380),IX
      C        TITLE
00033 65      READ(IFIN) IDEN,NX,(CLABEL(I),I=1,NX)
00034         WRITE(IKB,68) (CLABEL(I),I=1,NX)
00035 68      FORMAT(5X,'***** ',5A4,10(/,5X,5A4)/)
00036         GO TO 40
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      C       DIMENSIONS
00037 70    WRITE(IKB,75) NXS,NXC,NU,NW,NZ,NYS,NYO
00038 75    FORMAT(5X,'VECTOR DIMENSIONS : '/,
     +   7X,'NXS =',I3,' NXC =',I3,' NU =',I3,' NW =',I3,
     +       ' NZ =',I3,' NYS =',I3,' NYO =',I3/)
00039       GO TO 40
00040 80    WRITE(IKB,85) M1,M2,M1P
00041 85    FORMAT(5X,'MEASUREMENT PARTITION : M1 = ',I3,' M2 = ',I3,/,
     +       5X,'NUMBER OF FILTER STATES : M1P = ',I3,/)
00042       GO TO 40
      C       MNEMONICS
00043 90    DO 98 L=1,IX
00044       READ(IFIN) IDEN
00045       IF(IDEN.NE.IX-1) GO TO 98
00047       READ(IFIN) IDEN,NX,(CLABEL(I),I=1,NX)
00048       WRITE(IKB,95) (CLABEL(I),I=1,NX)
00049 95    FORMAT(5X,15A4/)
00050 98    CONTINUE
00051       GO TO 40
      C       MATRICES
00052 100   CONTINUE
00053       IF(NXS.EQ.0.OR.NW.EQ.0) GO TO 1950
00055       DO 110 L=1,IX
00056       READ(IFIN) IDEN
00057       IF(IDEN.EQ.3) READ(IFIN) IDEN,NX,(CLABEL(I),I=1,NX)
00059       IF(IDEN.EQ.10) READ(IFIN) IDEN,NX,(RLABEL(I),I=1,NX)
00061       IF(IDEN.EQ.12) READ(IFIN) IDEN,NX,NY,((RARRAY(I,J),J=1,NY),I=1,NX)
00063 110   CONTINUE
00064       CALL MATLIS(13,'GAMMAS MATRIX',NDIM,NXS,NW,RLABEL,CLABEL,RARRAY,
     +           CARRAY,0)
00065       GO TO 40
00066 120   CONTINUE
00067       IF(NXS.EQ.0) GO TO 1950
00069       DO 130 L=1,IX
00070       READ(IFIN) IDEN
00071       IF(IDEN.EQ.10) READ(IFIN) IDEN,NX,(CLABEL(I),I=1,NX)
00073       IF(IDEN.EQ.13) READ(IFIN) IDEN,NX,NY,((RARRAY(I,J),J=1,NY),I=1,NX)
00075 130   CONTINUE
00076       CALL MATLIS(9,'PS MATRIX',NDIM,NXS,NXS,CLABEL,CLABEL,RARRAY,
     +           CARRAY,P)
00077       GO TO 40
00078 140   CONTINUE
00079       IF(NYS.EQ.0.OR.NXS.EQ.0) GO TO 1950
00081       DO 150 L=1,IX
00082       READ(IFIN) IDEN
00083       IF(IDEN.EQ.4) READ(IFIN) IDEN,NX,(RLABEL(I),I=1,NX)
00085       IF(IDEN.EQ.10) READ(IFIN) IDEN,NX,(CLABEL(I),I=1,NX)
00087       IF(IDEN.EQ.14) READ(IFIN) IDEN,NX,NY,((RARRAY(I,J),J=1,NY),I=1,NX)
00089 150   CONTINUE
00090       CALL MATLIS(9,'HS MATRIX',NDIM,NYS,NXS,RLABEL,CLABEL,RARRAY,
     +           CARRAY,0)
00091       GO TO 40
00092 160   CONTINUE
00093       IF(NXC.EQ.0.OR.NW.EQ.0) GO TO 1950
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00095          DO 170 L=1,IX
00096          READ(IFIN) IDEN
00097          IF(IDEN.EQ.3) READ(IFIN) IDEN,NX,(CLABEL(I),I=1,NX)
00099          IF(IDEN.EQ.11) READ(IFIN) IDEN,NX,(RLABEL(I),I=1,NX)
00101          IF(IDEN.EQ.15) READ(IFIN) IDEN,NX,NY,((RARRAY(I,J),J=1,NY),I=1,NX)
00103 170      CONTINUE
00104          CALL MATLIS(13,'GAMMAC MATRIX',NDIM,NXC,NN,RLABEL,CLABEL,RARRAY,
              +                CARRAY,0)
00105          GO TO 40
00106 180      CONTINUE
00107          IF(NXC.EQ.0.OR.NU.EQ.0) GO TO 1950
00109          DO 190 L=1,IX
00110          READ(IFIN) IDEN
00111          IF(IDEN.EQ.2) READ(IFIN) IDEN,NX,(CLABEL(I),I=1,NX)
00113          IF(IDEN.EQ.11) READ(IFIN) IDEN,NX,(RLABEL(I),I=1,NX)
00115          IF(IDEN.EQ.16) READ(IFIN) IDEN,NX,NY,((RARRAY(I,J),J=1,NY),I=1,NX)
00117 190      CONTINUE
00118          CALL MATLIS(9,'GC MATRIX',NDIM,NXC,NU,RLABEL,CLABEL,RARRAY,
              +                CARRAY,0)
00119          GO TO 40
00120 200      CONTINUE
00121          IF(NXC.EQ.0.OR.NYS.EQ.0) GO TO 1950
00123          DO 210 L=1,IX
00124          READ(IFIN) IDEN
00125          IF(IDEN.EQ.4) READ(IFIN) IDEN,NX,(CLABEL(I),I=1,NX)
00127          IF(IDEN.EQ.11) READ(IFIN) IDEN,NX,(RLABEL(I),I=1,NX)
00129          IF(IDEN.EQ.17) READ(IFIN) IDEN,NX,NY,((RARRAY(I,J),J=1,NY),I=1,NX)
00131 210      CONTINUE
00132          CALL MATLIS(9,'CC MATRIX',NDIM,NXC,NYS,RLABEL,CLABEL,RARRAY,
              +                CARRAY,0)
00133          GO TO 40
00134 220      CONTINUE
00135          IF(NXC.EQ.0) GO TO 1950
00137          DO 230 L=1,IX
00138          READ(IFIN) IDEN
00139          IF(IDEN.EQ.11) READ(IFIN) IDEN,NX,(RLABEL(I),I=1,NX)
00141          IF(IDEN.EQ.18) READ(IFIN) IDEN,NX,NY,((RARRAY(I,J),J=1,NY),I=1,NX)
00143 230      CONTINUE
00144          CALL MATLIS(9,'FC MATRIX',NDIM,NXC,NXC,RLABEL,RLABEL,RARRAY,
              +                CARRAY,0)
00145          GO TO 40
00146 240      CONTINUE
00147          IF(NZ.EQ.0.OR.NXC.EQ.0) GO TO 1950
00149          DO 250 L=1,IX
00150          READ(IFIN) IDEN
00151          IF(IDEN.EQ.9) READ(IFIN) IDEN,NX,(RLABEL(I),I=1,NX)
00153          IF(IDEN.EQ.11) READ(IFIN) IDEN,NX,(CLABEL(I),I=1,NX)
00155          IF(IDEN.EQ.19) READ(IFIN) IDEN,NX,NY,((RARRAY(I,J),J=1,NY),I=1,NX)
00157 250      CONTINUE
00158          CALL MATLIS(9,'HM MATRIX',NDIM,NZ,NXC,RLABEL,CLABEL,RARRAY,
              +                CARRAY,0)
00159          GO TO 40
00160 260      CONTINUE
00161          IF(NZ.EQ.0.OR.NYS.EQ.0) GO TO 1950
```

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00163          DO 270 L=1,IX
00164          READ(IFIN) IDEN
00165          IF(IDEN.EQ.4) READ(IFIN) IDEN,NX,(CLABEL(I),I=1,NX)
00167          IF(IDEN.EQ.9) READ(IFIN) IDEN,NX,(RLABEL(I),I=1,NX)
00169          IF(IDEN.EQ.20) READ(IFIN) IDEN,NX,NY,((RARRAY(I,J),J=1,NY),I=1,NX)
00171 270      CONTINUE
00172          CALL MATLIS(9,'FM MATRIX',NDIM,NZ,NYS,RLABEL,CLABEL,RARRAY,
              +            CARRAY,0)
00173          GO TO 40
00174 280      CONTINUE
00175          IF(NYO.EQ.0.OR.NXC.EQ.0) GO TO 1950
00177          DO 290 L=1,IX
00178          READ(IFIN) IDEN
00179          IF(IDEN.EQ.8) READ(IFIN) IDEN,NX,(RLABEL(I),I=1,NX)
00181          IF(IDEN.EQ.11) READ(IFIN) IDEN,NX,(CLABEL(I),I=1,NX)
00183          IF(IDEN.EQ.21) READ(IFIN) IDEN,NX,NY,((RARRAY(I,J),J=1,NY),I=1,NX)
00185 290      CONTINUE
00186          CALL MATLIS(9,'HO MATRIX',NDIM,NYO,NXC,RLABEL,CLABEL,RARRAY,
              +            CARRAY,0)
00187          GO TO 40
00188 300      CONTINUE
00189          IF(NYO.EQ.0.OR.NYS.EQ.0) GO TO 1950
00191          DO 310 L=1,IX
00192          READ(IFIN) IDEN
00193          IF(IDEN.EQ.4) READ(IFIN) IDEN,NX,(CLABEL(I),I=1,NX)
00195          IF(IDEN.EQ.8) READ(IFIN) IDEN,NX,(RLABEL(I),I=1,NX)
00197          IF(IDEN.EQ.22) READ(IFIN) IDEN,NX,NY,((RARRAY(I,J),J=1,NY),I=1,NX)
00199 310      CONTINUE
00200          CALL MATLIS(  'FO MATRIX',NDIM,NX,NYS,RLABEL,CLABEL,RARRAY,
              +            RRAY,0)
00201          GO TO 40
```

```
00202 320   CONTINUE
00203       IF(NXT.EQ.0) GO TO 1950
00205       DO 330 L=1,IX
00206       READ(IFIN) IDEN
00207       IF(IDEN.EQ.10) READ(IFIN) IDEN,NX,(RLABEL(I),I=1,NX)
00209       IF(IDEN.EQ.11) READ(IFIN) IDEN,NY,(RLABEL(I),I=1+NXS,NXS+NY)
00211       IF(IDEN.EQ.23) READ(IFIN) IDEN,NX,NY,((RARRAY(I,J),J=1,NY),I=1,NX)
00213 330   CONTINUE
00214       CALL MATLIS(8,'F MATRIX',NDIM,NXT,NXT,RLABEL,RLABEL,RARRAY,
           +            CARRAY,0)
00215       GO TO 40
00216 340   CONTINUE
00217       IF(NXT.EQ.0.OR.NU.EQ.0) GO TO 1950
00219       DO 350 L=1,IX
00220       READ(IFIN) IDEN
00221       IF(IDEN.EQ.2) READ(IFIN) IDEN,NX,(CLABEL(I),I=1,NX)
00223       IF(IDEN.EQ.10) READ(IFIN) IDEN,NX,(RLABEL(I),I=1,NX)
00225       IF(IDEN.EQ.11) READ(IFIN) IDEN,NY,(RLABEL(I),I=1+NXS,NXS+NY)
00227       IF(IDEN.EQ.24) READ(IFIN) IDEN,NX,NY,((RARRAY(I,J),J=1,NY),I=1,NX)
00229 350   CONTINUE
00230       CALL MATLIS(8,'G MATRIX',NDIM,NXT,NY,RLABEL,CLABEL,RARRAY,
           +            CARRAY,0)
00231       GO TO 40
00232 360   CONTINUE
00233       IF(NXT.EQ.0.OR.NV.EQ.0) GO TO 1950
00235       DO 370 L=1,IX
00236       READ(IFIN) IDEN
00237       IF(IDEN.EQ.3) READ(IFIN) IDEN,NX,(CLABEL(I),I=1,NX)
00239       IF(IDEN.EQ.10) READ(IFIN) IDEN,NX,(RLABEL(I),I=1,NX)
00241       IF(IDEN.EQ.11) READ(IFIN) IDEN,NY,(RLABEL(I),I=1+NXS,NXS+NY)
00243       IF(IDEN.EQ.25) READ(IFIN) IDEN,NX,NY,((RARRAY(I,J),J=1,NY),I=1,NX)
00245 370   CONTINUE
00246       CALL MATLIS(12,'GAMMA MATRIX',NDIM,NXT,NV,RLABEL,CLABEL,RARRAY,
           +            CARRAY,0)
00247       GO TO 40
00248 380   CONTINUE
00249       IF(NZ.EQ.0.OR.NXT.EQ.0) GO TO 1950
00251       DO 390 L=1,IX
00252       READ(IFIN) IDEN
00253       IF(IDEN.EQ.9) READ(IFIN) IDEN,NX,(RLABEL(I),I=1,NX)
00255       IF(IDEN.EQ.10) READ(IFIN) IDEN,NX,(CLABEL(I),I=1,NX)
00257       IF(IDEN.EQ.11) READ(IFIN) IDEN,NY,(CLABEL(I),I=1+NXS,NXS+NY)
00259       IF(IDEN.EQ.26) READ(IFIN) IDEN,NX,NY,((RARRAY(I,J),J=1,NY),I=1,NX)
00261 390   CONTINUE
00262       CALL MATLIS(8,'H MATRIX',NDIM,NZ,NXT,RLABEL,CLABEL,RARRAY,
           +            CARRAY,0)
00263       GO TO 40
00264 400   CONTINUE
00265       IF(NZT.EQ.0.OR.NXT.EQ.0) GO TO 1950
00267       DO 410 L=1,IX
00268       READ(IFIN) IDEN
00269       IF(IDEN.EQ.7) READ(IFIN) IDEN,NX,(RLABEL(I),I=1,NX)
00271       IF(IDEN.EQ.8) READ(IFIN) IDEN,NY,(RLABEL(I),I=1+NZ,NZ+NY)
00273       IF(IDEN.EQ.10) READ(IFIN) IDEN,NX,(CLABEL(I),I=1,NX)
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00275          IF(IDEN.EQ.11) READ(IFIN) IDEN,NY,(CLABEL(I),I=1+NXS,NXS+NY)
00277          IF(IDEN.EQ.27) READ(IFIN) IDEN,NX,NY,((RARRAY(I,J),J=1,NY),I=1,NX)
00279 410    CONTINUE
00280          CALL MATLIS(9,'HR MATRIX',NDIM,NZT,NXT,RLABEL,CLABEL,RARRAY,
              +                CARRAY,0)
00281          GO TO 40
00282 420    CONTINUE
00283          IF(NZT.EQ.0.OR.NYS.EQ.0) GO TO 1950
00285          DO 430 L=1,IX
00286          READ(IFIN) IDEN
00287          IF(IDEN.EQ.4) READ(IFIN) IDEN,NX,(CLABEL(I),I=1,NX)
00289          IF(IDEN.EQ.7) READ(IFIN) IDEN,NX,(RLABEL(I),I=1,NX)
00291          IF(IDEN.EQ.8) READ(IFIN) IDEN,NY,(RLABEL(I),I=1+NZ,NZ+NY)
00293          IF(IDEN.EQ.28) READ(IFIN) IDEN,NX,NY,((RARRAY(I,J),J=1,NY),I=1,NX)
00295 430    CONTINUE
00296          CALL MATLIS(9,'E1 MATRIX',NDIM,NZT,NYS,RLABEL,CLABEL,RARRAY,
              +                CARRAY,0)
00297          GO TO 40
00298 440    CONTINUE
00299          IF(NZ.EQ.0.OR.NYS.EQ.0) GO TO 1950
00301          DO 450 L=1,IX
00302          READ(IFIN) IDEN
00303          IF(IDEN.EQ.4) READ(IFIN) IDEN,NX,(CLABEL(I),I=1,NX)
00305          IF(IDEN.EQ.9) READ(IFIN) IDEN,NX,(RLABEL(I),I=1,NX)
00307          IF(IDEN.EQ.29) READ(IFIN) IDEN,NX,NY,((RARRAY(I,J),J=1,NY),I=1,NX)
00309 450    CONTINUE
00310          CALL MATLIS(9,'E2 MATRIX',NDIM,NZ,NYS,RLABEL,CLABEL,RARRAY,
              +                CARRAY,0)
00311          GO TO 40
00312 460    CONTINUE
00313          IF(NXT.EQ.0.OR.NYS.EQ.0) GO TO 1950
00315          DO 470 L=1,IX
00316          READ(IFIN) IDEN
00317          IF(IDEN.EQ.4) READ(IFIN) IDEN,NX,(CLABEL(I),I=1,NX)
00319          IF(IDEN.EQ.10) READ(IFIN) IDEN,NX,(RLABEL(I),I=1,NX)
00321          IF(IDEN.EQ.11) READ(IFIN) IDEN,NY,(RLABEL(I),I=1+NXS,NXS+NY)
00323          IF(IDEN.EQ.30) READ(IFIN) IDEN,NX,NY,((RARRAY(I,J),J=1,NY),I=1,NX)
00325 470    CONTINUE
00326          CALL MATLIS(9,'E3 MATRIX',NDIM,NXT,NYS,RLABEL,CLABEL,RARRAY,
              +                CARRAY,0)
00327          GO TO 40
00328 480    CONTINUE
00329          IF(NZ.EQ.0) GO TO 1950
00331          DO 490 L=1,IX
00332          READ(IFIN) IDEN
00333          IF(IDEN.EQ.32) READ(IFIN) IDEN,NX,(RLABEL(I),I=1,NX)
00335          IF(IDEN.EQ.34) READ(IFIN) IDEN,NX,NY,((RARRAY(I,J),J=1,NY),I=1,NX)
00337 490    CONTINUE
00338          CALL MATLIS(9,'TZ MATRIX',
              +      NDIM,NZ,NZ,RLABEL,RLABEL,RARRAY,CARRAY,0)
00339          GO TO 40
00340 500    CONTINUE
00341          IF(NXT.EQ.0) GO TO 1950
00343          DO 510 L=1,IX
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00344          READ(IFIN) IDEN
00345          IF(IDEN.EQ.10) READ(IFIN) IDEN,NX,(CLABEL(I),I=1,NX)
00347          IF(IDEN.EQ.11) READ(IFIN) IDEN,NY,(CLABEL(I),I=1+NXS,NXS+NY)
00349          IF(IDEN.EQ.33) READ(IFIN) IDEN,NX,(RLABEL(I),I=1,NX)
00351          IF(IDEN.EQ.IX-1) READ(IFIN) IDEN,NX,NY,((RARRAY(I,J),J=1,NY),
              +       I=1,NX)
00353 510      CONTINUE
00354          IF(IX.EQ.36) CALL MATLIS(8,'T MATRIX'
              +    ,NDIM,NXT,NXT,RLABEL,CLABEL,RARRAY,CARRAY,0)
00356          IF(IX.EQ.37) CALL MATLIS(9,'TI MATRIX'
              +    ,NDIM,NXT,NXT,CLABEL,RLABEL,RARRAY,CARRAY,0)
00358          GO TO 40
00359 540      CONTINUE
00360          IF(M1P.EQ.0) GO TO 1950
00362          DO 550 L=1,IX
00363          READ(IFIN) IDEN
00364          IF(IDEN.EQ.33) READ(IFIN) IDEN,NX,(RLABEL(I),I=1,NX)
00366          IF(IDEN.EQ.37) READ(IFIN) IDEN,NX,NY,((RARRAY(I,J),J=1,NY),I=1,NX)
00368 550      CONTINUE
00369          CALL MATLIS(10,'F11 MATRIX',NDIM,M1P,M1P,RLABEL,RLABEL,RARRAY,
              +    CARRAY,0)
00370          GO TO 40
00371 560      CONTINUE
00372          IF(M1P.EQ.0.OR.M2.EQ.0) GO TO 1950
00374          DO 570 L=1,IX
00375          READ(IFIN) IDEN
00376          IF(IDEN.EQ.33) READ(IFIN) IDEN,NX,(RLABEL(I),I=1,M1P),
              +     (CLABEL(I),I=1,M2)
00378          IF(IDEN.EQ.38) READ(IFIN) IDEN,NX,NY,((RARRAY(I,J),J=1,NY),I=1,NX)
00380 570      CONTINUE
00381          CALL MATLIS(10,'F12 MATRIX',NDIM,M1P,M2,RLABEL,CLABEL,RARRAY,
              +    CARRAY,0)
00382          GO TO 40
00383 580      CONTINUE
00384          IF(M2.EQ.0.OR.M1P.EQ.0) GO TO 1950
00386          DO 590 L=1,IX
00387          READ(IFIN) IDEN
00388          IF(IDEN.EQ.33) READ(IFIN) IDEN,NX,(CLABEL(I),I=1,M1P),
              +       (RLABEL(I),I=1,M2)
00390          IF(IDEN.EQ.39) READ(IFIN) IDEN,NX,NY,((RARRAY(I,J),J=1,NY),I=1,NX)
00392 590      CONTINUE
00393          CALL MATLIS(10,'F21 MATRIX',NDIM,M2,M1P,RLABEL,CLABEL,RARRAY,
              +    CARRAY,0)
00394          GO TO 40
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00395 600   CONTINUE
00396       IF(M2.EQ.0) GO TO 1950
00398       DO 610 L=1,IX
00399       READ(IFIN) IDEN
00400       IF(IDEN.EQ.33.AND.M1P.NE.0) READ(IFIN) IDEN,NX,(CLABEL(I),I=1,M1P)
           +      ,(RLABEL(I),I=1,M2)
00402       IF(IDEN.EQ.33.AND.M1P.EQ.0) READ(IFIN) IDEN,NX,
           +       (RLABEL(I),I=1,M2)
00404       IF(IDEN.EQ.40) READ(IFIN) IDEN,NX,NY,((RARRAY(I,J),J=1,NY),I=1,NX)
00405 610   CONTINUE
00407       CALL MATLIS(10,'F22 MATRIX',
           +     NDIM,M2,M2,RLABEL,RLABEL,RARRAY,CARRAY,0)
00408       GO TO 40
00409 620   CONTINUE
00410       IF(M1P.EQ.0.OR.NU.EQ.0) GO TO 1950
00412       DO 630 L=1,IX
00413       READ(IFIN) IDEN
00414       IF(IDEN.EQ.2) READ(IFIN) IDEN,NX,(CLABEL(I),I=1,NX)
00416       IF(IDEN.EQ.33) READ(IFIN) IDEN,NX,(RLABEL(I),I=1,NX)
00418       IF(IDEN.EQ.41) READ(IFIN) IDEN,NX,NY,((RARRAY(I,J),J=1,NY),I=1,NX)
00420 630   CONTINUE
00421       CALL MATLIS(9,'G1 MATRIX',
           +     NDIM,M1P,NU,RLABEL,CLABEL,RARRAY,CARRAY,0)
00422       GO TO 40
00423 640   CONTINUE
00424       IF(M2.EQ.0.OR.NU.EQ.0) GO TO 1950
00426       DO 650 L=1,IX
00427       READ(IFIN) IDEN
00428       IF(IDEN.EQ.2) READ(IFIN) IDEN,NX,(CLABEL(I),I=1,NX)
00430       IF(IDEN.EQ.33.AND.M1P.NE.0) READ(IFIN) IDEN,NX,(RLABEL(I),I=1,M1P)
           +      ,(RLABEL(I),I=1,M2)
00432       IF(IDEN.EQ.33.AND.M1P.EQ.0) READ(IFIN) IDEN,NX,
           +       (RLABEL(I),I=1,NX)
00434       IF(IDEN.EQ.42) READ(IFIN) IDEN,NX,NY,((RARRAY(I,J),J=1,NY),I=1,NX)
00435 650   CONTINUE
00437       CALL MATLIS(9,'G2 MATRIX',
           +     NDIM,M2,NU,RLABEL,CLABEL,RARRAY,CARRAY,0)
00438       GO TO 40
00439 660   CONTINUE
00440       IF(M1P.EQ.0.OR.NW.EQ.0) GO TO 1950
00442       DO 670 L=1,IX
00443       READ(IFIN) IDEN
00444       IF(IDEN.EQ.3) READ(IFIN) IDEN,NX,(CLABEL(I),I=1,NX)
00446       IF(IDEN.EQ.33) READ(IFIN) IDEN,NX,(RLABEL(I),I=1,NX)
00448       IF(IDEN.EQ.43) READ(IFIN) IDEN,NX,NY,((RARRAY(I,J),J=1,NY),I=1,NX)
00450 670   CONTINUE
00451       CALL MATLIS(13,'GAMMA1 MATRIX'
           +     ,NDIM,M1P,NW,RLABEL,CLABEL,RARRAY,CARRAY,0)
00452       GO TO 40
00453 680   CONTINUE
00454       IF(M2.EQ.0.OR.NW.EQ.0) GO TO 1950
00455       DO 690 L=1,IX
00457       READ(IFIN) IDEN
00458       IF(IDEN.EQ.3) READ(IFIN) IDEN,NX,(CLABEL(I),I=1,NX)
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00460       IF(IDEN.EQ.33.AND.M1P.NE.0) READ(IFIN) IDEN,NX,(RLABEL(I),I=1,M1P)
           +     ,(RLABEL(I),I=1,M2)
00462       IF(IDEN.EQ.33.AND.M1P.EQ.0) READ(IFIN) IDEN,NX,(RLABEL(I),I=1,NX)
00464       IF(IDEN.EQ.44) READ(IFIN) IDEN,NX,NY,((RARRAY(I,J),J=1,NY),I=1,NX)
00465 690   CONTINUE
00467       CALL MATLIS(13,'GAMMA2 MATRIX'
           +     ,NDIM,M2,NN,RLABEL,CLABEL,RARRAY,CARRAY,0)
00468       GO TO 40
00469 700   CONTINUE
00470       IF(NZ.EQ.0.OR.NXT.EQ.0) GO TO 1950
00472       DO 710 L=1,IX
00473       READ(IFIN) IDEN
00474       IF(IDEN.EQ.10) READ(IFIN) IDEN,NX,(CLABEL(I),I=1,NX)
00476       IF(IDEN.EQ.11) READ(IFIN) IDEN,NY,(CLABEL(I),I=1+NXS,NXS+NY)
00478       IF(IDEN.EQ.32) READ(IFIN) IDEN,NX,(RLABEL(I),I=1,NX)
00480       IF(IDEN.EQ.45) READ(IFIN) IDEN,NX,NY,((RARRAY(I,J),J=1,NY),I=1,NX)
00482 710   CONTINUE
00483       CALL MATLIS(18,'REORDERED H MATRIX'
           +     ,NDIM,NZ,NXT,RLABEL,CLABEL,RARRAY,CARRAY,0)
00484       GO TO 40
00485 720   CONTINUE
00486       IF(M1.EQ.0.OR.M1P.EQ.0) GO TO 1950
00488       DO 730 L=1,IX
00489       READ(IFIN) IDEN
00490       IF(IDEN.EQ.32) READ(IFIN) IDEN,NX,(RLABEL(I),I=1,NX)
00492       IF(IDEN.EQ.33) READ(IFIN) IDEN,NX,(CLABEL(I),I=1,NX)
00494       IF(IDEN.EQ.46) READ(IFIN) IDEN,NX,NY,((RARRAY(I,J),J=1,NY),I=1,NX)
00496 730   CONTINUE
00497       CALL MATLIS(10,'H11 MATRIX'
           +     ,NDIM,M1,M1P,RLABEL,CLABEL,RARRAY,CARRAY,0)
00498       GO TO 40
00499 740   CONTINUE
00500       IF(M1.EQ.0.OR.M2.EQ.0) GO TO 1950
00502       DO 750 L=1,IX
00503       READ(IFIN) IDEN
00504       IF(IDEN.EQ.33.AND.M1P.NE.0) READ(IFIN) IDEN,NX,(CLABEL(I),I=1,M1P)
           +     ,(CLABEL(I),I=1,M2)
00506       IF(IDEN.EQ.33.AND.M1P.EQ.0) READ(IFIN) IDEN,NX,(CLABEL(I),I=1,NX)
00508       IF(IDEN.EQ.33) READ(IFIN) IDEN,NX,(RLABEL(I),I=1,NX)
00510       IF(IDEN.EQ.47) READ(IFIN) IDEN,NX,NY,((RARRAY(I,J),J=1,NY),I=1,NX)
00512 750   CONTINUE
00513       CALL MATLIS(10,'H12 MATRIX'
           +     ,NDIM,M1,M2,RLABEL,CLABEL,RARRAY,CARRAY,0)
00514       GO TO 40
00515 760   CONTINUE
00516       IF(M2.EQ.0) GO TO 1950
00518       DO 770 L=1,IX
00519       READ(IFIN) IDEN
00520       IF(IDEN.EQ.32.AND.M1.NE.0) READ(IFIN) IDEN,NX,(RLABEL(I),I=1,M1),
           +     (RLABEL(I),I=1,M2)
00522       IF(IDEN.EQ.32.AND.M1.EQ.0) READ(IFIN) IDEN,NX,(RLABEL(I),I=1,NX)
00524       IF(IDEN.EQ.33.AND.M1P.NE.0) READ(IFIN) IDEN,NX,(CLABEL(I),I=1,M1P)
           +     ,(CLABEL(I),I=1,M2)
00526       IF(IDEN.EQ.33.AND.M1P.EQ.0) READ(IFIN) IDEN,NX,(CLABEL(I),I=1,NX)
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00528         IF(IDEN.EQ.48) READ(IFIN) IDEN,NX,NY,((RARRAY(I,J),J=1,NY),I=1,NX)
00530 770     CONTINUE
00531         CALL MATLIS(10,'H22 MATRIX'
             +     ,NDIM,M2,M2,RLABEL,CLABEL,RARRAY,CARRAY,0)
00532         GO TO 40
00533 780     CONTINUE
00534         IF(NW.EQ.0) GO TO 1950
00536         DO 790 L=1,IX
00537         READ(IFIN) IDEN
00538         IF(IDEN.EQ.3) READ(IFIN) IDEN,NX,(RLABEL(I),I=1,NX)
00540         IF(IDEN.EQ.49) READ(IFIN) IDEN,NX,(RARRAY(I,1),I=1,NX)
00542 790     CONTINUE
00543         NC=1
00544         CLABEL(1)=BLANK
00545         CALL MATLIS(25,'Q MATRIX DIAGONAL, FILTER'
             +     ,NDIM,NW,NC,RLABEL,CLABEL,RARRAY,CARRAY,0)
00546         GO TO 40
00547 800     CONTINUE
00548         IF(NZ.EQ.0) GO TO 1950
00550         DO 810 L=1,IX
00551         READ(IFIN) IDEN
00552         IF(IDEN.EQ.32) READ(IFIN) IDEN,NX,(RLABEL(I),I=1,NX)
00554         IF(IDEN.EQ.50) READ(IFIN) IDEN,NX,(RARRAY(I,1),I=1,NX)
00556 810     CONTINUE
00557         NC=1
00558         CLABEL(1)=BLANK
00559         CALL MATLIS(25,'R MATRIX DIAGONAL, FILTER'
             +     ,NDIM,NZ,NC,RLABEL,CLABEL,RARRAY,CARRAY,0)
00560         GO TO 40
00561 820     CONTINUE
00562         IF(M1P.EQ.0) GO TO 1950
00564         DO 830 L=1,IX
00565         READ(IFIN) IDEN
00566         IF(IDEN.EQ.33) READ(IFIN) IDEN,NX,(RLABEL(I),I=1,NX)
00568         IF(IDEN.EQ.51) READ(IFIN) IDEN,NX,NY,((RARRAY(I,J),J=1,NY),I=1,NX)
00570 830     CONTINUE
00571         DO 835 I=1,M1P
00572 835     RLABEL(I+M1P)=RLABEL(I)
00573         NR=2*M1P
00574         CALL MATLIS(33,'EULER LAGRANGE SYS MATRIX, FILTER'
             +     ,NDIM,NR,NR,RLABEL,RLABEL,RARRAY,CARRAY,0)
00575         GO TO 40
00576 840     CONTINUE
00577         IF(M2.EQ.0) GO TO 1950
00579         DO 850 L=1,IX
00580         READ(IFIN) IDEN
00581         IF(IDEN.EQ.33.AND.M1P.EQ.0) READ(IFIN) IDEN,NX,(RLABEL(I),I=1,NX)
00583         IF(IDEN.EQ.33.AND.M1P.NE.0) READ(IFIN) IDEN,NX,(RLABEL(I),I=1,M1P)
             +     ,(RLABEL(I),I=1,M2)
00585         IF(IDEN.EQ.52) READ(IFIN) IDEN,NX,NY,((RARRAY(I,J),J=1,NY),I=1,NX)
00587 850     CONTINUE
00588         CALL MATLIS(36,'AUGMENTED GM2*QD*GM2T INVERSE MATRIX'
             +     ,NDIM,M2,M2,RLABEL,RLABEL,RARRAY,CARRAY,0)
00589         GO TO 40
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00590 930   CONTINUE
00591       IF(M1P.EQ.0) GO TO 1950
00593       DO 910 L=1,IX
00594       READ(IFIN) IDEN
00595       IF(IDEN.EQ.33) READ(IFIN) IDEN,NX,(RLABEL(I),I=1,NX)
00597       IF(IDEN.EQ.IX-1) READ(IFIN) IDEN,NX,(BARRAY(I),I=1,NX)
00599 910   CONTINUE
00600       DO 915 I=1,M1P
00601       RARRAY(I,1)=CABS(BARRAY(I))
00602 915   CARRAY(I,1)=57.29578*ATAN2(AIMAG(BARRAY(I)),REAL(BARRAY(I)))
00603       NC=1
00604       CLABEL(1)=BLANK
00605       IF(IX.EQ.55) CALL MATLIS(29,'OPEN LOOP EIGENVALUES, FILTER'
          +       ,NDIM,M1P,NC,RLABEL,CLABEL,RARRAY,CARRAY,1)
00607       IF(IX.EQ.56) CALL MATLIS(31,'CLOSED LOOP EIGENVALUES, FILTER'
          +       ,NDIM,M1P,NC,RLABEL,CLABEL,RARRAY,CARRAY,1)
00609       GO TO 40
00610 920   CONTINUE
00611       IF(M1P.EQ.0) GO TO 1950
00613       DO 930 L=1,IX
00614       READ(IFIN) IDEN
00615       IF(IDEN.EQ.33) READ(IFIN) IDEN,NX,(RLABEL(I),I=1,NX)
00617       IF(IDEN.EQ.56) READ(IFIN) IDEN,NX,NY,((C1PRAY(I,J),J=1,NY),I=1,NX)
00619 930   CONTINUE
00620       DO 935 I=1,M1P
00621       DO 935 J=1,M1P
00622       RARRAY(I,J)=REAL(C1PRAY(I,J))
00623 935   CARRAY(I,J)=AIMAG(C1PRAY(I,J))
00624       CALL MATLIS(32,'CLOSED LOOP EIGENVECTORS, FILTER'
          +       ,NDIM,M1P,M1P,RLABEL,RLABEL,RARRAY,CARRAY,1)
00625       GO TO 40
00626 940   CONTINUE
00627       IF(M1P.EQ.0) GO TO 1950
00629       DO 950 L=1,IX
00630       READ(IFIN) IDEN
00631       IF(IDEN.EQ.33) READ(IFIN) IDEN,NX,(RLABEL(I),I=1,NX)
00633       IF(IDEN.EQ.57) READ(IFIN) IDEN,NX,NY,((RARRAY(I,J),J=1,NY),I=1,NX)
00635 950   CONTINUE
00636       CALL MATLIS(32,'RICCATI MATRIX SOLUTIONS, FILTER'
          +       ,NDIM,M1P,M1P,RLABEL,RLABEL,RARRAY,CARRAY,0)
00637       GO TO 40
00638 960   CONTINUE
00639       IF(M1P.EQ.0.OR.M1.EQ.0) GO TO 1950
00641       DO 970 L=1,IX
00642       READ(IFIN) IDEN
00643       IF(IDEN.EQ.32) READ(IFIN) IDEN,NX,(CLABEL(I),I=1,NX)
00645       IF(IDEN.EQ.33) READ(IFIN) IDEN,NX,(RLABEL(I),I=1,NX)
00647       IF(IDEN.EQ.58) READ(IFIN) IDEN,NX,NY,((RARRAY(I,J),J=1,NY),I=1,NX)
00649 970   CONTINUE
00650       CALL MATLIS(23,'K11 GAIN MATRIX, FILTER'
          +       ,NDIM,M1P,M1,RLABEL,CLABEL,RARRAY,CARRAY,0)
00651       GO TO 40
00652 980   CONTINUE
00653       IF(M1P.EQ.0.OR.M2.EQ.0) GO TO 1950
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00655        DO 990 L=1,IX
00656        READ(IFIN) IDEN
00657        IF(IDEN.EQ.32.AND.M1.NE.0) READ(IFIN) IDEN,NX,(CLABEL(I),I=1,M1)
            +       ,(CLABEL(I),I=1,M2)
00659        IF(IDEN.EQ.32.AND.M1.EQ.0) READ(IFIN) IDEN,NX,(CLABEL(I),I=1,NX)
00661        IF(IDEN.EQ.33) READ(IFIN) IDEN,NX,(RLABEL(I),I=1,NX)
00663        IF(IDEN.EQ.59) READ(IFIN) IDEN,NX,NY,((RARRAY(I,J),J=1,NY),I=1,NX)
00665 990    CONTINUE
00666        CALL MATLIS(23,'K12 GAIN MATRIX, FILTER'
            +      ,NDIM,M1P,M2,RLABEL,CLABEL,RARRAY,CARRAY,0)
00667        GO TO 40
00668 1000   CONTINUE
00669        IF(NXT.EQ.0) GO TO 1950
00671        DO 1010 L=1,IX
00672        READ(IFIN) IDEN
00673        IF(IDEN.EQ.10) READ(IFIN) IDEN,NX,(RLABEL(I),I=1,NX)
00675        IF(IDEN.EQ.11) READ(IFIN) IDEN,NY,(RLABEL(I),I=1+NXS,NXS+NY)
00677        IF(IDEN.EQ.60) READ(IFIN) IDEN,NX,(RARRAY(I,1),I=1,NX)
00679 1010   CONTINUE
00680        NC=1
00681        CLABEL(1)=BLANK
00682        CALL MATLIS(27,'R4S STATE EST ERROR, FILTER'
            +      ,NDIM,NXT,NC,RLABEL,CLABEL,RARRAY,CARRAY,0)
00683        GO TO 40
00684 1020   CONTINUE
00685        IF(NXT.EQ.0) GO TO 1950
00687        DO 1030 L=1,IX
00688        READ(IFIN) IDEN
00689        IF(IDEN.EQ.10) READ(IFIN) IDEN,NX,(RLABEL(I),I=1,NX)
00691        IF(IDEN.EQ.11) READ(IFIN) IDEN,NY,(RLABEL(I),I=1+NXS,NXS+NY)
00693        IF(IDEN.EQ.61) READ(IFIN) IDEN,NX,NY,((RARRAY(I,J),J=1,NY),I=1,NX)
00695 1030   CONTINUE
00696        CALL MATLIS(34,'STATE EST ERROR COV MATRIX, FILTER'
            +      ,NDIM,NXT,NXT,RLABEL,RLABEL,RARRAY,CARRAY,0)
00697        GO TO 40
00698 1040   CONTINUE
00699        IF(NZT.EQ.0) GO TO 1950
00701        DO 1050 L=1,IX
00702        READ(IFIN) IDEN
00703        IF(IDEN.EQ.7) READ(IFIN) IDEN,NX,(RLABEL(I),I=1,NX)
00705        IF(IDEN.EQ.8) READ(IFIN) IDEN,NY,(RLABEL(I),I=1+NZ,NZ+NY)
00707        IF(IDEN.EQ.62) READ(IFIN) IDEN,NX,(RARRAY(I,1),I=1,NX)
00709 1050   CONTINUE
00710        NC=1
00711        CLABEL(1)=BLANK
00712        CALL MATLIS(26,'Q MATRIX DIAGONAL, REGULATOR'
            +      ,NDIM,NZT,NC,RLABEL,CLABEL,RARRAY,CARRAY,0)
00713        GO TO 40
00714 1060   CONTINUE
00715        IF(NU.EQ.0) GO TO 1950
00717        DO 1070 L=1,IX
00718        READ(IFIN) IDEN
00719        IF(IDEN.EQ.2) READ(IFIN) IDEN,NX,(RLABEL(I),I=1,NX)
00721        IF(IDEN.EQ.63) READ(IFIN) IDEN,NX,(RARRAY(I,1),I=1,NX)
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00723 1070  CONTINUE
00724       NC=1
00725       CLABEL(1)=BLANK
00726       CALL MATLIS(28,'R MATRIX DIAGONAL, REGULATOR'
           +     ,NDIM,NU,NC,RLABEL,CLABEL,RARRAY,CARRAY,0)
00727       GO TO 40
00728 1080  CONTINUE
00729       IF(NXT.EQ.0) GO TO 1950
00731       DO 1090 L=1,IX
00732       READ(IFIN) IDEN
00733       IF(IDEN.EQ.10) READ(IFIN) IDEN,NX,(RLABEL(I),I=1,NX)
00735       IF(IDEN.EQ.11) READ(IFIN) IDEN,NY,(RLABEL(I),I=1+NXS,NXS+NY)
00737       IF(IDEN.EQ.64) READ(IFIN) IDEN,NX,NY,((RARRAY(I,J),J=1,NY),I=1,NX)
00739 1090  CONTINUE
00740       DO 1095 I=1,NXT
00741 1095  RLABEL(I+NXT)=RLABEL(I)
00742       NR=2*NXT
00743       CALL MATLIS(36,'EULER LAGRANGE SYS MATRIX, REGULATOR'
           +     ,NDIM,NR,NR,RLABEL,RLABEL,RARRAY,CARRAY,0)
00744       GO TO 40
00745 1100  CONTINUE
00746       IF(NXT.EQ.0) GO TO 1950
00748       DO 1110 L=1,IX
00749       READ(IFIN) IDEN
00750       IF(IDEN.EQ.10) READ(IFIN) IDEN,NX,(RLABEL(I),I=1,NX)
00752       IF(IDEN.EQ.11) READ(IFIN) IDEN,NY,(RLABEL(I),I=1+NXS,NXS+NY)
00754       IF(IDEN.EQ.IX-1) READ(IFIN) IDEN,NX,(RARRAY(I),I=1,NX)
00756 1110  CONTINUE
00757       DO 1115 I=1,NXT
00758       RARRAY(I,1)=CABS(RARRAY(I))
00759 1115  CARRAY(I,1)=57.29578*ATAN2(AIMAG(RARRAY(I)),REAL(RARRAY(I)))
00760       NC=1
00761       CLABEL(1)=BLANK
00762       IF(IX.EQ.66) CALL MATLIS(32,'OPEN LOOP EIGENVALUES, REGULATOR'
           +     ,NDIM,NXT,NC,RLABEL,CLABEL,RARRAY,CARRAY,1)
00764       IF(IX.EQ.67) CALL MATLIS(34,'CLOSED LOOP EIGENVALUES, REGULATOR'
           +     ,NDIM,NXT,NC,RLABEL,CLABEL,RARRAY,CARRAY,1)
00766       GO TO 40
00767 1140  CONTINUE
00768       IF(NXT.EQ.0) GO TO 1950
00770       DO 1150 L=1,IX
00771       READ(IFIN) IDEN
00772       IF(IDEN.EQ.10) READ(IFIN) IDEN,NX,(RLABEL(I),I=1,NX)
00774       IF(IDEN.EQ.11) READ(IFIN) IDEN,NY,(RLABEL(I),I=1+NXS,NXS+NY)
00776       IF(IDEN.EQ.67) READ(IFIN) IDEN,NX,NY,((CMPRAY(I,J),J=1,NY),I=1,NX)
00778 1150  CONTINUE
00779       DO 1155 I=1,NXT
00780       DO 1155 J=1,NXT
00781       RARRAY(I,J)=REAL(CMPRAY(I,J))
00782 1155  CARRAY(I,J)=AIMAG(CMPRAY(I,J))
00783       CALL MATLIS(35,'CLOSED LOOP EIGENVECTORS, REGULATOR'
           +     ,NDIM,NXT,NXT,RLABEL,RLABEL,RARRAY,CARRAY,1)
00784       GO TO 40
00785 1160  CONTINUE
```

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00786         IF(NXT.EQ.0) GO TO 1950
00788         DO 1170 L=1,IX
00789         READ(IFIN) IDEN
00790         IF(IDEN.EQ.10) READ(IFIN) IDEN,NX,(RLABEL(I),I=1,NX)
00792         IF(IDEN.EQ.11) READ(IFIN) IDEN,NY,(RLABEL(I),I=1+NXS,NXS+NY)
00794         IF(IDEN.EQ.68) READ(IFIN) IDEN,NX,NY,((RARRAY(I,J),J=1,NY),I=1,NX)
00795 1170    CONTINUE
00797         CALL MATLIS(35,'RICCATI MATRIX SOLUTIONS, REGULATOR'
             +     ,NDIM,NXT,NXT,RLABEL,RLABEL,RARRAY,CARRAY,0)
00798         GO TO 40
00799 1180    CONTINUE
00800         IF(NU.EQ.0.OR.NXT.EQ.0) GO TO 1950
00802         DO 1190 L=1,IX
00803         READ(IFIN) IDEN
00804         IF(IDEN.EQ.2) READ(IFIN) IDEN,NX,(RLABEL(I),I=1,NX)
00806         IF(IDEN.EQ.10) READ(IFIN) IDEN,NX,(CLABEL(I),I=1,NX)
00808         IF(IDEN.EQ.11) READ(IFIN) IDEN,NY,(CLABEL(I),I=1+NXS,NXS+NY)
00810         IF(IDEN.EQ.69) READ(IFIN) IDEN,NX,NY,((RARRAY(I,J),J=1,NY),I=1,NX)
00812 1190    CONTINUE
00813         CALL MATLIS(21,'REGULATOR GAIN MATRIX'
             +     ,NDIM,NU,NXT,RLABEL,CLABEL,RARRAY,CARRAY,0)
00814         GO TO 40
```

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00815 1200  CONTINUE
00816       IF(NXT.EQ.0) GO TO 1950
00818       DO 1210 L=1,IX
00819       READ(IFIN) IDEN
00820       IF(IDEN.EQ.10) READ(IFIN) IDEN,NX,(RLABEL(I),I=1,NX)
00822       IF(IDEN.EQ.11) READ(IFIN) IDEN,NY,(RLABEL(I),I=1+NXS,NXS+NY)
00824       IF(IDEN.EQ.66) READ(IFIN) IDEN,NX,(BARRAY(I),I=1,NX)
00826       IF(IDEN.EQ.IX-1) READ(IFIN) IDEN,NX,NY,((CMPRAY(I,J),J=1,NY),
           +       I=1,NX)
00828 1210  CONTINUE
00829       K=0
00830       DO 1212 I=1,NXT
00831       IF(AIMAG(BARRAY(I)).LT.0.) GO TO 1212
00833       K=K+1
00834       BARRAY(K)=BARRAY(I)
00835 1212  CONTINUE
00836       L=(IDEN-68)/3
00837       WRITE(IWO,1213) BARRAY(L)
00838 1213  FORMAT(5X,'NORMALIZED F MATRIX SENSITIVITY TO EIGENVALUE : ',
           +       2G11.3/)
00839       DO 1215 I=1,NXT
00840       DO 1215 J=1,NXT
00841       RARRAY(I,J)=CABS(CMPRAY(I,J))
00842 1215  CARRAY(I,J)=57.29578*ATAN2(AIMAG(CMPRAY(I,J)),REAL(CMPRAY(I,J)))
00843       CALL MATLIS(8,DBLANK,NDIM,NXT,NXT,RLABEL,RLABEL,RARRAY,CARRAY,1)
00844       GO TO 40
00845 1220  CONTINUE
00846       IF(NXT.EQ.0.OR.NU.EQ.0)  GO TO 1950
00848       DO 1230 L=1,IX
00849       READ(IFIN) IDEN
00850       IF(IDEN.EQ.2) READ(IFIN) IDEN,NX,(CLABEL(I),I=1,NX)
00852       IF(IDEN.EQ.10) READ(IFIN) IDEN,NX,(RLABEL(I),I=1,NX)
00854       IF(IDEN.EQ.11) READ(IFIN) IDEN,NY,(RLABEL(I),I=1+NXS,NXS+NY)
00856       IF(IDEN.EQ.66) READ(IFIN) IDEN,NX,(BARRAY(I),I=1,NX)
00858       IF(IDEN.EQ.IX-1) READ(IFIN) IDEN,NX,NY,((CMPRAY(I,J),J=1,NY),
           +       I=1,NX)
00860 1230  CONTINUE
00861       K=0
00862       DO 1232 I=1,NXT
00863       IF(AIMAG(BARRAY(I)).LT.0.) GO TO 1232
00865       K=K+1
00866       BARRAY(K)=BARRAY(I)
00867 1232  CONTINUE
00868       L=(IDEN-69)/3
00869       WRITE(IWO,1233) BARRAY(L)
00870 1233  FORMAT(5X,'NORMALIZED G MATRIX SENSITIVITY TO EIGENVALUE : ',
           +       2G11.3)
00871       DO 1235 I=1,NXT
00872       DO 1235 J=1,NU
00873       RARRAY(I,J)=CABS(CMPRAY(I,J))
00874 1235  CARRAY(I,J)=57.29578*ATAN2(AIMAG(CMPRAY(I,J)),REAL(CMPRAY(I,J)))
00875       CALL MATLIS(8,DBLANK,NDIM,NXT,NU,RLABEL,CLABEL,RARRAY,CARRAY,1)
00876       GO TO 40
00877 1240  CONTINUE
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00870         IF(NU.EQ.0.OR.NXT.EQ.0) GO TO 1950
00890         DO 1250 L=1,IX
00891         READ(IFIN) IDEN
00892         IF(IDEN.EQ.2) READ(IFIN) IDEN,NX,(RLABEL(I),I=1,NX)
00894         IF(IDEN.EQ.10) READ(IFIN) IDEN,NX,(CLABEL(I),I=1,NX)
00896         IF(IDEN.EQ.11) READ(IFIN) IDEN,NY,(CLABEL(I),I=1+NXS,NXS+NY)
00898         IF(IDEN.EQ.66) READ(IFIN) IDEN,NX,(BARRAY(I),I=1,NX)
00890         IF(IDEN.EQ.IX-1) READ(IFIN) IDEN,NX,NY,((CMPRAY(I,J),J=1,NY),
             +       I=1,NX)
00892 1250    CONTINUE
00893         K=0
00894         DO 1252 I=1,NXT
00895         IF(AIMAG(BARRAY(I)).LT.0.) GO TO 1252
00897         K=K+1
00898         BARRAY(K)=BARRAY(I)
00899 1252    CONTINUE
00900         L=(IDEN-70)/3
00901         WRITE(IKB,1253) BARRAY(L)
00902 1253    FORMAT(5X,'NORMALIZED C MATRIX SENSITIVITY TO EIGENVALUE : ',
             +      2G11.3)
00903         DO 1255 I=1,NU
00904         DO 1255 J=1,NXT
00905         BARRAY(I,J)=CABS(CMPRAY(I,J))
00906 1255    CARRAY(I,J)=57.29578*ATAN2(AIMAG(CMPRAY(I,J)),REAL(CMPRAY(I,J)))
00907         CALL MATLIS(8,DBLANK,NDIM,NU,NXT,RLABEL,CLABEL,BARRAY,CARRAY,1)
00908         GO TO 40
00909 1260    CONTINUE
00910         IF(M1P.EQ.0) GO TO 1950
00912         DO 1270 L=1,IX
00913         READ(IFIN) IDEN
00914         IF(IDEN.EQ.33) READ(IFIN) IDEN,NX,(RLABEL(I),I=1,NX)
00916         IF(IDEN.EQ.115) READ(IFIN) IDEN,NX,NY,((BARRAY(I,J),J=1,NY),
             +       I=1,NX)
00918 1270    CONTINUE
00919         CALL MATLIS(9,'AF MATRIX'
             +      ,NDIM,M1P,M1P,RLABEL,RLABEL,BARRAY,CARRAY,0)
00920         GO TO 40
00921 1280    CONTINUE
00922         IF(M1P.EQ.0.OR.NZ.EQ.0) GO TO 1950
00924         DO 1290 L=1,IX
00925         READ(IFIN) IDEN
00926         IF(IDEN.EQ.9) READ(IFIN) IDEN,NX,(CLABEL(I),I=1,NX)
00928         IF(IDEN.EQ.33) READ(IFIN) IDEN,NX,(RLABEL(I),I=1,NX)
00930         IF(IDEN.EQ.116) READ(IFIN) IDEN,NX,NY,((BARRAY(I,J),J=1,NY),
             +      I=1,NX)
00932 1290    CONTINUE
00933         CALL MATLIS(9,'BF MATRIX'
             +      ,NDIM,M1P,NZ,RLABEL,CLABEL,BARRAY,CARRAY,0)
00934         GO TO 40
00935 1300    CONTINUE
00936         IF(NU.EQ.0.OR.M1P.EQ.0) GO TO 1950
00938         DO 1310 L=1,IX
00939         READ(IFIN) IDEN
00940         IF(IDEN.EQ.2) READ(IFIN) IDEN,NX,(RLABEL(I),I=1,NX)
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00942         IF(IDEN.EQ.33) READ(IFIN) IDEN,NX,(CLABEL(I),I=1,NX)
00944         IF(IDEN.EQ.117) READ(IFIN) IDEN,NX,NY,((RARRAY(I,J),J=1,NY),
             +      I=1,NX)
00946 1310    CONTINUE
00947         CALL MATLIS(9,'CF MATRIX'
             +      ,NDIM,NU,NZ,RLABEL,CLABEL,RARRAY,CARRAY,0)
00948         GO TO 40
00949 1320    CONTINUE
00950         IF(NU.EQ.0.OR.NZ.EQ.0) GO TO 1950
00952         DO 1330 I=1,IX
00953         READ(IFIN) IDEN
00954         IF(IDEN.EQ.2) READ(IFIN) IDEN,NX,(RLABEL(I),I=1,NX)
00955         IF(IDEN.EQ.9) READ(IFIN) IDEN,NX,(CLABEL(I),I=1,NX)
00958         IF(IDEN.EQ.118) READ(IFIN) IDEN,NX,NY,((RARRAY(I,J),J=1,NY),
             +      I=1,NX)
00960 1330    CONTINUE
00961         CALL MATLIS(9,'DF MATRIX'
             +      ,NDIM,NU,NZ,RLABEL,CLABEL,RARRAY,CARRAY,0)
00962         GO TO 40
00963 1340    CONTINUE
00964         IF(NXT+M1P.EQ.0) GO TO 1950
00966         DO 1350 I=1,IX
00967         READ(IFIN) IDEN
00968         IF(IDEN.EQ.10) READ(IFIN) IDEN,NX,(RLABEL(I),I=1,NX)
00970         IF(IDEN.EQ.11) READ(IFIN) IDEN,NY,(RLABEL(I),I=1+NXS,NXS+NY)
00972         IF(IDEN.EQ.33) READ(IFIN) IDEN,NY,(RLABEL(I),I=1+NXT,NXT+NY)
00974         IF(IDEN.EQ.IX-1) READ(IFIN) IDEN,NX,NY,((RARRAY(I,J),J=1,NY),
             +      I=1,NX)
00976 1350    CONTINUE
00977         NR=NXT+M1P
00978         IF(IX.EQ.120) CALL MATLIS(29,'CLOSED LOOP SYS SYSTEM MATRIX'
             +      ,NDIM,NR,NR,RLABEL,RLABEL,RARRAY,CARRAY,0)
00980         IF(IX.EQ.121) CALL MATLIS(25,'COV MATRIX, PROCESS NOISE'
             +      ,NDIM,NR,NR,RLABEL,RLABEL,RARRAY,CARRAY,0)
00982         IF(IX.EQ.123) CALL MATLIS(29,'COV MATRIX, MEASUREMENT NOISE'
             +      ,NDIM,NR,NR,RLABEL,RLABEL,RARRAY,CARRAY,0)
00984         IF(IX.EQ.125) CALL MATLIS(17,'COV MATRIX, TOTAL'
             +      ,NDIM,NR,NR,RLABEL,RLABEL,RARRAY,CARRAY,0)
00986         GO TO 40
00987 1360    CONTINUE
00988         IF(NXT+M1P.EQ.0) GO TO 1950
00990         DO 1370 I=1,IX
00991         READ(IFIN) IDEN
00992         IF(IDEN.EQ.10) READ(IFIN) IDEN,NX,(RLABEL(I),I=1,NX)
00994         IF(IDEN.EQ.11) READ(IFIN) IDEN,NY,(RLABEL(I),I=1+NXS,NXS+NY)
00996         IF(IDEN.EQ.33) READ(IFIN) IDEN,NY,(RLABEL(I),I=1+NXT,NXT+NY)
00998         IF(IDEN.EQ.IX-1) READ(IFIN) IDEN,NX,(RARRAY(I,1),I=1,NX)
01000 1370    CONTINUE
01001         NR=NXT+M1P
01002         CLABEL(1)=BLANK
01003         NC=1
01004         IF(IX.EQ.122) CALL MATLIS(18,'RMS, PROCESS NOISE'
             +      ,NDIM,NR,NC,RLABEL,CLABEL,RARRAY,CARRAY,0)
01006         IF(IX.EQ.124) CALL MATLIS(21,'RMS, MEASUREMENT NOISE'
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     +      ,NDIM,NR,NC,RLABEL,CLABEL,RARRAY,CARRAY,Ø)
Ø1ØØ8        IF(IX.EQ.126) CALL MATLIS(1Ø,'R4S, TOTAL'
     +      ,NDIM,NR,NC,RLABEL,CLABEL,RARRAY,CARRAY,Ø)
Ø1Ø1Ø         GO TO 4Ø
Ø1Ø11 1390   CONTINUE
Ø1Ø12        IF(NZ+NYO+NU.EQ.Ø) GO TO 1950
Ø1Ø14        DO 1390 L=1,IX
Ø1Ø15        READ(IFIN,END=1392) IDEN
Ø1Ø16        IF(IDEN.EQ.2.AND.NU.NE.Ø) READ(IFIN) IDEN,NX,(RLABEL(I),
     +          I=1+NZT,NZT+NX)
Ø1Ø18        IF(IDEN.EQ.8.AND.NYO.NE.Ø) READ(IFIN) IDEN,NX,(RLABEL(I),
     +          I=1+NZ,NZ+NX)
Ø1Ø2Ø        IF(IDEN.EQ.9) READ(IFIN) IDEN,NX,(RLABEL(I),I=1,NX)
Ø1Ø22        IF(IDEN.EQ.IX-1) READ(IFIN) IDEN,NX,NY,((RARRAY(I,J),J=1,NY),
     +      I=1,NX)
Ø1Ø24 1390   CONTINUE
Ø1Ø25 1392   NR=NZ+NYO+NU
Ø1Ø26        IF(IX.EQ.127) CALL MATLIS(27,'COV MATRIX, OUTPUT+CONTROLS'
     +      ,NDIM,NR,NR,RLABEL,RLABEL,RARRAY,CARRAY,Ø)
Ø1Ø28        IF(IX.EQ.129) CALL MATLIS(27,'COR MATRIX, OUTPUT+CONTROLS'
     +      ,NDIM,NR,NR,RLABEL,RLABEL,RARRAY,CARRAY,Ø)
Ø1Ø3Ø         GO TO 4Ø
Ø1Ø31 1400   CONTINUE
Ø1Ø32        IF(NZ+NYO+NU.EQ.Ø) GO TO 1950
Ø1Ø34        DO 1410 L=1,IX
Ø1Ø35        READ(IFIN,END=1412) IDEN
Ø1Ø36        IF(IDEN.EQ.2.AND.NU.NE.Ø) READ(IFIN) IDEN,NX,(RLABEL(I),
     +      I=1+NZT,NZT+NX)
Ø1Ø38        IF(IDEN.EQ.8.AND.NYO.NE.Ø) READ(IFIN) IDEN,NX,(RLABEL(I),
     +      I=1+NZ,NZ+NX)
Ø1Ø4Ø        IF(IDEN.EQ.9) READ(IFIN) IDEN,NX,(RLABEL(I),I=1,NX)
Ø1Ø42        IF(IDEN.EQ.127) READ(IFIN) IDEN,NX,(RARRAY(I,1),I=1,NX)
Ø1Ø44 1410   CONTINUE
Ø1Ø45 1412   NR=NZ+NYO+NU
Ø1Ø46        NC=1
Ø1Ø47        CLABEL(1)=BLANK
Ø1Ø48        CALL MATLIS(2Ø,'R4S, OUTPUT+CONTROLS'
     +      ,NDIM,NR,NC,RLABEL,CLABEL,RARRAY,CARRAY,Ø)
Ø1Ø49         GO TO 4Ø
Ø1Ø5Ø 1950   WRITE(1Ø3,196Ø) IX
Ø1Ø51 196Ø   FORMAT(1X,'PROBLEM FILE ELEMENT ',I3,' HAS ZERO DIMENSIONS'/)
Ø1Ø52         GO TO 4Ø
Ø1Ø53 3ØØØ   STOP
Ø1Ø54        END
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AIMAG    00602   00623   00759   00782   00831IF 00842   00863IF 00874
         00895IF 00906
ASSIGN   00009CL 00014CL
ATAN2    00602   00759   00842   00874   00906
BARRAY   00002CX 00593RD 00601   00602   00755RD 00758   00759   00825RD
         00831IF 00834=  00837WR 00857RD 00863IF 00866=  00869WR 00889RD
         00895IF 00898=  00901WR
BLANK    00005DA 00544   00558   00604   00681   00711   00725   00761
         01002   01047
CABS     00601   00758   00841   00873   00905
CARRAY   00001DI 00064AG 00076AG 00090AG 00104AG 00118AG 00132AG 00144AG
         00159AG 00172AG 00186AG 00200AG 00214AG 00230AG 00246AG 00262AG
         00280AG 00296AG 00310AG 00326AG 00338AG 00355AG 00357AG 00369AG
         00381AG 00393AG 00407AG 00421AG 00437AG 00451AG 00467AG 00483AG
         00497AG 00513AG 00531AG 00545AG 00559AG 00574AG 00588AG 00602=
         00606AG 00608AG 00623=  00624AG 00636AG 00650AG 00666AG 00682AG
         00695AG 00712AG 00729AG 00743AG 00759=  00763AG 00765AG 00782=
         00783AG 00797AG 00813AG 00842=  00843AG 00874=  00875AG 00906=
         00907AG 00919AG 00933AG 00947AG 00961AG 00979AG 00981AG 00983AG
         00995AG 01005AG 01007AG 01009AG 01027AG 01029AG 01048AG
CLABEL   00001DI 00012RD 00014AG 00033RD 00034WR 00047RD 00048WR 00059RD
         00064AG 00072RD 00076AG 00086RD 00090AG 00098RD 00104AG 00112RD
         00118AG 00126RD 00132AG 00154RD 00159AG 00165RD 00172AG 00182RD
         00185AG 00194RD 00200AG 00222RD 00230AG 00239RD 00245AG 00256RD
         00259RD 00262AG 00274RD 00276RD 00280AG 00289RD 00296AG 00304RD
         00310AG 00318RD 00326AG 00345RD 00348RD 00355AG 00357AG 00377RD
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00811RD 00813AG 00841= 00843AG 00873= 00875AG 00905= 00907AG
00917RD 00919AG 00931RD 00933AG 00945RD 00947AG 00959RD 00961AG
00975RD 00979AG 00981AG 00983AG 00985AG 00999RD 01005AG 01007AG
01009AG 01023RD 01027AG 01029AG 01043RD 01048AG

REAL 00602 00622 00759 00781 00842 00874 00906

RLABEL 00001DI 00060RD 00064AG 00084RD 00090AG 00100RD 00104AG 00114RD
00118AG 00128RD 00132AG 00140RD 00144AG 00152RD 00158AG 00168RD
00172AG 00180RD 00186AG 00196RD 00200AG 00208RD 00210RD 00214AG
00224RD 00226RD 00230AG 00240RD 00242RD 00246AG 00254RD 00262AG
00270RD 00272RD 00280AG 00290RD 00292RD 00296AG 00306RD 00310AG
00320RD 00322RD 00326AG 00334RD 00338AG 00350RD 00355AG 00357AG

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            00355RD 00369AG 00377RD 00381AG 00389RD 00393AG 00401RD 00403RD
            00407AG 00417RD 00421AG 00431RD 00433RD 00437AG 00447RD 00451AG
            00461RD 00463RD 00467AG 00479RD 00483AG 00491RD 00497AG 00509RD
            00513AG 00521RD 00523RD 00531AG 00539RD 00545AG 00553RD 00559AG
            00567RD 00572=  00574AG 00582RD 00584RD 00588AG 00596RD 00600AG
            00608AG 00616RD 00624AG 00632RD 00636AG 00646RD 00650AG 00662RD
            00666AG 00674RD 00676RD 00682AG 00690RD 00692RD 00696AG 00704RD
            00706RD 00712AG 00720RD 00726AG 00734RD 00736RD 00741=  00743AG
            00751RD 00753RD 00763AG 00765AG 00773RD 00775RD 00783AG 00791RD
            00793RD 00797AG 00805RD 00813AG 00821RD 00823RD 00843AG 00853RD
            00855RD 00875AG 00883RD 00907AG 00915RD 00919AG 00929RD 00933AG
            00941RD 00947AG 00955RD 00961AG 00969RD 00971RD 00973RD 00979AG
            00981AG 00983AG 00985AG 00993RD 00995RD 00997RD 01005AG 01007AG
            01009AG 01017RD 01019RD 01021RD 01027AG 01029AG 01037RD 01039RD
            01041RD 01048AG
XDATE       000003DP
XTIME       000003DP
10          000107R 00011*
100         00032GT 00052*
1000        00032GT 00568*
1010        00671DO 00679*
1020        00032GT 00684*
1030        00687DO 00695*
1040        00032GT 00698*
1050        00701DO 00709*
1060        00032GT 00714*
1070        00717DO 00723*
1080        00032GT 00728*
1090        00731DO 00739*
1095        00740DO 00741*
110         00055DO 00063*
1100        00032GT 00745*
1110        00748DO 00756*
1115        00757DO 00759*
1140        00032GT 00767*
1150        00770DO 00778*
1155        00779DO 00780DO 00782*
1160        00032GT 00785*
1170        00788DO 00796*
1180        00032GT 00799*
1190        00802DO 00812*
120         00032GT 00065*
1200        00032GT 00815*
1210        00818DO 00828*
1212        00830DO 00832GT 00835*
1213        00837NR 00838*
1215        00839DO 00840DO 00842*
1220        00032GT 00845*
1230        00848DO 00850*
1232        00962DO 00964GT 00867*
1233        00869NR 00870*
1235        00871DO 00872DO 00874*
1240        00032GT 00877*
1250        00880DO 00892*
```

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```
1252    00894DO 00898GT 00899*
1253    00901WR 00902*
1255    00903DO 00904DO 00905*
1260    00032GT 00909*
1270    00912DO 00918*
1280    00032GT 00921*
1290    00924DO 00932*
130     00069DO 00075*
1300    00032GT 00935*
1310    00938DO 00946*
1320    00032GT 00949*
1330    00952DO 00950*
1340    00032GT 00963*
1350    00966DO 00976*
1360    00032GT 00987*
1370    00990DO 01000*
1380    00032GT 01011*
1390    01014DO 01024*
1392    01015RD 01025*
140     00032GT 00078*
1400    00032GT 01031*
1410    01034DO 01044*
1412    01035RD 01045*
150     00081DO 00089*
160     00032GT 00092*
170     00095DO 00103*
180     00032GT 00106*
190     00109DO 00117*
1950    00054GT 00068GT 00080GT 00094GT 00108GT 00122GT 00136GT 00148GT
        00162GT 00176GT 00190GT 00204GT 00218GT 00234GT 00250GT 00266GT
        00284GT 00300GT 00314GT 00330GT 00342GT 00361GT 00373GT 00385GT
        00397GT 00411GT 00425GT 00441GT 00455GT 00471GT 00487GT 00501GT
        00517GT 00535GT 00549GT 00563GT 00578GT 00592GT 00612GT 00628GT
        00640GT 00654GT 00670GT 00685GT 00700GT 00716GT 00730GT 00747GT
        00759GT 00787GT 00801GT 00817GT 00847GT 00879GT 00911GT 00923GT
        00937GT 00951GT 00965GT 00989GT 01013GT 01033GT 01050*
1960    01050WR 01051*
20      00012RD 00013*
200     00032GT 00120*
210     00123DO 00131*
220     00032GT 00134*
230     00137DO 00143*
240     00032GT 00146*
25      00015DO 00021*
250     00149DO 00157*
26      00016RD 00022*
260     00032GT 00160*
270     00163DO 00171*
280     00032GT 00174*
290     00177DO 00185*
30      00025WR 00026*
300     00032GT 00188*
3000    00030GT 01053*
310     00191DO 00199*
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320     000332GT 00202*
330     000350O 00213*
340     000332GT 00216*
350     000190O 00229*
360     000332GT 00232*
370     000250O 00245*
380     000332GT 00248*
390     000510O 00261*
40      000027*  000336GT 000396GT 000426GT 000516GT 000556GT 000776GT 000916GT
        001056GT 001196GT 001336GT 001456GT 001596GT 001736GT 001876GT 002016GT
        002156GT 002316GT 002476GT 002636GT 002816GT 002976GT 003116GT 003276GT
        003396GT 003586GT 003746GT 003926GT 004096GT 004246GT 004396GT 004526GT
        004686GT 004846GT 004996GT 005146GT 005326GT 005466GT 005606GT 005756GT
        005896GT 006056GT 006256GT 006376GT 006516GT 006576GT 006936GT 006976GT
        007136GT 007276GT 007446GT 007666GT 007846GT 007986GT 008146GT 008446GT
        008766GT 009086GT 009206GT 009346GT 009486GT 009626GT 009856GT 010106GT
        010306GT 010496GT 010526GT
400     000332GT 00264*
410     000670O 00279*
420     000332GT 00282*
430     000950O 00295*
440     000332GT 00298*
450     000310O 00309*
460     000332GT 00312*
470     000150O 00325*
480     000332GT 00328*
490     000330O 00337*
50      000027RO 00028*
500     000332GT 00340*
510     000430O 00353*
540     000332GT 00359*
550     000620O 00368*
560     000332GT 00371*
570     000740O 00382*
580     000332GT 00393*
590     000360O 00392*
600     000332GT 00395*
610     000990O 00406*
620     000332GT 00409*
630     000120O 00420*
640     000332GT 00423*
65      000332GT 00033*
650     000420O 00436*
660     000332GT 00439*
670     000420O 00450*
68      000340R 00035*
680     000332GT 00453*
690     000560O 00466*
70      000332GT 00037*
700     000332GT 00469*
710     000720O 00482*
720     000332GT 00485*
730     000480O 00496*
740     000332GT 00499*
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75      00037#R 00038*
750     00502D0 00512*
760     00032GT 00515*
770     00518D0 00530*
780     00032GT 00533*
790     00536D0 00542*
80      00032GT 00040*
800     00032GT 00547*
810     00550D0 00556*
820     00032GT 00561*
830     00564D0 00570*
835     00571D0 00572*
840     00032GT 00576*
85      00040#R 00041*
850     00579D0 00587*
90      00032GT 00043*
900     00032GT 00590*
910     00593D0 00599*
915     00600D0 00602*
920     00032GT 00610*
930     00613D0 00619*
935     00620D0 00521D0 00623*
940     00032GT 00626*
95      00048#R 00049*
950     00629D0 00635*
960     00032GT 00638*
970     00641D0 00649*
98      00043D0 00046GT 00050*
980     00032GT 00652*
990     00655D0 00665*
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```
      SUBROUTINE MATLIS(NT,TITLE,NDIM,NR,NC,RLABEL,CLABEL,RARRAY,
     +                  CARRAY,IX)
C       ROUTINE TO OUTPUT MATRICES IN READABLE FORM.
      DIMENSION RLABEL(NR),CLABEL(NC),RARRAY(NDIM,NC),CARRAY(NDIM,NC),
     +          NUM(7)
      LOGICAL*1 TITLE(NT)
      COMMON/IO/ IIN,IOUT
      DATA IDASHL,IDOTL,IDASHR,IDOTR,IEX,IB /' -','. ','- ',' .','!',
     +     ' '/
      DO 500 IPAGE=1,NC,6
      IF(IPAGE.EQ.1) WRITE(IOUT,10) (TITLE(I),I=1,NT)
 10   FORMAT(5X,44A1,/)
      NPAGE=IPAGE+5
      IF(NPAGE.GT.NC) NPAGE=NC
      DO 20 I=IPAGE,NPAGE
      II=I-IPAGE+1
 20   NUM(II)=I
      WRITE(IOUT,30) (NUM(I),I=1,NPAGE-IPAGE+1)
 30   FORMAT(2X,I9,5I11)
      WRITE(IOUT,40) (CLABEL(I),I=IPAGE,NPAGE)
 40   FORMAT(2X,A9,5A11)
      DO 45 I=1,7
 45   NUM(I)=IB
      IF(IPAGE.EQ.1) NUM(1)=IDASHL
      IF(IPAGE.NE.1) NUM(1)=IDOTL
      IF(NPAGE.EQ.NC) NUM(NPAGE-IPAGE+2)=IDASHR
      IF(NPAGE.NE.NC) NUM(7)=IDOTR
      WRITE(IOUT,50) (NUM(I),I=1,7)
 50   FORMAT(3X,A2,6(9X,A2))
      DO 400 I=1,NR
      IF(NPAGE.EQ.NC) GO TO 150
      IF(IX.EQ.1) GO TO 100
      IF(IPAGE.EQ.1) WRITE(IOUT,60) IEX,IEX,(RARRAY(I,J),J=IPAGE,NPAGE),
     +                               IEX
      IF(IPAGE.NE.1) WRITE(IOUT,60) IB,IB,(RARRAY(I,J),J=IPAGE,NPAGE),IB
 60   FORMAT(3X,A1,/,3X,A1,6G11.3,/,3X,A1)
      GO TO 400
 100  CONTINUE
      IF(IPAGE.EQ.1) WRITE(IOUT,110) IEX,IEX,(RARRAY(I,J),J=IPAGE,NPAGE)
     +                               ,IEX,(CARRAY(I,J),J=IPAGE,NPAGE),IEX
      IF(IPAGE.NE.1) WRITE(IOUT,110) IB,IB,(RARRAY(I,J),J=IPAGE,NPAGE),
     +                               IB,(CARRAY(I,J),J=IPAGE,NPAGE),IB
 110  FORMAT(3X,A1,/,3X,A1,6G11.3,/,3X,A1,6G11.3,/,3X,A1)
      GO TO 400
 150  CONTINUE
      GO TO (160,200,240,280,320,360),NPAGE-IPAGE+1
 160  CONTINUE
      IF(IX.EQ.1) GO TO 180
      IF(IPAGE.EQ.1) WRITE(IOUT,170) IEX,IEX,I,IEX,(RARRAY(I,J),J=IPAGE,
     +     NPAGE),IEX,RLABEL(I),IEX,IEX
      IF(IPAGE.NE.1) WRITE(IOUT,170) IB,IEX,I,IB,(RARRAY(I,J),
     +     J=IPAGE,NPAGE),
     +     IEX,RLABEL(I),IB,IEX
 170  FORMAT(3X,A1,11X,A1,2X,I2,/,3X,A1,G11.3,A1,1X,A3,/,3X,A1,11X,A1)
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00060          GO TO 400
00061 190      CONTINUE
00062          IF(IPAGE.EQ.1) WRITE(IOUT,193) IEX,IEX,IEX,(RARRAY(I,J),J=IPAGE,
              +     NPAGE),IEX,I,IEX,(CARRAY(I,J),J=IPAGE,NPAGE),IEX,
              +     RLABEL(I),IEX,IEX
00064          IF(IPAGE.NE.1) WRITE(IOUT,193) IB,IEX,IB,(RARRAY(I,J),
              +     J=IPAGE,NPAGE),
              +     IB,I,IB,(CARRAY(I,J),J=IPAGE,NPAGE),IEX,RLABEL(I),IB,IEX
00066 193      FORMAT(3X,A1,11X,A1,/,3X,A1,G11.3,A1,2X,I2,/,3X,A1,G11.3,A1,
              +        1X,A3,/,3X,A1,11X,A1)
00067          GO TO 400
00068 200      CONTINUE
00069          IF(IX.EQ.1) GO TO 220
00071          IF(IPAGE.EQ.1) WRITE(IOUT,213) IEX,IEX,I,IEX,(RARRAY(I,J),J=IPAGE,
              +     NPAGE),IEX,RLABEL(I),IEX,IEX
00073          IF(IPAGE.NE.1) WRITE(IOUT,213) IB,IEX,I,IB,(RARRAY(I,J),
              +     J=IPAGE,NPAGE),
              +     IEX,RLABEL(I),IB,IEX
00075 213      FORMAT(3X,A1,22X,A1,2X,I2,/,3X,A1,2G11.3,A1,1X,A3,/,3X,A1,22X,A1)
00076          GO TO 400
00077 220      CONTINUE
00078          IF(IPAGE.EQ.1) WRITE(IOUT,233) IEX,IEX,IEX,(RARRAY(I,J),J=IPAGE,
              +     NPAGE),IEX,I,IEX,(CARRAY(I,J),J=IPAGE,NPAGE),IEX,
              +     RLABEL(I),IEX,IEX
00080          IF(IPAGE.NE.1) WRITE(IOUT,233) IB,IEX,IB,(RARRAY(I,J),
              +     I=IPAGE,NPAGE),
              +     IB,I,IB,(CARRAY(I,J),J=IPAGE,NPAGE),IEX,RLABEL(I),IB,IEX
00082 233      FORMAT(3X,A1,22X,A1,/,3X,A1,2G11.3,A1,2X,I2,/,3X,A1,2G11.3,A1,
              +        1X,A3,/,3X,A1,22X,A1)
00083          GO TO 400
00084 240      CONTINUE
00085          IF(IX.EQ.1) GO TO 260
00087          IF(IPAGE.EQ.1) WRITE(IOUT,253) IEX,IEX,I,IEX,(RARRAY(I,J),J=IPAGE,
              +     NPAGE),IEX,RLABEL(I),IEX,IEX
00089          IF(IPAGE.NE.1) WRITE(IOUT,253) IB,IEX,I,IB,(RARRAY(I,J),
              +     J=IPAGE,NPAGE),
              +     IEX,RLABEL(I),IB,IEX
00091 253      FORMAT(3X,A1,33X,A1,2X,I2,/,3X,A1,3G11.3,A1,1X,A3,/,3X,A1,33X,A1)
00092          GO TO 400
00093 260      CONTINUE
00094          IF(IPAGE.EQ.1) WRITE(IOUT,273) IEX,IEX,IEX,(RARRAY(I,J),J=IPAGE,
              +     NPAGE),IEX,I,IEX,(CARRAY(I,J),J=IPAGE,NPAGE),IEX,
              +     RLABEL(I),IEX,IEX
00096          IF(IPAGE.NE.1) WRITE(IOUT,273) IB,IEX,IB,(RARRAY(I,J),
              +     I=IPAGE,NPAGE),
              +     IB,I,IB,(CARRAY(I,J),J=IPAGE,NPAGE),IEX,RLABEL(I),IB,IEX
00098 273      FORMAT(3X,A1,33X,A1,/,3X,A1,3G11.3,A1,2X,I2,/,3X,A1,3G11.3,A1,
              +        1X,A3,/,3X,A1,33X,A1)
00099          GO TO 400
00100 280      CONTINUE
00101          IF(IX.EQ.1) GO TO 300
00103          IF(IPAGE.EQ.1) WRITE(IOUT,293) IEX,IEX,I,IEX,(RARRAY(I,J),J=IPAGE,
              +     NPAGE),IEX,RLABEL(I),IEX,IEX
00105          IF(IPAGE.NE.1) WRITE(IOUT,293) IB,IEX,I,IB,(RARRAY(I,J),
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     +      J=IPAGE,NPAGE),
     +      IEX,RLABEL(I),IB,IEX
00107 290   FORMAT(3X,A1,44X,A1,2X,I2,/,3X,A1,4G11.3,A1,1X,A3,/,3X,A1,44X,A1)
00108       GO TO 400
00109 300   CONTINUE
00110       IF(IPAGE.EQ.1) WRITE(IOUT,310) IEX,IEX,IEX,(RARRAY(I,J),J=IPAGE,
     +      NPAGE),IEX,I,IEX,(CARRAY(I,J),J=IPAGE,NPAGE),IEX,
     +      RLABEL(I),IEX,IEX
00112       IF(IPAGE.NE.1) WRITE(IOUT,310) IB,IEX,IB,(RARRAY(I,J),
     +      J=IPAGE,NPAGE),
     +      IB,I,IB,(CARRAY(I,J),J=IPAGE,NPAGE),IEX,RLABEL(I),IB,IEX
00114 310   FORMAT(3X,A1,44X,A1,/,3X,A1,4G11.3,A1,2X,I2,/,3X,A1,4G11.3,A1,
     +      1X,A3,/,3X,A1,44X,A1)
00115       GO TO 400
00116 320   CONTINUE
00117       IF(IX.EQ.1) GO TO 340
00119       IF(IPAGE.EQ.1) WRITE(IOUT,330) IEX,IEX,I,IEX,(RARRAY(I,J),J=IPAGE,
     +      NPAGE),IEX,RLABEL(I),IEX,IEX
00121       IF(IPAGE.NE.1) WRITE(IOUT,330) IB,IEX,I,IB,(RARRAY(I,J),
     +      J=IPAGE,NPAGE),
     +      IEX,RLABEL(I),IB,IEX
00123 330   FORMAT(3X,A1,55X,A1,2X,I2,/,3X,A1,5G11.3,A1,1X,A3,/,3X,A1,55X,A1)
00124       GO TO 400
00125 340   CONTINUE
00126       IF(IPAGE.EQ.1) WRITE(IOUT,350) IEX,IEX,IEX,(RARRAY(I,J),J=IPAGE,
     +      NPAGE),IEX,I,IEX,(CARRAY(I,J),J=IPAGE,NPAGE),IEX,
     +      RLABEL(I),IEX,IEX
00128       IF(IPAGE.NE.1) WRITE(IOUT,350) IB,IEX,IB,(RARRAY(I,J),
     +      J=IPAGE,NPAGE),
     +      IB,I,IB,(CARRAY(I,J),J=IPAGE,NPAGE),IEX,RLABEL(I),IB,IEX
00130 350   FORMAT(3X,A1,55X,A1,/,3X,A1,5G11.3,A1,2X,I2,/,3X,A1,5G11.3,A1,
     +      1X,A3,/,3X,A1,55X,A1)
00131       GO TO 400
00132 360   CONTINUE
00133       IF(IX.EQ.1) GO TO 390
00135       IF(IPAGE.EQ.1) WRITE(IOUT,370) IEX,IEX,I,IEX,(RARRAY(I,J),J=IPAGE,
     +      NPAGE),IEX,RLABEL(I),IEX,IEX
00137       IF(IPAGE.NE.1) WRITE(IOUT,370) IB,IEX,I,IB,(RARRAY(I,J),
     +      J=IPAGE,NPAGE),
     +      IEX,RLABEL(I),IB,IEX
00139 370   FORMAT(3X,A1,66X,A1,2X,I2,/,2X,A1,6G11.3,A1,1X,A3,/,3X,A1,66X,A1)
00140       GO TO 400
00141 380   CONTINUE
00142       IF(IPAGE.EQ.1) WRITE(IOUT,390) IEX,IEX,IEX,(RARRAY(I,J),J=IPAGE,
     +      NPAGE),IEX,I,IEX,(CARRAY(I,J),J=IPAGE,NPAGE),IEX,
     +      RLABEL(I),IEX,IEX
00144       IF(IPAGE.NE.1) WRITE(IOUT,390) IB,IEX,IB,(RARRAY(I,J),
     +      J=IPAGE,NPAGE),
     +      IB,I,IB,(CARRAY(I,J),J=IPAGE,NPAGE),IEX,RLABEL(I),IB,IEX
00146 390   FORMAT(3X,A1,66X,A1,/,2X,A1,6G11.3,A1,2X,I2,/,3X,A1,6G11.3,A1,
     +      1X,A3,/,3X,A1,66X,A1)
00147 400   CONTINUE
00148       WRITE(IOUT,50) (SUM(I),I=1,7)
00149       WRITE(IOUT,450)
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00150 450   FORMAT(/////)
00151 500   CONTINUE
00152       REWIND IOUT
00153       RETURN
00154       END
```

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CARRAY  00001AG 00002DI 00045#R 00047#R 00053#R 00055#R 00079#R 00081#R
        00095#R 00097#R 00111#R 00113#R 00127#R 00129#R 00143#R 00145#R
CLABEL  00001AG 00002DI 00010#R
I       00008#R 00013DO 00014   00015   00016#R 00018#R 00020DO 00021
        00032#R 00032DO 00038#R 00044#R 00045#R 00047#R 00056#R 00058#R
        00063#R 00065#R 00072#R 00074#R 00079#R 00081#R 00088#R 00090#R
        00095#R 00097#R 00104#R 00106#R 00111#R 00113#R 00120#R 00122#R
        00127#R 00129#R 00136#R 00138#R 00143#R 00145#R 00148#R
IB      00005DA 00021   00044#R 00047#R 00058#R 00065#R 00074#R 00081#R
        00095#R 00097#R 00106#R 00113#R 00122#R 00129#R 00138#R 00145#R
IDASHL  00005DA 00023
IDASHR  00005DA 00027
IDOTL   00005DA 00025
IDOTR   00005DA 00029
IEX     00005DA 00038#R 00045#R 00058#R 00058#R 00063#R 00065#R 00072#R
        00074#R 00079#R 00081#R 00088#R 00090#R 00095#R 00097#R 00104#R
        00106#R 00111#R 00113#R 00120#R 00122#R 00127#R 00129#R 00136#R
        00138#R 00143#R 00145#R
II      00014=  00015
IIN     00004CN
IO      00004CN
IOUT    00004C4 00008#R 00016#R 00018#R 00030#R 00038#R 00040#R 00045#R
        00047#R 00058#R 00058#R 00063#R 00065#R 00072#R 00074#R 00079#R
        00081#R 00088#R 00090#R 00095#R 00097#R 00104#R 00106#R 00111#R
        00113#R 00120#R 00122#R 00127#R 00129#R 00136#R 00138#R 00143#R
        00148#R 00148#R 00149#R 00152#R
IPAGE   00006DO 00007IF 00010   00013DO 00014   00016#R 00018#R 00022IF
        00024IF 00027   00037IF 00038#R 00039IF 00040#R 00044IF 00045#R
        00046IF 00047#R 00051GT 00055IF 00058#R 00057IF 00058#R 00062IF
        00063#R 00064IF 00065#R 00071IF 00072#R 00073IF 00074#R 00078IF
        00079#R 00080IF 00081#R 00087IF 00088#R 00089IF 00090#R 00094IF
        00095#R 00096IF 00097#R 00103IF 00104#R 00105IF 00106#R 00110IF
        00111#R 00112IF 00113#R 00119IF 00120#R 00121IF 00122#R 00126IF
        00127#R 00128IF 00129#R 00135IF 00136#R 00137IF 00138#R 00142IF
        00143#R 00144IF 00145#R
IX      00001AG 00035IF 00053IF 00058IF 00085IF 00101IF 00117IF 00133IF
J       00038#R 00040#R 00045#R 00047#R 00058#R 00058#R 00063#R 00065#R
        00072#R 00074#R 00079#R 00081#R 00088#R 00090#R 00095#R 00097#R
        00104#R 00106#R 00111#R 00113#R 00120#R 00122#R 00127#R 00129#R
        00138#R 00138#R 00143#R 00145#R
MATLIS  00001SU
NC      00001AG 00002DI 00006DO 00011IF 00012   00026IF 00028IF 00033IF
NDIM    00001AG 00002DI
NPAGE   00010=  00011IF 00012=  00013DO 00016#R 00018#R 00026IF 00027
        00028IF 00033IF 00038#R 00040#R 00045#R 00047#R 00051GT 00058#R
        00058#R 00063#R 00065#R 00072#R 00074#R 00079#R 00081#R 00088#R
        00090#R 00095#R 00097#R 00104#R 00106#R 00111#R 00113#R 00120#R
        00122#R 00127#R 00129#R 00136#R 00138#R 00143#R 00145#R
NR      00001AG 00002DI 00032DO
NT      00001AG 00003LG 00038#R
NUM     00002DI 00015=  00016#R 00021=  00023=  00025=  00027=  00029=
        00038#R 00148#R
RARRAY  00001AG 00002DI 00038#R 00040#R 00045#R 00047#R 00058#R 00058#R
        00063#R 00065#R 00072#R 00074#R 00079#R 00081#R 00088#R 00090#R
```

```
            00099#R 00097#R 00134#R 00100#R 00112#R 00113#R 00120#R 00122#R
            00127#R 00129#R 00130#R 00130#R 00143#R 00145#R
RLABEL      00001#G 00002DI 00059#R 00057#R 00053#R 00055#R 00072#R 00074#R
            00079#R 00081#R 00088#R 00097#R 00095#R 00097#R 00104#R 00103#R
            00111#R 00113#R 00120#R 00122#R 00127#R 00129#R 00130#R 00138#R
            00143#R 00145#R
TITLE       00001#G 00003LG 00008#R
10          00008#R 00009*
100         00036#T 00043*
110         00045#R 00047#R 00048*
150         00034#T 00050*
160         00051#T 00052*
170         00053#R 00058#R 00059*
180         00054#T 00061*
190         00063#R 00065#R 00066*
20          00013DO 00015*
200         00051#T 00069*
210         00077#R 00074#R 00075*
220         00070#T 00077*
230         00079#R 00081#R 00082*
240         00051#T 00084*
250         00088#R 00090#R 00091*
260         00086#T 00093*
270         00095#R 00097#R 00098*
280         00051#T 00100*
290         00104#R 00106#R 00107*
30          00010#R 00017*
300         00102#T 00109*
310         00112#R 00113#R 00114*
320         00051#T 00116*
330         00120#R 00122#R 00123*
340         00118#T 00125*
350         00127#R 00129#R 00130*
360         00051#T 00132*
370         00136#R 00138#R 00139*
380         00134#T 00141*
390         00143#R 00145#R 00146*
40          00010#R 00019*
400         00032DO 00042#T 00049#T 00056#T 00067#T 00074#T 00083#T 00092#T
            00099#T 00108#T 00115#T 00124#T 00131#T 00140#T 00147*
45          00002DO 00021*
450         00149#R 00150*
50          00023#R 00021*  00145#R
500         00016DO 00151*
60          00039#R 00046#R 00041*
```

```
00001        SUBROUTINE BALANC(NM,N,A,LOW,IGH,SCALE)
00002        INTEGER I,J,K,L,M,N,JJ,NM,IGH,LOW,IEXC
00003        REAL A(NM,N),SCALE(N)
00004        REAL C,F,G,R,S,B2,RADIX
00005        REAL ABS
00006        LOGICAL NOCONV
             C
             C
             C
00007        RADIX=2
00008        B2=RADIX*RADIX
00009        K=1
00010        L=N
00011        GO TO 100
             C
             C
00012 20     SCALE(M)=J
00013        IF(J.EQ.M) GO TO 50
00015        DO 30 I=1,L
00016        F=A(I,J)
00017        A(I,J)=A(I,M)
00018        A(I,M)=F
00019 30     CONTINUE
00020        DO 40 I=K,N
00021        F=A(J,I)
00022        A(J,I)=A(M,I)
00023        A(M,I)=F
00024 40     CONTINUE
00025 50     GO TO (80,130),IEXC
             C
             C
00026 80     IF(L.EQ.1) GO TO 280
00028        L=L-1
             C
00029 100    DO 120 JJ=1,L
00030        J=L+1-JJ
00031        DO 110 I=1,L
00032        IF(I.EQ.J) GO TO 110
00034        IF(A(J,I).NE.0.0) GO TO 120
00036 110    CONTINUE
00037        M=L
00038        IEXC=1
00039        GO TO 20
00040 120    CONTINUE
00041        GO TO 140
             C
             C
00042 130    K=K+1
00043 140    DO 170 J=K,L
00044        DO 150 I=K,L
00045        IF(I.EQ.J) GO TO 150
00047        IF(A(I,J).NE.0.0) GO TO 170
00049 150    CONTINUE
00050        M=K
```

```
00051          IEXC=2
00052          GO TO 20
00053 170      CONTINUE
       C       ********** NOW BALANC THE SUBMATRIX IN ROWS K TO L **********
00054          DO 180 I=K,L
00055 180      SCALE(I)=1.0
       C       ********** ITERATIVE LOOP FOR NORM REDUCTION **********
00056 190      NOCONV=.FALSE.
00057          DO 270 I=K,L
00058          C=0.0
00059          R=0.0
00060          DO 200 J=K,L
00061          IF(J.EQ.I) GO TO 200
00063          C=C+ABS(A(J,I))
00064          R=R+ABS(A(I,J))
00065 200      CONTINUE
       C       ********** GUARD AGAINST ZERO C OR R DUE TO UNDERFLOW **********
00066          IF(C.EQ.0.0.OR.R.EQ.0.0) GO TO 270
00068          G=R/RADIX
00069          F=1.0
00070          S=C+R
00071 210      IF(C.GE.G) GO TO 220
00073          F=F*RADIX
00074          C=C*B2
00075          GO TO 210
00076 220      G=R*RADIX
00077 230      IF(C.LT.G) GO TO 240
00079          F=F/RADIX
00080          C=C/B2
00081          GO TO 230
       C       ********** NOW BALANC **********
00082 240      IF((C+R)/F.GE.0.95*S) GO TO 270
00084          G=1.0/F
00085          SCALE(I)=SCALE(I)*F
00086          NOCONV=.TRUE.
00087          DO 250 J=K,N
00088 250      A(I,J)=A(I,J)*G
00089          DO 260 J=1,L
00090 260      A(J,I)=A(J,I)*F
00091 270      CONTINUE
00092          IF(NOCONV) GO TO 190
00094 280      LOW=K
00095          IGH=L
00096          RETURN
00097          END
```

```
A       000001AG 000003RL 000016   000017=  000018=  000021   000022=  000023=
        000034IF 000047IF 000063   000064   000088=  000094=
ABS     000005RL 000063   000064
BALANC  000001SU
B2      000004RL 000008=  000074   000084
C       000004RL 000056=  000063=  000066IF 000070   000071IF 000074=  000077IF
        000080=  000082IF
F       000004RL 000016=  000018   000021=  000023   000069=  000073=  000079=
        000082IF 000084   000085   000090
G       000004RL 000068=  000071IF 000076=  000077IF 000084=  000086
I       000002IN 000015DO 000016   000017   000018   000020DO 000021   000022
        000023   000031DO 000032IF 000034IF 000044DO 000045IF 000047IF 000054DO
        000055   000057DO 000061IF 000063   000064   000085   000088   000090
IEXC    000002IN 000025GT 000030=  000051=
IGN     000001AG 000002IN 000095=
J       000002IN 000012   000013IF 000016   000017   000021   000022   000037=
        000032IF 000034IF 000043DO 000045IF 000047IF 000060DO 000061IF 000063
        000064   000067DO 000088   000089DO 000093
JJ      000002IN 000029DO 000030
K       000002IN 000009=  000020DO 000042=  000043DO 000044DO 000058   000054DO
        000057DO 000060DO 000087DO 000094
L       000002IN 000010=  000015DO 000026IF 000028=  000029DO 000030   000031DO
        000037   000043DO 000044DO 000054DO 000057DO 000060DO 000089DO 000095
LOW     000001AG 000002IN 000094=
M       000002IN 000012   000013IF 000017   000018   000022   000023   000037=
        000050=
N       000001AG 000002IN 000003RL 000010   000020DO 000087DO
N4      000001AG 000002IN 000003RL
NOCONV  000006LG 000056=  000096=  000092IF
R       000004RL 000059=  000064=  000066IF 000068   000070   000076   000082IF
RADIX   000004RL 000037=  000038   000068   000073   000076   000079
S       000004RL 000070=  000002IF
SCALE   000001AG 000003RL 000012=  000055=  000065=
100     000011GT 000029*
110     000031DO 000036GT 000036*
120     000029DO 000035GT 000040*
130     000025GT 000042*
140     000041GT 000043*
150     000044DO 000046GT 000046*
170     000043DO 000048GT 000053*
180     000054DO 000055*
190     000056*  000093GT
20      000012*  000039GT 000052GT
200     000050DO 000052GT 000065*
210     000071*  000075GT
220     000072GT 000076*
230     000077*  000081GT
240     000078GT 000082*
250     000087DO 000088*
260     000089DO 000090*
270     000057DO 000062GT 000083GT 000091*
280     000022GT 000094*
30      000015DO 000019*
40      000020DO 000024*
```

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50 [illegible] 00025*
30 [illegible] 00026*

```
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00001          SUBROUTINE BALBAK(NM,N,LOW,IGH,SCALE,M,Z)
00002          INTEGER I,J,K,M,N,II,NM,IGH,LOW
00003          REAL SCALE(N),Z(NM,M)
00004          REAL S
00005          IF(M.EQ.0) GO TO 200
00006          IF(IGH.EQ.LOW) GO TO 120
00007          DO 110 I=LOW,IGH
00008          S=SCALE(I)
               C     ********** LEFT HAND EIGENVECTORS ARE BACK TRANSFORMED
               C                IF THE FOREGOING STATEMENT IS REPLACED BY
               C                S=1.0/SCALE(I). **********
00009          DO 100 J=1,M
00010    100   Z(I,J)=Z(I,J)*S
00011    110   CONTINUE
               C     ********** FOR I=LOW-1 STEP -1 UNTIL 1,
               C                IGH+1 STEP 1 UNTIL N DO -- **********
00012    120   DO 140 II=1,N
00013          I=II
00014          IF(I.GE.LOW.AND.I.LE.IGH) GO TO 140
00015          IF(I.LT.LOW) I=LOW-II
00016          K=SCALE(I)
00017          IF(K.EQ.I) GO TO 140
00018          DO 130 J=1,M
00019          S=Z(I,J)
00020          Z(I,J)=Z(K,J)
00021          Z(K,J)=S
00022    130   CONTINUE
00023    140   CONTINUE
00024    200   RETURN
00025          END
```

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```
BALMAK  000015U
I       00002IN 00009DO 00010   00012   00015*  00016IF 00018IF 00019*
        00020   00021IF 00024   00025
IGM     00001AG 00002IN 00007IF 00009DO 00016IF
II      00002IN 00014DO 00015   00019
J       00002IN 00011DO 00012   00023DO 00024   00025   00026
K       00002IN 00020*  00021IF 00025   00026
LON     00001AG 00002IN 00007IF 00009DO 00016IF 00018IF 00019
M       00001AG 00002IN 00003RL 00005IF 00011DO 00023DO
N       00001AG 00002IN 00003RL 00014DO
NM      00001AG 00002IN 00003RL
S       00003RL 00010*  00012   00024*  00026
SCALE   00001AG 00003RL 00010   00024
Z       00001AG 00003RL 00012*  00024   00025*  00025*
100     00011DO 00012*
110     00009DO 00013*
120     00008GT 00014*
130     00022DO 00027*
140     00021DO 00017GT 00022GT 00023*
200     00006GT 00029*
```

```
00001          SUBROUTINE DECOMP(NDIM,N,A,COND,IPVT,WORK)
00002          INTEGER NDIM,N
00003          COMPLEX A(NDIM,N),T
00004          INTEGER IPVT(N)
               C     DECOMPOSES A COMPLEX MATRIX BY GAUSSIAN ELIMINATION
               C     AND ESTIMATES THE CONDITION OF THE MATRIX.
               C     USE SOLVE TO COMPUTE SOLUTIONS TO LINEAR SYSTEMS.
               C     INPUT..
               C       NDIM = DECLARED ROW DIMENSION OF THE ARRAY CONTAINING A.
               C       N = ORDER OF THE MATRIX.
               C       A = MATRIX TO BE TRIANGULARIZED.
               C     OUTPUT..
               C       A CONTAINS AN UPPER TRIANGULAR MATRIX U AND A PERMUTED
               C        VERSION OF A LOWER TRIANGULAR MATRIX I-L SO THAT
               C        (PERMUTATION MATRIX)*A = L*U
               C       COND = AN ESTIMATE OF THE CONDITION OF A.
               C         FOR THE LINEAR SYSTEM A*X = B, CHANGES IN A AND B
               C         MAY CAUSE CHANGES COND TIMES AS LARGE IN X.
               C         IF COND+1.0 .EQ. COND, A IS SINGULAR TO WORKING
               C         PRECISION. COND IS SET TO 1.0E+32 IF EXACT
               C         SINGULARITY IS DETECTED.
               C       IPVT = THE PIVOT VECTOR.
               C         IPVT(K) = THE INDEX OF THE K-TH PIVOT ROW
               C         IPVT(N) = (-1)**(NUMBER OF INTERCHANGES)
               C     WORK SPACE.. THE VECTOR WORK MUST BE DECLARED AND INCLUDED
               C                  IN THE CALL. ITS INPUT CONTENTS ARE IGNORED.
               C                  ITS OUTPUT CONTENTS ARE USUALLY UNIMPORTANT.
               C     THE DETERMINANT OF A CAN BE OBTAINED ON OUTPUT BY
               C       DET(A) = IPVT(N)*A(1,1)*A(2,2)*...*A(N,N).
00005          INTEGER NM1,I,J,K,KP1,KB,KM1,M
00006          COND=1.0
00007          IPVT(N)=1
00008          IF(N.EQ.1) GO TO 80
00010          NM1=N-1
               C     GAUSSIAN ELIMINATION WITH PARTIAL PIVOTING
00011          DO 35 K=1,NM1
00012          KP1=K+1
               C     FIND PIVOT
00013          M=K
00014          DO 15 I=KP1,N
00015          IF(CABS(A(I,K)).GT.CABS(A(M,K))) M=I
00017 15       CONTINUE
00018          IPVT(K)=M
00019          IF(M.NE.K) IPVT(N)=-IPVT(N)
00021          T=A(M,K)
00022          A(M,K)=A(K,K)
00023          A(K,K)=T
               C     SKIP STEP IF PIVOT IS ZERO
00024          IF(T.EQ.CMPLX(0.0,0.0)) GO TO 35
               C     COMPUTE MULTIPLIERS
00026          DO 20 I=KP1,N
00027          A(I,K)=-A(I,K)/T
00028 20       CONTINUE
               C     INTERCHANGE AND ELIMINATE BY COLUMNS
```

```
00029          DO 30 J=KP1,N
00030          T=A(M,J)
00031          A(M,J)=A(K,J)
00032          A(K,J)=T
00033          IF(T.EQ.CMPLX(0.0,0.0)) GO TO 30
00035          DO 35 I=KP1,N
00036          A(I,J)=A(I,J)+A(I,K)*T
00037    25    CONTINUE
00038    30    CONTINUE
00039    35    CONTINUE
00040          DO 40 I=1,N
00041    40    IF(A(I,I).EQ.CMPLX(0.,0.)) GO TO 90
00043          RETURN
         C     1 BY 1
00044    90    COND=1.0
00045          IF(A(1,1).NE.CMPLX(0.0,0.0)) RETURN
         C     EXACT SINGULARITY
00047    95    COND=1.0E+32
00048          RETURN
00049          END
```

```
A       000014G 000030X 00015IF 00021   00022=  00023=  00027=  00033
        00031=  00032=  00035=  00041IF 00045IF
CABS    00015IF
CMPLX   00024IF 00033IF 00041IF 00045IF
COND    000014G 00035=  00044=  00047=
DECOMP  000010U
I       000005IN 000100O 00015IF 00016   000200O 00027   000350O 00036
        000400O 00041IF
IPVT    000014G 000041N 00007=  00010=  00020=
J       000005IN 000200O 00030   00031   00032   00036
X       000005IN 000100O 00012   00013   00015IF 00018   00019IF 00021
        00022   00023   00027   00031   00032   00036
XB      000005IN
XR1     000005IN
XP1     000005IN 00012=  000140O 000200O 000250O 000350O
Y       000005IN 00013=  00015IF 00016=  00018   00019IF 00021   00022
        00030   00031
N       000014G 000021N 000030X 000041N 00007   00010IF 00010   000140O
        00020   000200O 000250O 000350O 000400O
NDIM    000014G 000021N 000030X
NM1     000005IN 00010=  000110O
T       000030X 00021=  00023   00024IF 00027   00030=  00032   00033IF
        00036
WORK    000014G
15      000400O 00017*
20      000250O 00020*
25      000350O 00037*
30      000200O 000340T 00038*
35      000110O 000250T 00039*
40      000400O 00041*
80      000200T 00044*
90      000240T 00047*
```

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POOR QUALITY

```
0001        SUBROUTINE EIGRF(A,N,IA,IJOB,W,Z,INT,SCALE,WR,WI,WK,IER)
            C  FUNCTION - TO CALCULATE EIGENVALUES AND (OPTIONALLY)
            C             EIGENVECTORS OF A REAL GENERAL MATRIX.
            C  ARGUMENTS  A   - INPUT REAL GENERAL MATRIX WITH ROW
            C                   DIMENSION IA AND COLUMN DIMENSION
            C                   AT LEAST N.
            C             N   - ORDER OF MATRIX A.
            C             IA  - ROW DIMENSION OF MATRIX A; IA MUST
            C                   BE GREATER THAN OR EQUAL TO N.
            C             IJOB- OPTION PARAMETER:
            C                   IJOB=0, COMPUTE EIGENVALUES ONLY
            C                   IJOB=1, COMPUTE EIGENVALUES AND
            C                           EIGENVECTORS.
            C             W   - OUTPUT COMPLEX VECTOR OF LENGTH N
            C                   CONTAINING THE EIGENVALUES OF A.
            C             Z   - OUTPUT N BY N COMPLEX MATRIX
            C                   CONTAINING THE EIGENVECTORS OF A;
            C                   THE EIGENVECTOR IN COLUMN J OF Z
            C                   CORRESPONDS TO THE EIGENVALUE W(J).
            C             INT,SCALE,WR,WI,WK - WORKING SPACE
            C             IER - IER=128+J INDICATES THAT MORE THAN
            C                   30 ITERATIONS WERE REQUIRED TO
            C                   COMPUTE THE JTH EIGENVALUE. EIGENVALUES
            C                   J+1,J+2,...,N HAVE BEEN CORRECTLY
            C                   COMPUTED, WHILE EIGENVALUES 1,...,J
            C                   ARE SET TO ZERO. NO EIGENVECTORS ARE
            C                   COMPUTED.
0002        INTEGER I,IA,IER,IERR,IGH,IJOB,J,LOW,N
0003        INTEGER INT(IA)
0004        DIMENSION SCALE(IA),WR(IA),WI(IA)
0005        DIMENSION A(IA,N),WK(IA,N)
0006        COMPLEX W(N),Z(IA,N)
0007        IER=0
0008        IF(IJOB.NE.0.AND.IJOB.NE.1) IJOB=1
0009        CALL BALANC(IA,N,A,LOW,IGH,SCALE)
0011        CALL ELMHES(IA,N,LOW,IGH,A,INT)
            C     EIGENVALUES ONLY
0012        IF(IJOB.NE.0) GO TO 10
0014        CALL HQR(IA,N,LOW,IGH,A,WR,WI,IERR)
0015        IF(IERR.NE.0) GO TO 20
0017        GO TO 30
            C     EIGENVALUES AND EIGENVECTORS
0018  10    CALL ELTRAN(IA,N,LOW,IGH,A,INT,WK)
0019        CALL HQR2(IA,N,LOW,IGH,A,WR,WI,WK,IERR)
0021        IF(IERR.NE.0) GO TO 20
0022        CALL BABAK(IA,N,LOW,IGH,SCALE,N,WK)
0023        GO TO 30
            C     ERROR HANDLING
0024  20    IER=128+IERR
            C     ENCODE EIGENVALUES AND EIGENVECTORS
            C     AS COMPLEX NUMBERS
0025  30    DO 40 I=1,N
0025  40    W(I)=CMPLX(WR(I),WI(I))
0027        IF(IJOB.EQ.0.OR.IER.NE.0) RETURN
```

```
00029        DO 50 J=1,N
00030        DO 50 I=1,N
00031        IF(WI(J).EQ.0.) Z(I,J)=CMPLX(WR(I,J),0.)
00033        IF(WI(J).GT.0.) Z(I,J)=CMPLX(WR(I,J),WR(I,J+1))
00035        IF(WI(J).LT.0.) Z(I,J)=CMPLX(WR(I,J-1),-WR(I,J))
00037  50    CONTINUE
00038        RETURN
00039        END
```

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```
A       0001AG 0005DI 0010AG 0011AG 0014AG 0018AG 0019AG
BALANC  0013CL
BALBAK  0022CL
CMPLX   0026   0032   0034   0036
EIGRF   0001SU
ELMHES  0011CL
ELTRAN  0010CL
HQR     0014CL
HQR2    0019CL
I       0002IN 0025DO 0026   0030DO 0032   0034   0036
IA      0001AG 0002IN 0003IN 0004DI 0005DI 0006CX 0010AG 0011AG
        0014AG 0018AG 0019AG 0022AG
IER     0001AG 0002IN 0007=  0024=  0027IF
IERR    0002IN 0004AG 0015IF 0019AG 0032IF 0024
IGH     0002IN 0010AG 0011AG 0014AG 0018AG 0019AG 0022AG
IJOB    0001AG 0002IN 0003IF 0009=  0012IF 0027IF
INT     0001AG 0003IN 0011AG 0018AG
J       0002IN 0025DO 0031IF 0032   0033IF 0034   0035IF 0036
LOW     0002IN 0010AG 0011AG 0014AG 0018AG 0019AG 0022AG
N       0001AG 0002IN 0005DI 0006CX 0010AG 0011AG 0014AG 0018AG
        0019AG 0022AG 0025DO 0029DO 0030DO
SCALE   0001AG 0004DI 0010AG 0022AG
W       0001AG 0006CX 0026=
WI      0001AG 0004DI 0014AG 0019AG 0026   0031IF 0033IF 0035IF
WK      0001AG 0005DI 0018AG 0019AG 0022AG 0032   0034   0036
WR      0001AG 0004DI 0014AG 0019AG 0026
Z       0001AG 0006CX 0032=  0034=  0036=
10      0013GT 0018*
20      0014GT 0021GT 0024*
30      0017GT 0023GT 0025*
40      0025DO 0026*
50      0029DO 0030DO 0037*
```

```
00001        SUBROUTINE ELMHES(NM,N,LOW,IGH,A,INT)
00002        INTEGER I,J,M,N,LA,NM,IGH,KP1,LOW,MM1,MP1
00003        REAL A(NM,N)
00004        REAL X,Y
00005        REAL ABS
00006        INTEGER INT(IGH)
00007        LA=IGH-1
00008        KP1=LOW+1
00009        IF(LA.LT.KP1) GO TO 200
00011        DO 180 M=KP1,LA
00012        MM1=M-1
00013        X=0.0
00014        I=M
00015        DO 100 J=M,IGH
00016        IF(ABS(A(J,MM1)).LE.ABS(X)) GO TO 100
00018        X=A(J,MM1)
00019        I=J
00020 100    CONTINUE
00021        INT(M)=I
00022        IF(I.EQ.M) GO TO 130
     C       ********** INTERCHANGE ROWS AND COLUMNS OF A **********
00024        DO 110 J=MM1,N
00025        Y=A(I,J)
00026        A(I,J)=A(M,J)
00027        A(M,J)=Y
00028 110    CONTINUE
00029        DO 120 J=1,IGH
00030        Y=A(J,I)
00031        A(J,I)=A(J,M)
00032        A(J,M)=Y
00033 120    CONTINUE
     C       ********** END INTERCHANGE **********
00034 130    IF(X.EQ.0.0) GO TO 180
00035        MP1=M+1
00037        DO 160 I=MP1,IGH
00038        Y=A(I,MM1)
00039        IF(Y.EQ.0.0) GO TO 160
00041        Y=Y/X
00042        A(I,MM1)=Y
00043        DO 140 J=M,N
00044 140    A(I,J)=A(I,J)-Y*A(M,J)
00045        DO 150 J=1,IGH
00046 150    A(J,M)=A(J,M)+Y*A(J,I)
00047 160    CONTINUE
00048 180    CONTINUE
00049 200    RETURN
00050        END
```

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```
A       00001AG 00003RL 00016IF 00018   00025   00026=  00027=  00030
        00031=  00032=  00038   00042=  00044=  00046=
ABS     00000RL 00016IF
ELMNTS  00001SU
I       00002IN 00014=  00019=  00021   00022IF 00025   00026   00030
        00031   00037DO 00038   00042   00044   00046
IGH     00001AG 00002IN 00006IN 00007   00015DO 00029DO 00037DO 00045DO
INT     00001AG 00006IN 00021=
J       00002IN 00015DO 00016IF 00018   00019   00024DO 00025   00026
        00027   00029DO 00030   00031   00032   00043DO 00044   00045DO
        00046
KPI     00002IN 00008=  00009IF 00011DO
LA      00002IN 00007=  00009IF 00011DO
LON     00001AG 00002IN 00008
M       00002IN 00011DO 00012   00014   00015DO 00021   00022IF 00026
        00027   00031   00032   00036   00043DO 00044   00046
MM1     00002IN 00012=  00016IF 00018   00024DO 00038   00042
MPI     00002IN 00036=  00037DO
N       00001AG 00002IN 00003RL 00024DO 00043DO
NM      00001AG 00002IN 00003RL
X       00004RL 00013=  00016IF 00018=  00034IF 00041
Y       00004RL 00025=  00027   00030=  00032   00039=  00039IF 00041=
        00042   00044   00046
100     00015DO 00017GT 00020*
110     00024DO 00028*
120     00029DO 00033*
130     00023GT 00034*
140     00043DO 00044*
150     00045DO 00046*
160     00037DO 00040GT 00047*
180     00011DO 00035GT 00048*
200     00010GT 00049*
```

```
00001        SUBROUTINE ELTRAN(NM,N,LOW,IGH,A,INT,Z)
00002        INTEGER I,J,N,KL,MM,MP,NM,IGH,LOW,MP1
00003        REAL A(NM,IGH),Z(NM,N)
00004        INTEGER INT(IGH)
     C       ********** INITIALIZE Z TO IDENTITY MATRIX **********
00005        DO 80 I=1,N
00006        DO 60 J=1,N
00007 60     Z(I,J)=0.0
00008        Z(I,I)=1.0
00009 80     CONTINUE
00010        KL=IGH-LOW-1
00011        IF(KL.LT.1) GO TO 200
     C       ********** FOR MP=IGH-1 STEP -1 UNTIL LOW+1 DO -- **********
00013        DO 140 MM=1,KL
00014        MP=IGH-MM
00015        MP1=MP+1
00016        DO 100 I=MP1,IGH
00017 100    Z(I,MP)=A(I,MP-1)
00018        I=INT(MP)
00019        IF(I.EQ.MP) GO TO 140
00021        DO 130 J=MP,IGH
00022        Z(MP,J)=Z(I,J)
00023        Z(I,J)=0.0
00024 130    CONTINUE
00025        Z(I,MP)=1.0
00026 140    CONTINUE
00027 200    RETURN
00028        END
```

```
 MT-11 INDEX V03  CROSS REFERENCE LISTING 13-APR-79 04:21:14 PAGE 00002
A       00001AG 00003RL 00017
ELTRAN  00001GU
I       00002IN 00005DO 00007   00008   00016DO 00017   00018=  00019IF
        00022   00023   00025
IGN     00001AG 00002IN 00003RL 00004IN 00010   00014   00016DO 00021DO
INT     00001AG 00004IN 00018
J       00002IN 00006DO 00007   00021DO 00022   00023
KL      00002IN 00010=  00011IF 00213DO
LOW     00001AG 00002IN 00010
M4      00002IN 00013DO 00014
MP      00002IN 00014=  00015   00017   00018   00019IF 00021DO 00022
        00025
MP1     00002IN 00015=  00016DO
N       00001AG 00002IN 00003RL 00005DO 00006DO
N4      00001AG 00002IN 00003RL
Z       00001AG 00003RL 00007=  00008=  00017=  00022=  00023=  00025=
16D     00016DO 00017*
13D     00021DO 00024*
14D     00012DO 00020GT 00026*
20D     00012GT 00027*
6W      00006DO 00007*
8D      00005DO 00009*
```

```
00001        SUBROUTINE GMINV(NR,NC,A,U,MR,MT)
             C
             C    GENERAL MATRIX INVERSE
             C
             C    INPUTS - NR = NUMBER OF ROWS IN A
             C             NC = NUMBER OF COLUMNS IN A
             C              A = MATRIX TO BE INVERTED
             C             MT = NOT USED
             C    OUTPUTS-  U = INVERTED MATRIX
             C             MR = RANK OF INVERTED MATRIX
00002        DIMENSION A(1),U(1),S(30)
00003        COMMON/NONAME/ NDIM
00004        NDIM1=NDIM+1
00005        TOL=1.E-14
00006        ADV=1.E-24
00007        MR=NC
00008        NRM1=NR-1
00009        TOL1=0.
00010        JJ=1
00011        DO 10 J=1,NC
00012        S(J)=DOT(NR,A(JJ),A(JJ))
00013        IF(S(J).GT.TOL1) TOL1=S(J)
00015 10     JJ=JJ+NDIM
00016        TOL1=ADV*TOL1
00017        ADV=TOL1
00018        JJ=1
00019        DO 100 J=1,NC
00020        FAC=S(J)
00021        JM1=J-1
00022        JRM=JJ+NRM1
00023        JCM=JJ+JM1
00024        DO 20 I=JJ,JCM
00025 20     U(I)=0.
00026        U(JCM)=1.0
00027        IF(J.EQ.1) GO TO 54
00029        KK=1
00030        DO 30 K=1,JM1
00031        IF(S(K).EQ.1.0) GO TO 30
00033        TEMP=-DOT(NR,A(JJ),A(KK))
00034        CALL VADD(K,TEMP,U(JJ),U(KK))
00035 30     KK=KK+NDIM
00036        DO 50 L=1,2
00037        KK=1
00038        DO 50 K=1,JM1
00039        IF(S(K).EQ.0.) GO TO 50
00041        TEMP=-DOT(NR,A(JJ),A(KK))
00042        CALL VADD(NR,TEMP,A(JJ),A(KK))
00043        CALL VADD(K,TEMP,U(JJ),U(KK))
00044 50     KK=KK+NDIM
00045        TOL1=TOL*FAC+ADV
00046        FAC=DOT(NR,A(JJ),A(JJ))
00047 54     IF(FAC.GT.TOL1) GO TO 70
00049        DO 55 I=JJ,JRM
00050 55     A(I)=0.
00051        S(J)=0.
00052        KK=1
```

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```
00353          DO 65 K=1,JM1
00354          IF(S(K).EQ.0.) GO TO 65
00356          TEMP=-DOT(K,U(KK),U(JJ))
00357          CALL VADD(NR,TEMP,A(JJ),A(KK))
00358    65    KK=KK+NDIM
00359          FAC=DOT(J,U(JJ),U(JJ))
00360          NR=NR-1
00361          GO TO 75
00362    70    S(J)=1.0
00363          KK=1
00364          DO 72 K=1,JM1
00365          IF(S(K).EQ.1.) GO TO 72
00367          TEMP=-DOT(NR,A(JJ),A(KK))
00368          CALL VADD(K,TEMP,U(JJ),U(KK))
00369    72    KK=KK+NDIM
00370    75    FAC=1./SQRT(FAC)
00371          DO 80 I=JJ,JCM
00372    80    A(I)=A(I)*FAC
00373          DO 85 I=JJ,JCM
00374    85    U(I)=U(I)*FAC
00375   100    JJ=JJ+NDIM
00376          NEND=NC*NDIM
00377          JJ=1
00378          DO 135 J=1,NC
00379          DO 125 I=1,NR
00380          II=I-J
00381          S(I)=0.
00382          DO 125 KK=JJ,NEND,NDIM
00383   125    S(I)=S(I)+A(II+KK)*U(KK)
00384          II=J
00385          DO 133 I=1,NR
00386          U(II)=S(I)
00387   133    II=II+NDIM
00388   135    JJ=JJ+NDIM1
00389          RETURN
00390          END
```

```
A        00001AG 00002DI 00012   00033   00041   00042AG 00046   00050=
         00057AG 00067   00072=  00083
ADV      00006=  00016   00017=  00045
DOT      00012   00033   00041   00046   00055   00059   00067
FAC      00020=  00045   00046=  00047IF 00059=  00070=  00072   00074
G*INV    00015U
I        00024DO 00025   00049DO 00053   00071DO 00072   00073DO 00074
         00079DO 00080   00081   00083   00085DO 00085
II       00080=  00083   00084=  00086   00087=
J        00011DO 00012   00013IF 00014   00019DO 00020   00021   00027IF
         00051   00059   00062   00078DO 00080   00084
JCM      00023=  00024DO 00026   00073DO
JJ       00010=  00012   00015=  00018=  00022   00023   00024DO 00033
         00034AG 00041   00042AG 00043AG 00045   00049DO 00055   00057AG
         00059   00067   00068AG 00071DO 00073DO 00075=  00077=  00082DO
         00088=
JM1      00021=  00023   00030DO 00039DO 00053DO 00064DO
JRM      00022=  00049DO 00071DO
K        00030DO 00031IF 00034AG 00038DO 00039IF 00043AG 00053DO 00054IF
         00055   00064DO 00065IF 00068AG
KK       00029=  00033   00034AG 00035=  00037=  00041   00042AG 00043AG
         00044=  00052=  00055   00057AG 00058=  00063=  00067   00068AG
         00069=  00082DO 00083
L        00035DO
MP       00001AG 00007=  00050=
MT       00001AG
NC       00001AG 00007   00011DO 00019DO 00076   00073DO
NDIM     00003CM 00004   00015   00035   00044   00058   00059   00075
         00076   00082DO 00087
NDIM1    00004=  00028
NEND     00076=  00082DO
NSNAME   00003CM
NR       00001AG 00008   00012   00033   00041   00042AG 00046   00057AG
         00067   00079DO 00085DO
NRM1     00008=  00022
S        00002DI 00012=  00013IF 00014   00020   00031IF 00039IF 00051=
         00054IF 00062=  00065IF 00081=  00083=  00086
SORT     00070
TEMP     00033=  00034AG 00041=  00042AG 00043AG 00056=  00057AG 00067=
         00068AG
TOL      00005=  00045
TOL1     00009=  00013IF 00014=  00016=  00017   00045=  00047IF
U        00001AG 00002DI 00025=  00026=  00034AG 00043AG 00053   00059
         00068AG 00074=  00083   00035=
VALD     00034CL 00042CL 00043CL 00057CL 00058CL
10       00011DO 00015*
100      00019DO 00075*
125      00079DO 00082DO 00083*
130      00085DO 00087*
135      00078DO 00088*
20       00024DO 00025*
30       00030DO 00032GT 00035*
50       00036DO 00039DO 00040GT 00044*
54       00029GT 00047*
```

```
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55      00049DO 00050*
65      00053DO 00055GT 00058*
70      00049GT 00052*
72      00054DO 00057GT 00059*
75      00051GT 00070*
80      00071DO 00072*
95      00073DO 00076*
```

```
      C       FUNCTION TO COMPUTE THE DOT PRODUCT
00001         FUNCTION DOT(NR,A,B)
00002         DIMENSION A(1),B(1)
00003         DOT=0.
00004         DO 1 I=1,NR
00005       1 DOT=DOT+A(I)*B(I)
00006         RETURN
00007         END
```

```
A        00001AG 00002DI 00005
B        00001AG 00002DI 00005
DOT      00001FU 00003=  00005=
I        00004DO 00005
NR       00001AG 00004DO
i        00004DO 00005*
```

```
      C        SUBROUTINE TO COMPUTE THE VECTOR SUM
0001          SUBROUTINE VADD(N,C1,A,B)
0002          DIMENSION A(1),B(1)
0003          DO 1 I=1,N
0004        1 A(I)=A(I)+C1*B(I)
0005          RETURN
0006          END
```

```
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A       0000AG  0002DI  0004=
B       0000AG  0002DI  0004
C1      0000AG  0004
I       0003DO  0004
N       0000AG  0003DO
VALID   0001SU
X       0003DO  0004*
```

```
00001        SUBROUTINE HQR(NM,N,LOW,IGH,H,WR,WI,IERR)
00002        INTEGER I,J,K,L,M,N,EN,LL,MM,NA,NM,IGH,ITS,LOW,MP2,ENM2,IERR
00003        REAL H(NM,N),WR(N),WI(N)
00004        REAL P,Q,R,S,T,W,X,Y,ZZ,NORM,MACHEP
00005        REAL SQRT,ABS,SIGN
00006        INTEGER MIN0
00007        LOGICAL NOTLAS
             C     ********** MACHEP IS A MACHINE DEPENDENT PARAMETER SPECIFYING
             C                THE RELATIVE PRECISION OF FLOATING POINT ARITHMETIC.
             C                **********
00008        MACHEP=2.**(-26)
00009        IERR=0
00010        NORM=0.0
00011        K=1
             C     ********** STORE ROOTS ISOLATED BY BALANC
             C                AND COMPUTE MATRIX NORM **********
00012        DO 50 I=1,N
00013        DO 40 J=K,N
00014  40    NORM=NORM+ABS(H(I,J))
00015        K=I
00016        IF(I.GE.LOW.AND.I.LE.IGH) GO TO 50
00018        WR(I)=H(I,I)
00019        WI(I)=0.0
00020  50    CONTINUE
00021        EN=IGH
00022        T=0.0
             C     ********** SEARCH FOR NEXT EIGENVALUES **********
00023  60    IF(EN.LT.LOW) GO TO 1001
00025        ITS=0.0
00026        NA=EN-1
00027        ENM2=NA-1
             C     ********** LOOK FOR SINGLE SMALL SUB-DIAGONAL ELEMENT
             C                FOR L=EN STEP -1 UNTIL LOW DO -- **********
00028  70    DO 80 LL=LOW,EN
00029        L=EN+LOW-LL
00030        IF(L.EQ.LOW) GO TO 100
00032        S=ABS(H(L-1,L-1))+ABS(H(L,L))
00033        IF(S.EQ.0.0) S=NORM
00035        IF(ABS(H(L,L-1)).LE.MACHEP*S) GO TO 100
00037  80    CONTINUE
             C     ********** FORM SHIFT **********
00038  100   X=H(EN,EN)
00039        IF(L.EQ.EN) GO TO 270
00041        Y=H(NA,NA)
00042        W=H(EN,NA)*H(NA,EN)
00043        IF(L.EQ.NA) GO TO 280
00045        IF(ITS.EQ.30) GO TO 1000
00047        IF(ITS.NE.10.AND.ITS.NE.20) GO TO 130
             C     ********** FORM EXCEPTIONAL SHIFT **********
00049        T=T+X
00050        DO 120 I=LOW,EN
00051  120   H(I,I)=H(I,I)-X
00052        S=ABS(H(EN,NA))+ABS(H(NA,ENM2))
00053        X=0.75*S
```

```
00054          Y=X
00055          W=-0.4375*S*S
00056 130      ITS=ITS+1
               C     ********** LOOK FOR TWO CONSECUTIVE SMALL
               C                SUB-DIAGONAL ELEMENTS.
               C                FOR M=EN-2 STEP -1 UNTIL L DO -- **********
00057          DO 140 MM=L,ENM2
00058          M=ENM2+L-MM
00059          ZZ=H(M,M)
00060          R=X-ZZ
00061          S=Y-ZZ
00062          P=(R*S-W)/H(M+1,M)+H(M,M+1)
00063          Q=H(M+1,M+1)-ZZ-R-S
00064          R=H(M+2,M+1)
00065          S=ABS(P)+ABS(Q)+ABS(R)
00066          P=P/S
00067          Q=Q/S
00068          R=R/S
00069          IF(M.EQ.L) GO TO 150
00071          IF(ABS(H(M,M-1))*(ABS(Q)+ABS(R)).LE.MACHEP*ABS(P)
              +    *(ABS(H(M-1,M-1))+ABS(ZZ)+ABS(H(M+1,M+1)))) GO TO 150
00073 140      CONTINUE
00074 150      MP2=M+2
00075          DO 160 I=MP2,EN
00076          H(I,I-2)=0.0
00077          IF(I.EQ.MP2) GO TO 160
00079          H(I,I-3)=0.0
00080 160      CONTINUE
               C     ********** DOUBLE QR STEP INVOLVING ROWS L TO EN AND
               C                COLUMNS M TO EN **********
00081          DO 260 K=M,NA
00082          NOTLAS=K.NE.NA
00083          IF(K.EQ.M) GO TO 170
00085          P=H(K,K-1)
00086          Q=H(K+1,K-1)
00087          R=0.0
00088          IF(NOTLAS) R=H(K+2,K-1)
00090          X=ABS(P)+ABS(Q)+ABS(R)
00091          IF(X.EQ.0.0) GO TO 260
00093          P=P/X
00094          Q=Q/X
00095          R=R/X
00096 170      S=SIGN(SQRT(P*P+Q*Q+R*R),P)
00097          IF(K.EQ.M) GO TO 180
00099          H(K,K-1)=-S*X
00100          GO TO 190
00101 180      IF(L.NE.M) H(K,K-1)=-H(K,K-1)
00103 190      P=P+S
00104          X=P/S
00105          Y=Q/S
00106          ZZ=R/S
00107          Q=Q/P
00109          R=R/P
               C     ********** ROW MODIFICATION **********
```

```
00109          DO 210 J=K,EN
00110          P=H(K,J)+Q*H(K+1,J)
00111          IF(.NOT.NOTLAS) GO TO 200
00113          P=P+R*H(K+2,J)
00114          H(K+2,J)=H(K+2,J)-P*ZZ
00115  200     H(K+1,J)=H(K+1,J)-P*Y
00116          H(K,J)=H(K,J)-P*X
00117  210     CONTINUE
00118          J=MIN0(EN,K+3)
       C       ********** COLUMN MODIFICATION **********
00119          DO 230 I=L,J
00120          P=X*H(I,K)+Y*H(I,K+1)
00121          IF(.NOT.NOTLAS) GO TO 220
00123          P=P+ZZ*H(I,K+2)
00124          H(I,K+2)=H(I,K+2)-P*R
00125  220     H(I,K+1)=H(I,K+1)-P*Q
00126          H(I,K)=H(I,K)-P
00127  230     CONTINUE
00128  260     CONTINUE
00129          GO TO 70
       C       ********** ONE ROOT FOUND **********
00130  270     WR(EN)=X+T
00131          WI(EN)=0.0
00132          EN=NA
00133          GO TO 60
       C       ********** TWO ROOTS FOUND **********
00134  280     P=(Y-X)/2.0
00135          Q=P*P+W
00136          ZZ=SQRT(ABS(Q))
00137          X=X+T
00138          IF(Q.LT.0.0) GO TO 320
       C       ********** REAL PAIR **********
00140          ZZ=P+SIGN(ZZ,P)
00141          WR(NA)=X+ZZ
00142          WR(EN)=WR(NA)
00143          IF(ZZ.NE.0.0) WR(EN)=X-W/ZZ
00145          WI(NA)=0.0
00146          WI(EN)=0.0
00147          GO TO 330
       C       ********** COMPLEX PAIR **********
00148  320     WR(NA)=X+P
00149          WR(EN)=X+P
00150          WI(NA)=ZZ
00151          WI(EN)=-ZZ
00152  330     EN=ENM2
00153          GO TO 60
       C       ********** SET ERROR -- NO CONVERGENCE TO AN
       C                  EIGENVALUE AFTER 30 ITERATIONS **********
00154  1000    IERR=EN
00155  1001    RETURN
00156          END
```

ABS 00005RL 00014 00032 00035IF 00052 00055 00071IF 00090
00136
EN 00002IN 00021= 00023IF 00026 00028DO 00029 00038 00039IF
00042 00050DO 00052 00075DO 00109DO 00118 00130 00131
00132= 00142 00144 00146 00149 00151 00152= 00154
EN42 00002IN 00027= 00052 00057DO 00058 00152
H 00001AG 00003RL 00014 00018 00032 00035IF 00038 00041
00042 00051= 00052 00059 00062 00063 00064 00071IF
00076= 00079= 00085 00086 00089 00099= 00102= 00110
00113 00114= 00115= 00116= 00120 00123 00124= 00125=
00126=
HOR 00001SU
I 00002IN 00012DO 00014 00015 00016IF 00018 00019 00050DO
00051 00075DO 00076 00077IF 00079 00119DO 00120 00123
00124 00125 00126
IERR 00001AG 00002IN 00009= 00154=
IGH 00001AG 00002IN 00016IF 00021
ITS 00002IN 00025= 00045IF 00047IF 00056=
J 00002IN 00013DO 00014 00109DO 00110 00113 00114 00115
00116 00118= 00119DO
K 00002IN 00011= 00013DO 00015= 00081DO 00082 00083IF 00085
00086 00089 00097IF 00099 00102 00109DO 00110 00113
00114 00115 00116 00118 00120 00123 00124 00125
00126
L 00002IN 00029= 00030IF 00032 00035IF 00039IF 00043IF 00057DO
00058 00059IF 00101IF 00119DO
LL 00002IN 00028DO 00029
LOW 00001AG 00002IN 00016IF 00023IF 00028DO 00029 00038IF 00050DO
M 00002IN 00058= 00059 00062 00063 00064 00069IF 00071IF
00074 00081DO 00083IF 00097IF 00101IF
MACHEP 00004RL 00038= 00035IF 00071IF
MING 00005IN 00118
MM 00002IN 00057DO 00058
MP2 00002IN 00074= 00075DO 00077IF
N 00001AG 00002IN 00003RL 00012DO 00013DO
NA 00002IN 00026= 00027 00041 00042 00043IF 00052 00081DO
00082 00132 00141 00142 00145 00148 00150
NM 00001AG 00002IN 00003RL
NORM 00004RL 00014= 00014= 00034
NOTLAS 00007LG 00082= 00088IF 00111IF 00121IF
P 00004RL 00052= 00055 00056= 00071IF 00085= 00090 00093=
00095 00103= 00104 00107 00108 00110= 00113= 00114
00115 00116 00120= 00123= 00124 00125 00126 00134=
00135 00140 00148 00149
Q 00004RL 00053= 00055 00067= 00071IF 00086= 00090 00094=
00095 00105 00107= 00110 00125 00135= 00136 00139IF
R 00004RL 00050= 00052 00053 00054= 00055 00058= 00071IF
00087= 00089= 00090 00095= 00095 00105 00108= 00113
00124
S 00004RL 00032= 00033IF 00034= 00035IF 00052= 00053 00055
00061= 00062 00063 00065= 00066 00067 00068 00096=
00099 00103 00104 00105 00106
SIGN 00005RL 00096 00140
SQRT 00006RL 00096 00136

```
T       000004RL 000022=  000049=  000130   000137
W       000004RL 000042=  000055=  000062   000135   000144
WI      000001AG 000003RL 000019=  000131=  000145=  000146=  000150=  000151=
WR      000001AG 000003RL 000018=  000130=  000141=  000142=  000144=  000148=
        000149=
X       000004RL 000038=  000049   000051   000053=  000054   000060   000090=
        000091IF 000093   000094   000095   000099   000104=  000116   000120
        000130   000134   000137=  000141   000144   000148   000149
Y       000004RL 000041=  000054=  000061   000105=  000115   000120   000134
ZZ      000004RL 000059=  000060   000061   000063   000071IF 000106=  000114
        000123   000136=  000140=  000141   000143IF 000144   000150   000151
1000    000031GT 000036GT 000038*
1000    000040GT 000154*
1001    000024GT 000155*
1200    000050DO 000051*
1300    000048GT 000056*
1400    000057DO 000073*
1500    000070GT 000072GT 000074*
1600    000075DO 000078GT 000080*
1700    000084GT 000096*
1000    000090GT 000101*
1900    000100GT 000103*
2000    000112GT 000115*
2100    000109DO 000117*
2200    000122GT 000125*
2300    000119DO 000127*
2400    000081DO 000092GT 000128*
2500    000004GT 000130*
2600    000044GT 000134*
3200    000139GT 000148*
3300    000147GT 000152*
40      000013DO 000014*
50      000120DO 000127GT 000200*
60      000023*  000130GT 000153GT
70      000026*  000129GT
80      000028DO 000037*
```

```
00001        SUBROUTINE HQR2(NM,N,LOW,IGH,H,WR,WI,Z,IERR)
00002        INTEGER I,J,K,L,M,N,EN,II,JJ,LL,MM,NA,NM,NN,
            +        IGH,ITS,LOW,MP2,ENM2,IERR
00003        REAL H(NM,N),WR(N),WI(N),Z(NM,N)
00004        REAL P,Q,R,S,T,W,X,Y,RA,SA,VI,VR,ZZ,NORM,MACHEP
00005        REAL SQRT,ABS,SIGN
00006        INTEGER MIN0
00007        LOGICAL NOTLAS
00008        COMPLEX Z3
00009        COMPLEX CMPLX
00010        REAL REAL,AIMAG
      C      ********** MACHEP IS A MACHINE DEPENDENT PARAMETER SPECIFYING
      C                   THE RELATIVE PRECISION OF FLOATING POINT ARITHMETIC.
      C                   **********
00011        MACHEP=2.**(-26)
00012        IERR=0
00013        NORM=0.0
00014        K=1
      C      ********** STORE ROOTS ISOLATED BY BALANC
      C                   AND COMPUTE MATRIX NORM **********
00015        DO 50 I=1,N
00016        DO 40 J=K,N
00017 40     NORM=NORM+ABS(H(I,J))
00018        K=I
00019        IF(I.GE.LOW.AND.I.LE.IGH) GO TO 50
00021        WR(I)=H(I,I)
00022        WI(I)=0.0
00023 50     CONTINUE
00024        EN=IGH
00025        T=0.0
      C      ********** SEARCH FOR NEXT EIGENVALUES **********
00026 60     IF(EN.LT.LOW) GO TO 340
00028        ITS=0
00029        NA=EN-1
00030        ENM2=NA-1
      C      ********** LOOK FOR SINGLE SMALL SUB-DIAGONAL ELEMENT
      C                   FOR L=EN STEP -1 UNTIL LOW DO -- **********
00031 70     DO 80 LL=LOW,EN
00032        L=EN+LOW-LL
00033        IF(L.EQ.LOW) GO TO 100
00035        S=ABS(H(L-1,L-1))+ABS(H(L,L))
00036        IF(S.EQ.0.0) S=NORM
00038        IF(ABS(H(L,L-1)).LE.MACHEP*S) GO TO 100
00040 80     CONTINUE
      C      ********** FORM SHIFT **********
00041 100    X=H(EN,EN)
00042        IF(L.EQ.EN) GO TO 270
00044        Y=H(NA,NA)
00045        W=H(EN,NA)*H(NA,EN)
00046        IF(L.EQ.NA) GO TO 280
00048        IF(ITS.EQ.30) GO TO 1000
00050        IF(ITS.NE.10.AND.ITS.NE.20) GO TO 130
      C      ********** FORM EXCEPTIONAL SHIFT **********
00052        T=T+X
```

```
00053        DO 120 I=LOW,EN
00054 120    H(I,I)=H(I,I)-X
00055        S=ABS(H(EN,NA))+ABS(H(NA,ENM2))
00056        X=0.75*S
00057        Y=X
00058        W=-0.4375*S*S
00059 130    ITS=ITS+1
             C     ********** LOOK FOR TWO CONSECUTIVE SMALL
             C                SUB-DIAGONAL ELEMENTS.
             C                FOR M=EN-2 STEP -1 UNTIL L DO -- **********
00060        DO 140 MM=L,ENM2
00061        M=ENM2+L-MM
00062        ZZ=H(M,M)
00063        R=X-ZZ
00064        S=Y-ZZ
00065        P=(R*S-W)/H(M+1,M)+H(M,M+1)
00066        Q=H(M+1,M+1)-ZZ-R-S
00067        R=H(M+2,M+1)
00068        S=ABS(P)+ABS(Q)+ABS(R)
00069        P=P/S
00070        Q=Q/S
00071        R=R/S
00072        IF(M.EQ.L) GO TO 150
00074        IF(ABS(H(M,M-1))*(ABS(Q)+ABS(R)).LE.MACHEP*ABS(P)
            +    *(ABS(H(M-1,M-1))+ABS(ZZ)+ABS(H(M+1,M+1)))) GO TO 150
00075 140    CONTINUE
00077 150    MP2=M+2
00078        DO 160 I=MP2,EN
00079        H(I,I-2)=0.0
00080        IF(I.EQ.MP2) GO TO 160
00082        H(I,I-3)=0.0
00083 160    CONTINUE
             C     ********** DOUBLE QR STEP INVOLVING ROWS L TO EN AND
             C                COLUMNS M TO EN **********
00084        DO 260 K=M,NA
00085        NOTLAS=K.NE.NA
00086        IF(K.EQ.M) GO TO 170
00088        P=H(K,K-1)
00089        Q=H(K+1,K-1)
00090        R=0.0
00091        IF(NOTLAS) R=H(K+2,K-1)
00093        X=ABS(P)+ABS(Q)+ABS(R)
00094        IF(X.EQ.0.0) GO TO 260
00095        P=P/X
00097        Q=Q/X
00098        R=R/X
00099 170    S=SIGN(SQRT(P*P+Q*Q+R*R),P)
00100        IF(K.EQ.M) GO TO 180
00102        H(K,K-1)=-S*X
00103        GO TO 190
00104 180    IF(L.NE.M) H(K,K-1)=-H(K,K-1)
00105 190    P=P+S
00107        X=P/S
00108        Y=Q/S
```

```
00109          ZZ=R/S
00110          Q=Q/P
00111          R=R/P
               C     ********** ROW MODIFICATION **********
00112          DO 210 J=K,N
00113          P=H(K,J)+Q*H(K+1,J)
00114          IF(.NOT.NOTLAS) GO TO 200
00115          P=P+R*H(K+2,J)
00117          H(K+2,J)=H(K+2,J)-P*ZZ
00118 200      H(K+1,J)=H(K+1,J)-P*Y
00119          H(K,J)=H(K,J)-P*X
00120 210      CONTINUE
00121          J=MIN0(EN,K+3)
               C     ********** COLUMN MODIFICATION **********
00122          DO 230 I=1,J
00123          P=X*H(I,K)+Y*H(I,K+1)
00124          IF(.NOT.NOTLAS) GO TO 220
00126          P=P+ZZ*H(I,K+2)
00127          H(I,K+2)=H(I,K+2)-P*R
00128 220      H(I,K+1)=H(I,K+1)-P*Q
00129          H(I,K)=H(I,K)-P
00130 230      CONTINUE
               C     ********** ACCUMULATE TRANSFORMATIONS **********
00131          DO 250 I=LOW,IGH
00132          P=X*Z(I,K)+Y*Z(I,K+1)
00133          IF(.NOT.NOTLAS) GO TO 240
00135          P=P+ZZ*Z(I,K+2)
00136          Z(I,K+2)=Z(I,K+2)-P*R
00137 240      Z(I,K+1)=Z(I,K+1)-P*Q
00138          Z(I,K)=Z(I,K)-P
00139 250      CONTINUE
00140 260      CONTINUE
00141          GO TO 70
               C     ********** ONE ROOT FOUND **********
00142 270      H(EN,EN)=X+T
00143          WR(EN)=H(EN,EN)
00144          WI(EN)=0.0
00145          EN=NA
00146          GO TO 60
               C     ********** TWO ROOTS FOUND **********
00147 280      P=(Y-X)/2.0
00148          Q=P*P+W
00149          ZZ=SQRT(ABS(Q))
00150          H(EN,EN)=X+T
00151          X=H(EN,EN)
00152          H(NA,NA)=Y+T
00153          IF(Q.LT.0.0) GO TO 320
               C     ********** REAL PAIR **********
00155          ZZ=P+SIGN(ZZ,P)
00156          WR(NA)=X+ZZ
00157          WR(EN)=WR(NA)
00159          IF(ZZ.NE.0.0) WR(EN)=X-W/ZZ
00160          WI(NA)=0.0
00161          WI(EN)=0.0
```

```
00162          X=H(EN,NA)
00163          S=ABS(X)+ABS(ZZ)
00164          P=X/S
00165          Q=ZZ/S
00166          R=SQRT(P*P+Q*Q)
00167          P=P/R
00168          Q=Q/R
               C     ********** ROW MODIFICATION **********
00169          DO 290 J=NA,N
00170          ZZ=H(NA,J)
00171          H(NA,J)=Q*ZZ+P*H(EN,J)
00172          H(EN,J)=Q*H(EN,J)-P*ZZ
00173 290      CONTINUE
               C     ********** COLUMN MODIFICATION **********
00174          DO 300 I=1,EN
00175          ZZ=H(I,NA)
00176          H(I,NA)=Q*ZZ+P*H(I,EN)
00177          H(I,EN)=Q*H(I,EN)-P*ZZ
00178 300      CONTINUE
               C     ********** ACCUMULATE TRANSFORMATIONS **********
00179          DO 310 I=LOW,IGH
00180          ZZ=Z(I,NA)
00181          Z(I,NA)=Q*ZZ+P*Z(I,EN)
00182          Z(I,EN)=Q*Z(I,EN)-P*ZZ
00183 310      CONTINUE
00184          GO TO 330
               C     ********** COMPLEX PAIR **********
00185 320      WR(NA)=X+P
00186          WR(EN)=X+P
00187          WI(NA)=ZZ
00188          WI(EN)=-ZZ
00189 330      EN=EN-2
00190          GO TO 60
               C     ********** ALL ROOTS FOUND. BACKSUBSTITUTE TO FIND
               C                VECTORS OF UPPER TRIANGULAR FORM **********
00191 340      IF(NORM.EQ.0.0) GO TO 1001
               C     ********** FOR EN=N STEP -1 UNTIL 1 DO -- **********
00193          DO 800 NN=1,N
00194          EN=N+1-NN
00195          P=WR(EN)
00196          Q=WI(EN)
00197          NA=EN-1
00198          IF(Q) 710,600,800
               C     ********** REAL VECTOR **********
00199 600      M=EN
00200          H(EN,EN)=1.0
00201          IF(NA.EQ.0) GO TO 800
               C     ********** FOR I=EN-1 STEP -1 UNTIL 1 DO -- **********
00203          DO 700 II=1,NA
00204          I=EN-II
00205          W=H(I,I)-P
00206          R=H(I,EN)
00207          IF(M.GT.NA) GO TO 620
00209          DO 610 J=M,NA
```

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```
00210 510     R=R+H(I,J)*H(J,IN)
00211 520     IF(WI(I).GE.0.0) GO TO 530
00213         ZZ=W
00214         S=R
00215         GO TO 700
00216 530     M=I
00217         IF(WI(I).NE.0.0) GO TO 540
00219         T=W
00220         IF(W.EQ.0.0) T=MACHEP*NORM
00222         H(I,IN)=-R/T
00223         GO TO 700
              C     ********** SOLVE REAL EQUATIONS **********
00224 540     X=H(I,I+1)
00225         Y=H(I+1,I)
00226         Q=(WR(I)-P)*(WR(I)-P)+WI(I)*WI(I)
00227         T=(X*S-ZZ*R)/Q
00228         H(I,IN)=T
00229         IF(ABS(X).LE.ABS(ZZ)) GO TO 550
00231         H(I+1,IN)=(-R-W*T)/X
00232         GO TO 700
00233 550     H(I+1,IN)=(-S-Y*T)/ZZ
00234 700     CONTINUE
              C     ********** END REAL VECTOR **********
00235         GO TO 900
              C     ********** COMPLEX VECTOR **********
00236 710     M=NA
              C     ********** LAST VECTOR COMPONENT CHOSEN IMAGINARY SO THAT
              C                EIGENVECTOR MATRIX IS TRIANGULAR **********
00237         IF(ABS(H(EN,NA)).LE.ABS(H(NA,EN))) GO TO 720
00239         H(NA,NA)=Q/H(EN,NA)
00240         H(NA,EN)=-(H(EN,EN)-P)/H(EN,NA)
00241         GO TO 730
00242 720     ZZ=CMPLX(0.0,-H(NA,EN))/CMPLX(H(NA,NA)-P,Q)
00243         H(NA,NA)=REAL(ZZ)
00244         H(NA,EN)=AIMAG(ZZ)
00245 730     H(EN,NA)=0.0
00246         H(EN,EN)=1.0
00247         ENM2=NA-1
00248         IF(ENM2.EQ.0) GO TO 800
              C     ********** FOR I=EN-2 STEP -1 UNTIL 1 DO -- **********
00250         DO 790 II=1,ENM2
00251         I=NA-II
00252         W=H(I,I)-P
00253         RA=0.0
00254         SA=H(I,IN)
00255         DO 760 J=M,NA
00256         RA=RA+H(I,J)*H(J,NA)
00257         SA=SA+H(I,J)*H(J,IN)
00258 760     CONTINUE
00259         IF(WI(I).GE.0.0) GO TO 770
00261         ZZ=W
00262         R=RA
00263         S=SA
00264         GO TO 790
```

```
00265 770    M=I
00266        IF(WI(I).NE.0.0) GO TO 780
00268        Z3=CMPLX(-RA,-SA)/CMPLX(W,Q)
00269        H(I,NA)=REAL(Z3)
00270        H(I,EN)=AIMAG(Z3)
00271        GO TO 790
             C     ********** SOLVE COMPLEX EQUATIONS **********
00272 780    X=H(I,I+1)
00273        Y=H(I+1,I)
00274        VR=(WR(I)-P)*(WR(I)-P)+WI(I)*WI(I)-Q*Q
00275        VI=(WR(I)-P)*2.0*Q
00276        IF(VR.EQ.0.0.AND.VI.EQ.0.0) VR=MACHEP*NORM
            +    *(ABS(W)+ABS(Q)+ABS(X)+ABS(Y)+ABS(ZZ))
00278        Z3=CMPLX(X*R-ZZ*RA+Q*SA,X*S-ZZ*SA-Q*RA)/CMPLX(VR,VI)
00279        H(I,NA)=REAL(Z3)
00280        H(I,EN)=AIMAG(Z3)
00281        IF(ABS(X).LE.ABS(ZZ)+ABS(Q)) GO TO 785
00283        H(I+1,NA)=(-RA-W*H(I,NA)+Q*H(I,EN))/X
00284        H(I+1,EN)=(-SA-W*H(I,EN)-Q*H(I,NA))/X
00285        GO TO 790
00286 785    Z3=CMPLX(-R-Y*H(I,NA),-S-Y*H(I,EN))/CMPLX(ZZ,Q)
00287        H(I+1,NA)=REAL(Z3)
00288        H(I+1,EN)=AIMAG(Z3)
00289 790    CONTINUE
             C     ********** END COMPLEX VECTOR **********
00290 800    CONTINUE
             C     ********** END BACK SUBSTITUTION.
             C                VECTORS OF ISOLATED ROOTS **********
00291        DO 840 I=1,N
00292        IF(I.GE.LOW.AND.I.LE.IGH) GO TO 840
00294        DO 820 J=I,N
00295 820    Z(I,J)=H(I,J)
00296 840    CONTINUE
             C     ********** MULTIPLY BY TRANSFORMATION MATRIX TO GIVE
             C                VECTORS OF ORIGINAL FULL MATRIX.
             C                FOR J=N STEP -1 UNTIL LOW DO -- **********
00297        DO 880 JJ=LOW,N
00298        J=N+LOW-JJ
00299        M=MIN0(J,IGH)
00300        DO 880 I=LOW,IGH
00301        ZZ=0.0
00302        DO 860 K=LOW,M
00303 860    ZZ=ZZ+Z(I,K)*H(K,J)
00304        Z(I,J)=ZZ
00305 880    CONTINUE
00306        GO TO 1001
             C     ********** SET ERROR -- NO CONVERGENCE TO AN
             C                EIGENVALUE AFTER 30 ITERATIONS **********
00307 1000   IERR=EN
00308 1001   RETURN
00309        END
```

ABS 000005RL 00017 00035 00038IF 00055 00058 00074IF 00093
00149 00163 00229IF 00237IF 00277 00281IF

ALMAG 000107RL 00244 00270 00280 00283

CMPLX 000009CX 00242 00268 00278 00286

EN 00002IN 00024= 00026IF 00029 00031DO 00032 00041 00042IF
00045 00053DO 00055 00078DO 00121 00142 00143 00144
00145= 00150 00151 00157 00159 00161 00162 00171
00172 00174DO 00175 00177 00181 00182 00186 00188
00189= 00194= 00195 00196 00197 00199 00200 00204
00205 00210 00222 00228 00231 00233 00237IF 00239
00243 00242 00244 00245 00246 00254 00257 00270
00280 00283 00284 00286 00288 00307

EN42 00002IN 00030= 00055 00053DO 00051 00189 00247= 00248IF
00255DO

II 000001AG 00003RL 00017 00021 00035 00038IF 00041 00044
00045 00054= 00055 00052 00065 00056 00067 00074IF
00079= 00082= 00088 00089 00092 00102= 00105= 00113
00116 00117= 00118= 00119= 00123 00126 00127= 00128=
00129= 00142= 00143 00150= 00151 00152= 00152 00170
00171= 00172= 00175 00176= 00177= 00200= 00205 00206
00210 00222= 00224 00225 00228= 00231= 00233= 00237IF
00239= 00240= 00242 00243= 00244= 00245= 00246= 00252
00254 00256 00257 00269= 00270= 00272 00273 00279=
00280= 00283= 00284= 00285 00287= 00289= 00295 00303

IOR2 000010U

I 00002IN 00015DO 00017 00018 00019IF 00021 00022 00053DO
00054 00078DO 00079 00080IF 00082 00122DO 00123 00126
00127 00128 00129 00131DO 00132 00135 00136 00137
00138 00174DO 00175 00176 00177 00179DO 00180 00181
00182 00204= 00205 00206 00210 00211IF 00216 00217IF
00222 00224 00225 00225 00223 00231 00233 00251=
00252 00254 00256 00257 00259IF 00265 00266IF 00269
00270 00272 00273 00274 00275 00279 00280 00283
00284 00285 00287 00288 00291DO 00292IF 00295 00300DO
00303 00304

IERR 000010AG 00002IN 00012= 00307=

IGI 000010AG 00002IN 00019IF 00024 00131DO 00179DO 00292IF 00299
00300DO

II 00002IN 00203DO 00204 00250DO 00251

ITS 00002IN 00028= 00048IF 00050IF 00059=

J 00002IN 00016DO 00017 00112DO 00113 00116 00117 00118
00119 00121= 00122DO 00160DO 00170 00171 00172 00230DO
00210 00125DO 00256 00257 00294DO 00295 00298= 00299
00303 00304

JJ 00002IN 00297DO 00298

K 00002IN 00014= 00017DO 00018= 00030DO 00085 00086IF 00088
00089 00092 00100IF 00102 00105 00112DO 00113 00116
00117 00118 00119 00121 00123 00126 00127 00128
00129 00132 00135 00136 00137 00139 00302DO 00303

L 00002IN 00032= 00033IF 00035 00038IF 00042IF 00046IF 00306DO
00051 00072IF 00104IF

LL 00002IN 00031DO 00032

LOW 000010AG 00002IN 00019IF 00026IF 00031DO 00032 00033IF 00053DO
00131DO 00179DO 00292IF 00297DO 00298 00300DO 00302DO

M 000002IN 00051= 00062 00065 00066 00067 00072IF 00074IF
00077 00094DO 00096IF 00100IF 00104IF 00199= 00207IF 00209DO
00216= 00236= 00255DO 00265= 00299= 00302DO
MACHEF 00044RL 00311= 00338IF 00074IF 00221 00277
MINUS 000005IN 00121 00299
M4 000002IN 00056DO 00061
MP2 000002IN 00077= 00078DO 00080IF
N 000001AG 000002IN 000003RL 00015DO 00016DO 00112DO 00169DO 00193DO
00194 00291DO 00294DO 00297DO 00298
NA 000002IN 00029= 00030 00044 00045 00046IF 00055 00084DO
00085 00145 00152 00156 00157 00166 00162 00169DO
00170 00171 00175 00176 00180 00181 00185 00187
00197= 00201IF 00203DO 00207IF 00209DO 00236 00237IF 00239
00240 00242 00243 00244 00245 00247 00251 00255DO
00256 00269 00279 00283 00284 00286 00287
NM 000001AG 000002IN 000003RL
NN 000002IN 00193DO 00194
NORM 000004RL 00013= 00017= 00037 00191IF 00221 00277
NOTLAS 000007LG 00085= 00091IF 00114IF 00124IF 00133IF
P 000004RL 00055= 00068 00069= 00074IF 00088= 00093 00096=
00099 00106= 00107 00110 00111 00113= 00116= 00117
00119 00119 00123= 00126= 00127 00128 00129 00132=
00135= 00136 00137 00138 00147= 00148 00155 00164=
00166 00167= 00171 00172 00176 00177 00181 00182
00185 00186 00195= 00205 00226 00240 00242 00252
00274 00275
Q 000004RL 00055= 00068 00070= 00074IF 00089= 00093 00097=
00099 00108 00113= 00113 00128 00127 00148= 00149
00153IF 00165= 00166 00168= 00171 00172 00176 00177
00181 00182 00195= 00198IF 00226= 00227 00239 00242
00268 00274 00275 00277 00278 00281IF 00283 00284
00286
R 000004RL 00053= 00055 00056 00067= 00068 00071= 00074IF
00094= 00092= 00093 00098= 00099 00109 00111= 00116
00127 00136 00155= 00157 00168 00205= 00210= 00214
00222 00227 00231 00252= 00278 00286
RA 000004RL 00253= 00256= 00262 00268 00278 00283
REAL 000010RL 00243 00269 00279 00287
S 000004RL 00035= 00036IF 00037= 00038IF 00055= 00056 00058
00056= 00065 00066 00068= 00069 00070 00071 00099=
00102 00105 00107 00108 00109 00163= 00164 00165
00214= 00227 00233 00253= 00278 00286
SA 000004RL 00254= 00257= 00263 00269 00278 00284
SIGN 000005RL 00099 00155
SORT 000005RL 00099 00149 00166
T 000004RL 00025= 00052= 00142 00150 00152 00219= 00221=
00222 00227= 00228 00231 00233
VI 000006RL 00275= 00275IF 00278
VR 000004RL 00274= 00275IF 00277= 00278
V 000004RL 00045= 00058= 00065 00148 00159 00205= 00213
00219 00220IF 00231 00252= 00261 00268 00277 00283
00284
XI 000001AG 000003RL 00022= 00144= 00160= 00161= 00187= 00188=
00193 00211IF 00217IF 00225 00259IF 00266IF 00274

```
WR      00001AG 00003RL 00021=  00143=  00156=  00157=  00159=  00185=
        00195=  00195   00226   00274   00275
X       00004RL 00041=  00052   00054   00056=  00057   00063   00093=
        00094IF 00095   00097   00098   00102   00107=  00119   00123
        00132   00142   00147   00150   00151=  00156   00159   00162=
        00163   00164   00185   00186   00224=  00227   00229IF 00231
        00272=  00277   00278   00281IF 00283   00284
Y       00004RL 00044=  00057=  00064   00108=  00118   00123   00132
        00147   00152   00225=  00233   00273=  00277   00286
Z       00001AG 00003RL 00132   00135   00136=  00137=  00138=  00180
        00181=  00182=  00295=  00303   00304=
ZZ      00004RL 00052=  00063   00064   00066   00074IF 00109=  00117
        00126   00135   00149=  00155=  00156   00158IF 00159   00163
        00165   00170=  00171   00172   00175=  00176   00177   00180=
        00181   00182   00187   00188   00213=  00227   00229IF 00233
        00261=  00277   00278   00281IF 00286   00301=  00303=  00304
Z3      00003CX 00242=  00243   00244   00269=  00269   00270   00278=
        00279   00280   00286=  00287   00288
100     00034GT 00039GT 00041*
1000    00049GT 00307*
1001    00192GT 00305GT 00308*
120     00053DO 00054*
130     00051GT 00059*
140     00065DO 00075*
150     00073GT 00075GT 00077*
160     00079DO 00081GT 00083*
170     00087GT 00099*
180     00101GT 00104*
190     00103GT 00105*
200     00115GT 00118*
210     00112DO 00120*
220     00125GT 00128*
230     00122DO 00130*
240     00134GT 00137*
250     00131DO 00139*
260     00034DO 00095GT 00140*
270     00140GT 00142*
280     00147GT 00147*
290     00169DO 00173*
300     00174DO 00178*
310     00179DO 00183*
320     00154GT 00185*
330     00188GT 00189*
340     00027GT 00191*
40      00016DO 00017*
50      00015DO 00020GT 00023*
60      00025*  00146GT 00190GT
600     00193IF 00199*
610     00209DO 00210*
620     00208GT 00211*
630     00212GT 00216*
640     00218GT 00224*
650     00230GT 00233*
70      00031*  00141GT
```

```
700     00207DO 00215GT 00223GT 00232GT 00234*
710     00199IF 00236*
720     00238GT 00242*
730     00241GT 00245*
752     00255DO 00258*
770     00260GT 00265*
780     00267GT 00272*
785     00282GT 00286*
790     00254DO 00254GT 00271GT 00285GT 00289*
80      00031DO 00040*
900     00193DO 00199IF 00202GT 00239GT 00249GT 00290*
820     00294DO 00295*
840     00291DO 00293GT 00296*
860     00327DO 00333*
880     00297DO 00300DO 00305*
```

```
00001        SUBROUTINE LEQT2C(A,N,IA,B,M,IB,IPVT,C,WK,IWK,IER)
             C  FUNCTION - MATRIX DECOMPOSITION, LINEAR EQUATION SOLUTION
             C             FOR COMPLEX MATRICES.
             C  ARGUMENTS  A - INPUT COMPLEX MATRIX, DIMENSIONED N BY N.
             C             N - ORDER OF A.
             C            IA - ROW DIMENSION OF A.
             C             B - INPUT COMPLEX MATRIX DIMENSIONED N BY M.
             C                 ON OUTPUT, SOLUTION MATRIX X REPLACES B.
             C             M - NUMBER OF RIGHT HAND SIDES.
             C            IB - ROW DIMENSION OF B.
             C          IPVT - PIVOT VECTOR
             C          C,WK - WORKING SPACE
             C           IWK - DIMENSION OF WK
             C           IER - TERMINAL ERROR 128+N:
             C                 N = 2 INDICATES A IS SINGULAR.
00002        DIMENSION IPVT(IA)
00003        COMPLEX A(IA,N),B(IB,M),C(IA),WK(IWK)
00004        IER=0
00005        NDIM=IA
00006        II=0
00007        DO 10 J=1,N
00008        DO 10 I=1,IA
00009        II=II+1
00010        WK(II)=A(I,J)
00011 10     CONTINUE
00012        CALL DECOMP(NDIM,N,A,COND,IPVT,WORK)
00013        IF(COND.EQ.COND+1) GO TO 50
00015        DO 40 J=1,M
00016        DO 20 I=1,N
00017 20     C(I)=B(I,J)
00018        CALL SOLVE(NDIM,N,A,C,IPVT)
00019        DO 30 I=1,N
00020 30     B(I,J)=C(I)
00021 40     CONTINUE
00022        II=0
00023        DO 45 J=1,N
00024        DO 45 I=1,IA
00025        II=II+1
00026        A(I,J)=WK(II)
00027 45     CONTINUE
00028        RETURN
00029 50     IER=129
00030        RETURN
00031        END
```

```
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A       00001AG 00003CX 00010   00012AG 00018AG 00026=
B       00001AG 00003CX 00017   00020=
C       00001AG 00003CX 00017=  00018AG 00020
COND    00012AG 00013EF
DECOMP  00012CL
I       00007DO 00010   00015DO 00017   00019DO 00020   00024DO 00026
IA      00001AG 00002DI 00003CX 00005   00008DO 00024DO
IB      00001AG 00003CX
IER     00001AG 00004=  00029=
II      00006=  00009=  00010   00022=  00025=  00026
IPVT    00001AG 00002DI 00012AG 00018AG
IWK     00001AG 00003CX
J       00007DO 00010   00015DO 00017   00020   00023DO 00026
LEQT2C  00001SU
M       00001AG 00003CX 00015DO
N       00001AG 00003CX 00007DO 00012AG 00015DO 00018AG 00019DO 00023DO
NDIM    00005=  00012AG 00018AG
SOLVE   00018CL
WK      00001AG 00003CX 00010=  00026
WORK    00012AG
10      00007DO 00008DO 00011*
20      00015DO 00017*
30      00019DO 00020*
40      00015DO 00021*
45      00023DO 00024DO 00027*
50      00014GT 00029*
```

```
00001        SUBROUTINE LINEQ1(NDIM,N,A,C,X,E,F,TR,SCALE)
     C          SOLVES  AX + XA' + C = 0
00002        COMMON/NONAME/ NDIM1
00003        DIMENSION A(NDIM,N),C(NDIM,N),X(NDIM,N),E(NDIM,N),F(NDIM,N),TR(N)
00004        DIMENSION SCALE(N)
     C          BALANCE THE A AND C MATRICES
00005        CALL BALANC(NDIM,N,A,LOW,IGH,SCALE)
00006        DO 10 I=1,N
00007        DO 10 J=1,N
00008        E(I,J)=0.
00009 10     E(I,I)=1.
00010        DO 50 J=1,N
00011        IF(J.GE.LOW.AND.J.LE.IGH) GO TO 40
00013        K=SCALE(J)
00014        DO 20 I=1,N
00015        DUM=C(I,J)
00016        C(I,J)=C(I,K)
00017 20     C(I,K)=DUM
00018        DO 30 I=1,N
00019        DUM=C(J,I)
00020        C(J,I)=C(K,I)
00021 30     C(K,I)=DUM
00022        GO TO 50
00023 40     E(J,J)=SCALE(J)
00024 50     CONTINUE
00025        NDIM1=NDIM
00026        CALL G1INV(N,N,E,X,MT,0)
00027        CALL MMUL(NDIM,X,C,N,N,N,F)
00028        CALL MMUL(NDIM,F,X,N,N,N,C)
     C          SOLVE AX + XA' + C = 0
00029        TOL=.0001
00030        DT=.5
00031        DT1=0.
00032        DO 70 I=1,N
00033 70     DT1=DT1+A(I,I)
00034        DT1=-DT1/N
00035        IF(DT1-4.0) 90,90,80
00036 80     DT=DT*4.0/DT1
00037 90     DO 110 I=1,N
00038        DO 100 J=1,N
00039 100    X(I,J)=DT*A(J,I)
00040 110    X(I,I)=X(I,I)-.5
00041        NDIM1=NDIM
00042        CALL G1INV(N,N,X,F,MR,0)
00043        CALL MMUL(NDIM,C,F,N,N,N,E)
00044        DO 130 I=1,N
00045        DO 120 J=1,N
00046 120    C(I,J)=F(J,I)*DT
00047 130    F(I,I)=F(I,I)+1.
00048        CALL MMUL(NDIM,C,E,N,N,N,X)
00049        DO 180 IT=1,20
00050        ME2=0
00051        CALL MMUL(NDIM,X,F,N,N,N,C)
00052        DO 170 I=1,N
```

```
00053          TR(I)=X(I,I)
00054          DO 150 J=I,N
00055          E(I,J)=F(I,J)
00056          E(J,I)=F(J,I)
00057          DO 140 K=1,N
00058  140     X(I,J)=X(I,J)+F(K,I)*C(K,J)
00059  150     X(J,I)=X(I,J)
00060          IF(ABS(X(I,I)-TR(I))-(.0000001+TOL*ABS(X(I,I)))) 160,160,170
00061  160     NEZ=NEZ+1
00062  170     CONTINUE
00063          ITT=IT
00064          IF(NEZ-N) 180,190,190
00065  180     CALL MMUL(NDIM,E,E,N,N,N,F)
00066  190     CONTINUE
00067          TOL=ITT
       C            BALANCE BACK THE MATRIX
00068          DO 230 I=1,N
00069          DO 230 J=1,N
00070          E(I,J)=0.
00071          E(I,I)=1.
00072          IF(I.GE.LOW.AND.I.LE.IGH) E(I,I)=SCALE(I)
00074  230     CONTINUE
00075          CALL MMUL(NDIM,E,X,N,N,N,F)
00076          CALL MMUL(NDIM,F,E,N,N,N,X)
00077          DO 240 J=1,N
00078          IF(J.GE.LOW.AND.J.LE.IGH) GO TO 240
00080          K=SCALE(J)
00081          DO 220 I=1,N
00082          DUM=X(I,J)
00083          X(I,J)=X(I,K)
00084  220     X(I,K)=DUM
00085          DO 230 I=1,N
00086          DUM=X(J,I)
00087          X(J,I)=X(K,I)
00088  230     X(K,I)=DUM
00089  240     CONTINUE
00090          CALL MMUL(NDIM,E,A,N,N,N,F)
00091          DO 250 I=1,N
00092  250     E(I,I)=1./E(I,I)
00093          CALL MMUL(NDIM,F,E,N,N,N,A)
00094          DO 280 J=1,N
00095          IF(J.GE.LOW.AND.J.LE.IGH) GO TO 280
00097          K=SCALE(J)
00098          DO 260 I=1,N
00099          DUM=A(I,J)
00100          A(I,J)=A(I,K)
00101  260     A(I,K)=DUM
00102          DO 270 I=1,N
00103          DUM=A(J,I)
00104          A(J,I)=A(K,I)
00105  270     A(K,I)=DUM
00106  280     CONTINUE
       C            THE END
00107          RETURN
```

```
001038          END
```

```
A       00001AG 00003DI 00005AG 00033   00039   00090AG 00093AG 00099
        00100=  00101=  00103   00104=  00105=
ABS     00000JIF
BALANC  00005CL
C       00021AG 00023DI 00015   00016=  00017=  00019   00020=  00021=
        00027AG 00028AG 00043AG 00046=  00043AG 00051AG 00058
DT      00030=  00036=  00039   00046
DT1     00031=  00033=  00034=  00035IF 00036
DUM     00015=  00017   00019=  00021   00032=  00034   00036=  00088
        00099=  00101   00103=  00105
E       00021AG 00023DI 00008=  00009=  00023=  00026AG 00043AG 00049AG
        00055=  00056=  00065AG 00071=  00073=  00075AG 00076AG
        00090AG 00092=  00093AG
F       00021AG 00023DI 00027AG 00028AG 00042AG 00043AG 00046   00047=
        00051AG 00055   00056   00058   00065AG 00075AG 00076AG 00093AG
        00093AG
G41NV   00022CL 00042CL
I       00000DO 00008   00009   00014DO 00015   00016   00017   00018DO
        00019   00020   00021   00032DO 00033   00037DO 00039   00040
        00044DO 00045   00047   00052DO 00053   00054DO 00055   00056
        00058   00059   00065IF 00069DO 00070   00071   00072IF 00073
        00090DO 00092   00093   00094   00085DO 00086   00087   00088
        00091DO 00092   00098DO 00099   00100   00101   00102DO 00103
        00104   00105
IGN     00005AG 00011IF 00072IF 00078IF 00095IF
IT      00049DO 00053
ITT     00053=  00057
J       00007DO 00008   00010DO 00011IF 00013   00015   00016   00019
        00020   00023   00030DO 00039   00045DO 00046   00054DO 00055
        00056   00058   00059   00069DO 00070   00077DO 00078IF 00080
        00082   00083   00086   00087   00094DO 00095IF 00097   00099
        00100   00103   00104
K       00013=  00016   00017   00020   00021   00057DO 00058   00084=
        00083   00084   00087   00088   00097=  00100   00101   00104
        00105
LINBUF  00005BU
LOW     00005AG 00011IF 00072IF 00078IF 00095IF
MMUL    00027CL 00028CL 00043CL 00049CL 00051CL 00065CL 00075CL 00076CL
        00090CL 00093CL
MR      00042AG
MT      00026AG
N       00021AG 00023DI 00024DI 00025AG 00026DO 00027DO 00010DO 00014DO
        00018DO 00020AG 00027AG 00028AG 00032DO 00034   00037DO 00038DO
        00042AG 00043AG 00044DO 00045DO 00048AG 00051AG 00052DO 00054DO
        00057DO 00061IF 00065AG 00068DO 00069DO 00075AG 00076AG 00077DO
        00081DO 00085DO 00090AG 00091DO 00093AG 00094DO 00095DO 00102DO
NDIM    00021AG 00023DI 00025AG 00025   00027AG 00029AG 00041   00043AG
        00049AG 00051AG 00065AG 00075AG 00076AG 00090AG 00093AG
NDIM1   00022CM 00025=  00041=
NEZ     00054=  00056=  00061IF
NONAME  00022CN
SCALE   00021AG 00024DI 00025AG 00013   00023   00073   00088   00097
TOL     00029=  00061IF 00067=
TR      00021AG 00023DI 00053=  00056IF
```

```
X       00031AG 00003DI 00026AG 00027AG 00028AG 00039=  00040=  00042AG
        00048AG 00051AG 00053   00058=  00059=  00060IF 00075AG 00076AG
        00082   00083=  00084=  00086   00087=  00088=
10      00006DO 00007DO 00009*
100     00039DO 00039*
110     00037DO 00040*
120     00045DO 00046*
130     00044DO 00047*
140     00057DO 00058*
150     00054DO 00059*
160     00060IF 00061*
170     00052DO 00060IF 00062*
180     00049DO 00064IF 00065*
190     00054IF 00066*
20      00014DO 00017*
200     00059DO 00059DO 00074*
220     00   DO 00084*
230     00085DO 00088*
240     00077DO 00079GT 00089*
250     00091DO 00092*
260     00098DO 00101*
270     00102DO 00105*
280     00094DO 00096GT 00106*
30      00018DO 00021*
40      00012GT 00023*
50      00016DO 00022GT 00024*
70      00022DO 00033*
80      00035IF 00036*
90      00035IF 00037*
```

```
      C       MATRIX MULTIPLY
00001         SUBROUTINE MMUL(NDIM,A,B,N,L,M,C)
00002         DIMENSION A(NDIM,L),B(NDIM,M),C(NDIM,N)
00003         DO 1 I=1,N
00004         DO 1 J=1,M
00005       1 C(I,J)=0.
00006         DO 2 I=1,N
00007         DO 2 J=1,M
00008         DO 2 K=1,L
00009       2 C(I,J)=C(I,J)+A(I,K)*B(K,J)
00010         RETURN
00011         END
```

```
A       000016AG 00002DI  00009
B       000016AG 00002DI  00009
C       000016AG 00002DI  00005=  00009=
I       00003DO  00005    00006DO 00009
J       00004DO  00005    00007DO 00009
K       00008DO  00009
L       000016AG 00032DI  00038DO
M       000016AG 00042DI  00044DO 00047DO
MMUL    00001SU
N       000016AG 00023DO  00026DO
NDIM    000016AG 00002DI
1       00003DO  00004DO  00005*
2       00006DO  00007DO  00003DO 00009*
```

```
00001          SUBROUTINE RENR(IIN,IOUT,TTLNEW,IS,LASTID,ARRAY,IARRAY)
               C     SUBROUTINE READS DATA FROM IIN, COMPOSES NEW TITLE
               C     AND WRITES DATA TO IOUT
00002          DIMENSION TTLNEW(5),ARRAY(IS),IARRAY(IS)
00003          DO 100 I=1,LASTID
00004          IF(I.EQ.1) GO TO 10
00006          IF(I.EQ.2) GO TO 20
00008          IF(I.EQ.54) GO TO 25
00010          IF(I.GE.3.AND.I.LE.12) GO TO 30
00012          IF(I.GE.32.AND.I.LE.34) GO TO 30
00014          IF(I.GE.13.AND.I.LE.31) GO TO 50
00016          IF(I.GE.35.AND.I.LE.49) GO TO 50
00018          IF(I.GE.58.AND.I.LE.60) GO TO 50
00020          IF(I.EQ.52.OR.I.EQ.53) GO TO 50
00022          IF(I.EQ.62.OR.I.EQ.65) GO TO 50
00024          IF(I.EQ.69.OR.I.EQ.70) GO TO 60
00026          IF(I.GE.116.AND.I.LE.123) GO TO 60
00028          IF(I.EQ.57.OR.I.EQ.68) GO TO 70
00030          IF(I.GE.71.AND.I.LE.115) GO TO 70
00032          IF(I.EQ.50.OR.I.EQ.51) GO TO 30
00034          IF(I.EQ.61) GO TO 30
00036          IF(I.EQ.63.OR.I.EQ.64) GO TO 30
00038          IF(I.EQ.55.OR.I.EQ.56) GO TO 40
00040          IF(I.EQ.66.OR.I.EQ.67) GO TO 40
00042          GO TO 100
00043 10       READ(IIN) IDEN,LEN,(ARRAY(J),J=1,LEN)
00044          NENLEN=LEN+5
00045          WRITE(IOUT) IDEN,NENLEN,(ARRAY(J),J=1,LEN),(TTLNEW(J),J=1,5)
00046          GO TO 100
00047 20       READ(IIN) IDEN,(IARRAY(J),J=1,7)
00048          WRITE(IOUT) IDEN,(IARRAY(J),J=1,7)
00049          GO TO 100
00050 25       READ(IIN) IDEN,(IARRAY(J),J=1,4)
00051          WRITE(IOUT) IDEN,(IARRAY(J),J=1,4)
00052          GO TO 100
00053 30       READ(IIN) IDEN,NX,(ARRAY(J),J=1,NX)
00054          NXT=NX
00055          GO TO 50
00056 40       READ(IIN) IDEN,NX,(ARRAY(J),J=1,2*NX)
00057          NXT=NX*2
00058 50       WRITE(IOUT) IDEN,NX,(ARRAY(J),J=1,NXT)
00059          GO TO 100
00060 60       READ(IIN) IDEN,NX,NY,(ARRAY(J),J=1,NX*NY)
00061          NTOT=NX*NY
00062          GO TO 80
00063 70       READ(IIN) IDEN,NX,NY,(ARRAY(J),J=1,2*NX*NY)
00064          NTOT=2*NX*NY
00065 80       WRITE(IOUT) IDEN,NX,NY,(ARRAY(J),J=1,NTOT)
00066 100      CONTINUE
00067          RETURN
00068          END
```

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```
ARRAY   000001AG 000002DI 000043RD 000049WR 000053RD 000056RD 000058WR 000060RD
        000063RD 000065WR
I       000030O  000034IF 000036IF 000038IF 000010IF 000012IF 000014IF 000016IF
        000018IF 000020IF 000022IF 000024IF 000026IF 000028IF 000030IF 000032IF
        000034IF 000036IF 000038IF 000040IF
IARRAY  000001AG 000002DI 000047RD 000048WR 000050RD 000051WR
IDEN    000043RD 000045WR 000047RD 000048WR 000050RD 000051WR 000053RD 000056RD
        000058WR 000060RD 000063RD 000065WR
IIN     000001AG 000043RD 000047RD 000050RD 000053RD 000056RD 000060RD 000063RD
IOUT    000001AG 000045WR 000048WR 000051WR 000058WR 000065WR
IS      000001AG 000002DI
J       000043RD 000045WR 000047RD 000048WR 000050RD 000051WR 000053RD 000056RD
        000058WR 000060RD 000063RD 000065WR
LASTID  000001AG 000030O
LEN     000043RD 000044   000045WR
NEWLEN  000044=  000045WR
NTOT    000051=  000054=  000065WR
NX      000053RD 000054   000056RD 000057   000058WR 000060RD 000061   000063RD
        000064   000065WR
NXT     000054=  000057=  000058WR
NY      000060RD 000061   000063RD 000064   000065WR
RESR    000016U
TTLNEW  000001AG 000002DI 000045WR
10      000056GT 000043*
100     000030O  000042GT 000043GT 000049GT 000052GT 000059GT 000063*
20      000037GT 000047*
25      000056GT 000050*
30      000011GT 000013GT 000033GT 000035GT 000037GT 000053*
40      000039GT 000041GT 000056*
50      000056GT 000053*
60      000015GT 000017GT 000019GT 000021GT 000023GT 000025GT 000027GT 000063*
70      000029GT 000031GT 000063*
80      000062GT 000065*
```

```
00001          SUBROUTINE SOLVE(NDIM,N,A,B,IPVT)
00002          INTEGER NDIM,N,IPVT(N)
00003          COMPLEX A(NDIM,N),B(N),T
               C
               C  SOLUTION OF LINEAR SYSTEM A*X=C
               C
               C  DO NOT USE OF DECOMP HAS DETECTED SINGULARITY
               C
               C  INPUT..
               C
               C    NDIM = DECLARED ROW DIMENSION OF ARRAY CONTAINING A
               C
               C    N = ORDER OF MATRIX.
               C
               C    A = TRIANGULARIZED MATRIX OBTAINED FROM DECOMP.
               C
               C    B = RIGHT HAND SIDE VECTOR.
               C
               C    IPVT = PIVOT VECTOR OBTAINED FROM DECOMP
               C
               C  OUTPUT..
               C
               C    B = SOLUTION VECTOR, X.
00004          INTEGER KB,KM1,NM1,KP1,I,K,M
               C
               C  FORWARD ELIMINATION
00005          IF(N.EQ.1) GO TO 50
00007          NM1=N-1
00008          DO 20 K=1,NM1
00009          KP1=K+1
00010          M=IPVT(K)
00011          T=B(M)
00012          B(M)=B(K)
00013          B(K)=T
00014          DO 10 I=KP1,N
00015          B(I)=B(I)+A(I,K)*T
00016    10    CONTINUE
00017    20    CONTINUE
               C
               C  BACK SUBSTITUTION
               C
00018          DO 40 KB=1,NM1
00019          KM1=N-KB
00020          K=KM1+1
00021          B(K)=B(K)/A(K,K)
00022          T=-B(K)
00023          DO 30 I=1,KM1
00024          B(I)=B(I)+A(I,K)*T
00025    30    CONTINUE
00026    40    CONTINUE
00027    50    B(1)=B(1)/A(1,1)
00028          RETURN
00029          END
```

```
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A       000001AG 00003CX 00015   00021   00024   00027
B       000011AG 00003CX 00011   00012=  00013=  00015=  00021=  00022
        00024=  00027=
I       00004IN 00014DO 00015    00023DO 00024
IPVT    00001AG 00002IN 00010
K       00004IN 00038DO 00009    00010   00012   00013   00015   00020=
        00021   00022   00024
KB      00004IN 00018DO 00019
K1      00004IN 00019=  00020    00023DO
KP1     00004IN 00009=  00014DO
M       00004IN 00010=  00011    00012
N       00001AG 00002IN 00003CX  00005IF 00007   00014DO 00019
NDIM    00001AG 00002IN 00003CX
R1      00004IN 00007=  00038DO  00018DO
SOLVE   00001SU
T       00003CX 00011=  00013    00015   00022=  00024
10      00014DO 00016*
20      00038DO 00017*
30      00023DO 00025*
40      00018DO 00026*
50      00005GT 00027*
```

END

DATE

FILMED

JAN 30 1981