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SOUTHEASTERN MASSACHUSETTS UNIV NORTH DARTMOUTH DEPT --ETC F/G 9/2  
A NEW SOFTWARE PACKAGE FOR SEISMIC AND IMAGERY RECOGNITION.(U)  
SEP 76 C H CHEN

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AFOSR-TR-76-1166

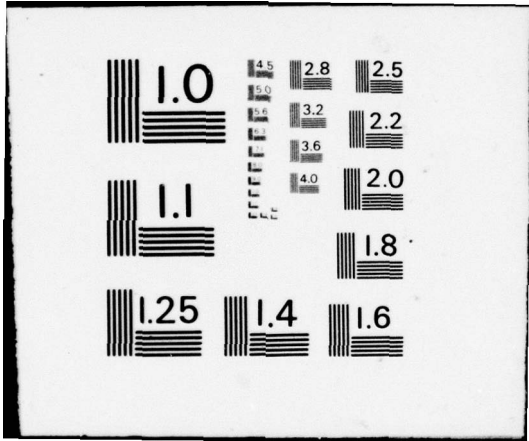
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TECHNICAL REPORT SERIES IN INFORMATION SCIENCES  
(Dr. C. H. Chen, Principal Investigator)

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Grant AFOSR 76-2951  
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September 7, 1976

## AFOSR - TR - 76 - 1166

### A NEW SOFTWARE PACKAGE FOR SEISMIC AND IMAGERY RECOGNITION

by

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#### Abstract

This report summarizes the software development effort on seismic and imagery pattern recognition studies under the support of the Grant. The program libraries and major program listings are described in detail. The complete recognition system based on PDP 11-45 minicomputer and display units is truly interactive with the aid of the software package described. Furthermore, all algorithms of the programs listed have provided excellent recognition results.

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## A New Software Package for Seismic and Imagery Recognition

C. H. Chen

### I. Introduction

This report provides a most up-to-date description of computer programs on teleseismic pattern recognition and imagery pattern recognition studies which have been carried out in this research group under the support of grant from the Directorate of Mathematical and Information Sciences, Air Force Office of Scientific Research. Documentation of the software on seismic recognition research was made over two years ago (1). A considerable change in the programs has been made since then. The present report includes both seismic and imagery programs which are written in more efficient manner although the programming language is still Fortran. In every pattern recognition research group throughout the world, nearly one-half of the research effort has to be devoted to the software development. To unify and thus simplify such effort is impossible because each group has its own computer facility and would prefer to use its own algorithms. However, by documenting a software package as this report, other groups with similar computer facilities may not have to duplicate the extensive programming effort if the same algorithms are used. All algorithms presented in this report have provided good recognition results. Our computer recognition system, the PDP 11-45 along with display units, and the Fortran language used are both quite typical throughout the world. Thus we believe this report will definitely provide a useful service to the pattern recognition research community.

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(1) C. H. Chen and I. C. Lin, "A Summary of PDP 11-45 computer software package for seismic data analysis and discrimination", DECUS Proceedings, Boston, May 1974.

## II. Program Directory and Library

In the following pages is a list of typical program directory under different user numbers. The directory includes the names of all computer programs for both seismic and image studies. The directory may change from time to time. However there are some programs which are used very often and should be better protected. They can be placed in the program libraries. The Fortran library comes with the computer system and is essential to link any Fortran program. The list of other libraries particularly useful for the recognition studies is provided in the following pages. This includes: SPS Library and SSP Library for basic recognition operations; TCS Library for the Technonix keyboard screen display; XY Library and GT Library for interface with XY plotter and GT 40 display terminal respectively.

DIRECTORY DKO: [ 30.1 ]

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|             |     |           |       |
|-------------|-----|-----------|-------|
| CMPX        | 1   | 22-APR-72 | <233> |
| SPIKE3      | 3   | 25-JAN-72 | <233> |
| FFT1        | 2   | 17-MAY-72 | <233> |
| C2          | 2   | 07-MAR-72 | <233> |
| ATO . DDT   | 80C | 06-MAR-72 | <233> |
| DFT5        | 2   | 06-FEB-72 | <233> |
| AUTO1       | 2   | 06-MAR-72 | <233> |
| FFT3        | 2   | 17-MAY-72 | <233> |
| C8          | 3   | 16-MAR-72 | <233> |
| HSGRAM      | 1   | 30-JAN-72 | <233> |
| COCN2       | 1   | 18-FEB-72 | <233> |
| ATO . DAT   | 41C | 31-MAR-72 | <233> |
| PLOT        | 1   | 13-MAY-72 | <233> |
| STST        | 1   | 06-APR-72 | <233> |
| ATO2        | 1   | 06-MAR-72 | <233> |
| COCN1       | 2   | 05-FEB-72 | <233> |
| DIST        | 2   | 17-MAY-72 | <233> |
| DIST2       | 1   | 17-MAY-72 | <233> |
| CMX . DAT   | 18C | 15-APR-72 | <233> |
| C5          | 3   | 16-MAR-72 | <233> |
| TEST        | 1   | 23-JAN-72 | <233> |
| AT1 . DAT   | 3C  | 28-MAR-72 | <233> |
| PQINT       | 1   | 07-MAR-72 | <233> |
| TEST2       | 2   | 24-JAN-72 | <233> |
| FFT . DAT   | 5C  | 13-MAR-72 | <233> |
| COMPAR      | 1   | 25-JAN-72 | <233> |
| DFT4        | 3   | 31-JAN-72 | <233> |
| SPIKE1      | 3   | 25-JAN-72 | <233> |
| CLASO       | 2   | 17-MAY-72 | <233> |
| ATO         | 1   | 17-MAY-72 | <233> |
| SPIKE       | 3   | 25-JAN-72 | <233> |
| S1          | 1   | 31-JAN-72 | <233> |
| SHOW        | 2   | 12-MAR-72 | <233> |
| TEST1       | 2   | 23-JAN-72 | <233> |
| EAQ . EXP   | 2C  | 02-JAN-72 | <233> |
| TEST4       | 1   | 27-MAR-72 | <233> |
| FFT4        | 3   | 15-APR-72 | <233> |
| C4          | 3   | 07-MAR-72 | <233> |
| LEVEL       | 2   | 04-FEB-72 | <233> |
| DIST1 . LDA | 18  | 11-MAY-72 | <233> |
| ATO1        | 1   | 17-MAY-72 | <233> |
| TEST5       | 1   | 07-MAR-72 | <233> |
| S2          | 1   | 25-JAN-72 | <233> |
| DIST1       | 1   | 17-MAY-72 | <233> |
| SPIKE2      | 3   | 25-JAN-72 | <233> |
| COCNO       | 4   | 04-FEB-72 | <233> |
| AC1         | 1   | 28-MAR-72 | <233> |
| MEAN        | 3   | 25-JAN-72 | <233> |
| FFT5        | 3   | 19-APR-72 | <233> |
| D2M         | 1   | 25-JAN-72 | <233> |
| C7          | 3   | 23-MAR-72 | <233> |
| C6          | 2   | 11-MAR-72 | <233> |
| C10         | 2   | 23-MAR-72 | <233> |
| CLAS3       | 3   | 04-APR-72 | <233> |
| TTST        | 1   | 13-MAR-72 | <233> |
| CLAS1       | 2   | 17-MAY-72 | <233> |
| PLOT5       | 2   | 23-APR-72 | <233> |

List of Names of Programs  
Stored in the Disk  
(continued next page)

|             |      |           |       |
|-------------|------|-----------|-------|
| HAMING      | 1    | 17-MAY-72 | <233> |
| MAIN        | 2    | 27-MAR-72 | <233> |
| SHOW1       | 1    | 13-MAR-72 | <233> |
| TABLE       | 2    | 04-FEB-72 | <233> |
| C9          | 3    | 11-MAR-72 | <233> |
| HST         | 1    | 04-FEB-72 | <233> |
| CLASO . LDA | 23   | 11-MAY-72 | <233> |
| TEST6       | 1    | 07-MAR-72 | <233> |
| PROJT . OBJ | 14   | 23-APR-72 | <233> |
| P3          | 3    | 04-FEB-72 | <233> |
| FFT         | 3    | 28-MAR-72 | <233> |
| M2D         | 1    | 04-FEB-72 | <233> |
| COC14       | 1    | 05-FEB-72 | <233> |
| PROJT       | 3    | 23-APR-72 | <233> |
| ATC . DAT   | 3C   | 23-MAR-72 | <233> |
| FT3 . DAT   | 8C   | 16-APR-72 | <233> |
| MAIN2       | 1    | 07-MAR-72 | <233> |
| FT1 . DAT   | 6C   | 28-MAR-72 | <233> |
| CLAS4       | 3    | 11-MAY-72 | <233> |
| PLOT1       | 2    | 23-MAR-72 | <233> |
| MAIN1       | 1    | 28-MAR-72 | <233> |
| AC          | 1    | 24-MAR-72 | <233> |
| CA          | 2    | 30-MAR-72 | <233> |
| CLAS1 . LDA | 23   | 11-MAY-72 | <233> |
| PLOT2       | 2    | 23-APR-72 | <233> |
| PLOT6       | 1    | 29-MAR-72 | <233> |
| PQ2 . DAT   | 2C   | 28-MAR-72 | <233> |
| FT2 . DAT   | 41C  | 04-APR-72 | <233> |
| CLAS4 . LDA | 24   | 11-MAY-72 | <233> |
| PQINT1      | 1    | 28-MAR-72 | <233> |
| PLOT3       | 1    | 28-MAR-72 | <233> |
| QX1 . DAT   | 816C | 16-APR-72 | <233> |
| EPLID       | 2    | 25-MAR-72 | <233> |
| MAG . DPH   | 6C   | 27-MAR-72 | <233> |
| TEST3       | 1    | 27-MAR-72 | <233> |
| COPY3       | 2    | 29-MAR-72 | <233> |
| TST         | 1    | 15-APR-72 | <233> |
| PLOT7       | 1    | 29-MAR-72 | <233> |
| TTT         | 1    | 06-APR-72 | <233> |
| SMP . DAT   | 1C   | 01-APR-72 | <233> |
| PLOT4       | 1    | 24-APR-72 | <233> |
| CLAS2       | 3    | 21-APR-72 | <233> |
| PQ3 . DAT   | 2C   | 18-APR-72 | <233> |
| SPP         | 1    | 18-APR-72 | <233> |
| CLAS5       | 3    | 19-APR-72 | <233> |

TOTL BLKS: 1284

TOTL FILES: 102



DIRECTORY DK0: [ 30, 2 ]

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|              |      |           |       |
|--------------|------|-----------|-------|
| XYGRD5       | 3    | 17-MAY-72 | <233> |
| MAIN1        | 2    | 28-MAR-72 | <233> |
| SEE2         | 2    | 22-MAY-72 | <233> |
| HOUGH2       | 2    | 08-MAY-72 | <233> |
| XYP3         | 3    | 28-MAR-72 | <233> |
| TEM . TEM    | 256C | 24-MAY-72 | <233> |
| MAIN         | 3    | 28-MAR-72 | <233> |
| HOUGH1       | 2    | 08-MAY-72 | <233> |
| HAMING       | 3    | 28-MAR-72 | <233> |
| SEE2 . LDA   | 18   | 07-MAY-72 | <233> |
| HOUGH0       | 2    | 26-APR-72 | <233> |
| TMP . DAT    | 113C | 07-MAY-72 | <233> |
| TEST4        | 1    | 23-MAY-72 | <233> |
| XYP1         | 2    | 28-MAR-72 | <233> |
| HGH1         | 3    | 24-MAY-72 | <233> |
| GRAD1        | 1    | 25-MAY-72 | <233> |
| TSM1         | 2    | 28-MAR-72 | <233> |
| DIN2         | 1    | 24-MAY-72 | <233> |
| XYP2         | 2    | 28-MAR-72 | <233> |
| MIDL         | 2    | 07-MAY-72 | <233> |
| DFT1         | 3    | 28-MAR-72 | <233> |
| XYTS         | 2    | 28-MAR-72 | <233> |
| MAIN4        | 3    | 28-MAR-72 | <233> |
| MIDL . LDA   | 15   | 07-MAY-72 | <233> |
| XYHT         | 5    | 28-MAR-72 | <233> |
| D2M1         | 2    | 28-MAR-72 | <233> |
| DAT . DAT    | 256C | 26-APR-72 | <233> |
| COPY         | 2    | 13-MAY-72 | <233> |
| D2M          | 2    | 28-MAR-72 | <233> |
| SEE4         | 1    | 24-MAY-72 | <233> |
| HOUGH3       | 2    | 24-MAY-72 | <233> |
| HOUGH5       | 3    | 24-MAY-72 | <233> |
| HGH . DAT    | 57C  | 27-APR-72 | <233> |
| COPY . OBJ   | 8    | 26-MAY-72 | <233> |
| SEE1         | 1    | 24-MAY-72 | <233> |
| SEE . LDA    | 17   | 24-MAY-72 | <233> |
| HGH2         | 1    | 24-MAY-72 | <233> |
| DOUT         | 1    | 27-APR-72 | <233> |
| HGH2 . LDA   | 17   | 24-MAY-72 | <233> |
| GRAD . LDA   | 20   | 06-APR-72 | <233> |
| DIN . LDA    | 20   | 21-MAY-72 | <233> |
| DIN          | 1    | 24-MAY-72 | <233> |
| TEST4 . LDA  | 18   | 23-MAY-72 | <233> |
| HOUGH4 . LDA | 23   | 22-MAY-72 | <233> |
| TTSS         | 1    | 06-MAY-72 | <233> |
| DIN1         | 1    | 24-MAY-72 | <233> |
| HOUGH3 . LDA | 22   | 27-APR-72 | <233> |
| TMP . TMP    | 57C  | 28-APR-72 | <233> |
| XYGRD5 . LDA | 32   | 16-MAY-72 | <233> |
| XYGRD4       | 3    | 16-MAY-72 | <233> |
| XYGRD6       | 3    | 13-MAY-72 | <233> |
| XYGRD6 . LDA | 29   | 13-MAY-72 | <233> |
| XYGRD8       | 3    | 13-MAY-72 | <233> |
| TTSS . LDA   | 17   | 06-MAY-72 | <233> |
| SEE1 . LDA   | 18   | 24-MAY-72 | <233> |
| XYGRD7       | 3    | 15-MAY-72 | <233> |
| XYGRD2       | 2    | 06-MAY-72 | <233> |
| DIN2 . LDA   | 12   | 24-MAY-72 | <233> |
| GRAD2 . LDA  | 20   | 25-MAY-72 | <233> |
| HGH3 . LDA   | 21   | 24-MAY-72 | <233> |
| XYGRD        | 2    | 06-MAY-72 | <233> |

|              |     |           |       |
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| GRAD3        | 1   | 25-MAY-72 | <233> |
| HGH3         | 1   | 24-MAY-72 | <233> |
| XYGRD9       | 4   | 15-MAY-72 | <233> |
| HST          | 2   | 06-MAY-72 | <233> |
| TEST1        | 1   | 23-MAY-72 | <233> |
| HST1         | 1   | 06-MAY-72 | <233> |
| TEST         | 1   | 23-MAY-72 | <233> |
| DIN3         | 1   | 24-MAY-72 | <233> |
| GRAD2        | 2   | 25-MAY-72 | <233> |
| HGH4         | 1   | 24-MAY-72 | <233> |
| DIN1 . LDA   | 21  | 24-MAY-72 | <233> |
| DIN3 . LDA   | 11  | 24-MAY-72 | <233> |
| XYGRD3       | 3   | 06-MAY-72 | <233> |
| GRAD         | 2   | 06-APR-72 | <233> |
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| TEST2        | 1   | 23-MAY-72 | <233> |
| SEE3         | 2   | 24-MAY-72 | <233> |
| XYGRD1       | 3   | 06-APR-72 | <233> |
| TEST3        | 1   | 23-MAY-72 | <233> |
| TEM . DAT    | 64C | 24-MAY-72 | <233> |
| XYGRD1 . LDA | 24  | 06-APR-72 | <233> |
| GRAD0        | 1   | 25-MAY-72 | <233> |
| SEE          | 1   | 24-MAY-72 | <233> |
| SEE3 . LDA   | 20  | 24-MAY-72 | <233> |
| SEE4 . LDA   | 17  | 24-MAY-72 | <233> |
| HST2         | 1   | 24-MAY-72 | <233> |
| HOUGH4       | 2   | 24-MAY-72 | <233> |
| HST2 . LDA   | 24  | 24-MAY-72 | <233> |
| HGH0         | 2   | 24-MAY-72 | <233> |
| HGH0 . LDA   | 23  | 24-MAY-72 | <233> |
| GRAD3 . LDA  | 18  | 25-MAY-72 | <233> |
| GRAD0 . LDA  | 18  | 25-MAY-72 | <233> |

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DIRECTORY DK0: [ 1, 1 ]

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|              |      |           |       |
|--------------|------|-----------|-------|
| BADB . SYS   | 1    | 14-APR-70 | <377> |
| MONLIB . CIL | 175C | 27-MAR-71 | <377> |
| PIP . LDA    | 35C  | 26-MAR-71 | <233> |
| FURTRN . LDA | 34   | 28-MAR-71 | <233> |
| XYLIB . OBJ  | 18   | 06-MAY-72 | <233> |
| SPSLIB . OBJ | 38   | 23-MAY-72 | <233> |
| VERIFY . LDA | 68C  | 27-MAR-71 | <233> |
| MACRO . LDA  | 40C  | 27-MAR-71 | <233> |
| LINK . LDA   | 68C  | 27-MAR-71 | <233> |
| SKIP . LDA   | 4    | 22-MAY-71 | <233> |
| EDIT . LDA   | 14   | 27-MAR-71 | <233> |
| SSSLIB . OBJ | 1    | 25-MAY-72 | <233> |
| SSPLIB . OBJ | 151  | 25-MAY-72 | <000> |
| LIBR . LDA   | 10   | 27-MAR-71 | <233> |
| TRCLIB . OBJ | 13   | 28-MAR-71 | <233> |
| FTNLIB . OBJ | 170  | 27-MAR-71 | <233> |
| SYSMAC . SML | 27   | 28-MAR-71 | <233> |
| FURTRN . OVR | 119C | 28-MAR-71 | <233> |
| FORRUN . DGN | 16C  | 28-MAR-71 | <233> |
| FORCOM . DGN | 21C  | 28-MAR-71 | <233> |
| TCSLIB . OBJ | 144  | 21-MAY-71 | <233> |
| GTLIB . OBJ  | 21   | 21-MAY-71 | <233> |

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TOTL FILES: 22

List of Programs in the Program Libraries (continued next page)

| LIBR V05A   |        |           | LIBR V05A   |        |           |
|-------------|--------|-----------|-------------|--------|-----------|
| SPSLIB. OBJ |        | 28-AUG-76 | SSPLIB. OBJ |        | 24-AUG-76 |
| SEQ.        | NAME   | VERSION   | SEQ.        | NAME   | VERSION   |
| 00001       | SPSPRO |           | 00001       | DECONV |           |
| 00002       | PRNTZ  |           | 00002       | SIZE   |           |
| 00003       | TAPE   |           | 00003       | FFOUR  |           |
| 00004       | DL1110 |           | 00004       | FWT    |           |
| 00005       | WALCAL |           | 00005       | REVBIT |           |
| 00006       | SPSHIS |           | 00006       | NLOG   |           |
| 00007       | SPSEXW |           | 00007       | NEXP   |           |
| 00008       | SPSROT |           | 00008       | UNWRAP |           |
| 00009       | SPSSHI |           | 00009       | REMOVE |           |
| 00010       | SPSHAN |           | 00010       | SET    |           |
| 00011       | SPSHAF |           | 00011       | FMIN   |           |
| 00012       | SPSLOU |           | 00012       | FMAX   |           |
| 00013       | SPSEXP |           | 00013       | SUM    |           |
| 00014       | SPSLOG |           | 00014       | MULT   |           |
| 00015       | SPSMOV |           | 00015       | DIVD   |           |
| 00016       | SPSNEG |           | 00016       | ADD    |           |
| 00017       | SPSMUL |           | 00017       | SUB    |           |
| 00018       | SPSADD |           | 00018       | COPY   |           |
| 00019       | SPSP2R |           | 00019       | SWAP   |           |
| 00020       | SPSR2P |           | 00020       | AMPL   |           |
| 00021       | SPSA2B |           | 00021       | CONV   |           |
| 00022       | SPSSET |           | 00022       | RE     |           |
| 00023       | SPSSIZ |           | 00023       | IM     |           |
| 00024       | SPSFFT |           | 00024       | SHIFTR |           |
| 00025       | SPSBPA |           | 00025       | SHIFTL |           |
| 00026       | SPSBNO |           | 00026       | ROTR   |           |
| 00027       | SPSELI |           | 00027       | ROTL   |           |
| 00028       | FFTIFT |           | 00028       | SINE   |           |
| 00029       | WALSH  |           | 00029       | COSINE |           |
| 00030       | FSICO  |           | 00030       | TAPE   |           |
| 00031       | FSQRT  |           | 00031       | ZERO   |           |
| 00032       | FATAN  |           | 00032       | NORM   |           |
| 00033       | FLOG   |           | 00033       | AUTO   |           |
| 00034       | FEXP   |           | 00034       | MARKEL |           |
|             |        |           | 00035       | DISCR  |           |
|             |        |           | 00036       | NNR    |           |
|             |        |           | 00037       | SCAN   |           |
|             |        |           | 00038       | PROJ   |           |
|             |        |           | 00039       | KBPLOT |           |
|             |        |           | 00040       | KBPROJ |           |
|             |        |           | 00041       | XYPLOT |           |
|             |        |           | 00042       | GTPROJ |           |
|             |        |           | 00043       | INPUT  |           |
|             |        |           | 00044       | NEWFIL |           |
|             |        |           | 00045       | PLOTS  |           |
|             |        |           | 00046       | BELL   |           |
|             |        |           | 00047       | DATSWT |           |
|             |        |           | 00048       | BY2IN  |           |
|             |        |           | 00049       | READIT |           |
|             |        |           | 00050       | READUN |           |

## LIBR V05A

TCSLIB . OBJ 29-AUG-76

| SEQ.  | NAME   | VERSION |
|-------|--------|---------|
| 00001 | INITT  |         |
| 00002 | FINITT |         |
| 00003 | BELL   |         |
| 00004 | POINTR |         |
| 00005 | DASHR  |         |
| 00006 | DASHA  |         |
| 00007 | DSHREL |         |
| 00008 | DSHABS |         |
| 00009 | DRAWR  |         |
| 00010 | POINTA |         |
| 00011 | SDRAWA |         |
| 00012 | DRAWA  |         |
| 00013 | MOVER  |         |
| 00014 | REL2AB |         |
| 00015 | SMOVEA |         |
| 00016 | MOVEA  |         |
| 00017 | VCURSR |         |
| 00018 | V2ST   |         |
| 00019 | CLIPT  |         |
| 00020 | PARCLT |         |
| 00021 | PNTREL |         |
| 00022 | PNTABS |         |
| 00023 | DRWREL |         |
| 00024 | DRWABS |         |
| 00025 | MOVREL |         |
| 00026 | SETTAB |         |
| 00027 | RSTTAB |         |
| 00028 | TABHOR |         |
| 00029 | TABVER |         |
| 00030 | DSHMOD |         |
| 00031 | MODCHK |         |
| 00032 | TKDASH |         |
| 00033 | ERASE  |         |
| 00034 | HDCOPY |         |
| 00035 | KIN    |         |
| 00036 | KCM    |         |
| 00037 | DCURSR |         |
| 00038 | ANCHO  |         |
| 00039 | NEWLIN |         |
| 00040 | CARTN  |         |
| 00041 | LINEF  |         |
| 00042 | BAKSP  |         |
| 00043 | HOME   |         |
| 00044 | NEWPAG |         |
| 00045 | RESTAT |         |
| 00046 | MOVABS |         |
| 00047 | VECMOD |         |
| 00048 | Csize  |         |
| 00049 | PNTMOD |         |
| 00050 | XYCNVT |         |
| 00051 | LVLCHT |         |
| 00052 | REVCOT |         |
| 00053 | PCLIPT |         |
| 00054 | PWINDO |         |
| 00055 | VWINDO |         |
| 00056 | SWINDO |         |

|       |        |  |
|-------|--------|--|
| 00057 | TWINDO |  |
| 00058 | LWINDO |  |
| 00059 | DWINDO |  |
| 00060 | WINCOT |  |
| 00061 | RESCAL |  |
| 00062 | USDRAW |  |
| 00063 | URSCAL |  |
| 00064 | USECOT |  |
| 00065 | UREVCT |  |
| 00066 | SVSTAT |  |
| 00067 | GENFLG |  |
| 00068 | ANMODE |  |
| 00069 | FSTPNT |  |
| 00070 | TEKMAC |  |

## LIBR V05A

XYLIB . OBJ 29-AUG-76

| SEQ.  | NAME   | VERSION |
|-------|--------|---------|
| 00001 | XYVECS |         |
| 00002 | ROT    |         |
| 00003 | UNSCLE |         |
| 00004 | XYREAD |         |
| 00005 | XYSCLE |         |
| 00006 | CHAR1  |         |
| 00007 | XYINT  |         |
| 00008 | XY1    |         |
| 00009 | XYO    |         |

## LIBR V05A

GTLIB . OBJ 29-AUG-76

| SEQ.  | NAME   | VERSION |
|-------|--------|---------|
| 00001 | GTPLOT |         |
| 00002 | GTPAK4 |         |
| 00003 | GTPAK3 |         |
| 00004 | GTPAK2 |         |
| 00005 | GTPAK1 |         |
| 00006 | DL1110 |         |

### III. Listing of Major Computer Programs

Twelve seismic recognition programs and twelve imagery recognition programs are listed in the following pages. Emphasis is placed on programs that provide displays on line printer, screen of the key-board, and the XY plotter. Thus with the aid of this software package, the recognition system is fully interactive. For example in imagery recognition, a display of desired segment of a picture can be made by specifying the row number and column number of the upper leftmost picture element as well as the size of the picture segment.

Included in the seismic programs are the program to compute autocovariance features which are extremely effective in seismic discrimination, and the program for learning sample selection in nearest-neighbor classification rule (NNR). Learning sample selection is needed because of a large variation in quality among all seismic signatures.

Included in the image programs are the program to generate a modified gradient picture which is much better than the more familiar gradient picture, and the program to tabulate a third-order texture measure for each of the 64 subpictures. In experimental study performed, the largest texture measure correctly identifies the location of interesting object in all reconnaissance images studied.

Seismic Program #1

This program computes the autocovariance features. 16 features are taken from the normalized record.

FORTRAN V06.13

00:00:00

21-AUG-76

```
0001      DIMENSION A(1200),SUM(17),S(16)
0002      CALL SETFIL(1,'ATO.DAT',IR,'DK',0)
0003      DEFINE FILE 1(323,32,U,LN)
0004      DO 3 L=1,323
0005      READ(2)A
0006      SM=0.0
0007      DO 1 I=1,1200
0008      1      SM=SM+A(I)
0009      SM=SM/1200.0
0010      DO 7 I=1,1200
0011      7      A(I)=A(I)-SM
0012      DO 6 I=1,17
0013      SUM(I)=0.0
0014      K=1201-I
0015      DO 6 J=1,K
0016      KK=I+J-1
0017      SUM(I)=SUM(I)+A(J)*A(KK)
0018      6      CONTINUE
0019      DO 2 I=1,16
0020      S(I)=SUM(I+1)/SUM(I)
0021      2      CONTINUE
0022      WRITE(1'L)S
0023      3      CONTINUE
0024      CALL EXIT
0025      END
```

ROUTINES CALLED:  
SETFIL, EXIT

OPTIONS =/OP:2

| BLOCK | LENGTH         |
|-------|----------------|
| MAIN. | 2739 (012546)* |

| **COMPILER   | ----  | CORE** |  |  |
|--------------|-------|--------|--|--|
| PHASE        | USED  | FREE   |  |  |
| DECLARATIVES | 00622 | 15026  |  |  |
| EXECUTABLES  | 00863 | 14785  |  |  |
| ASSEMBLY     | 01119 | 19169  |  |  |

Seismic Program #2

This program computes the entropy in two definitions from  $G(f)$ , the normalized spectrum of seismic signature:

$$S1 = \sum \ln G(f) \quad , \quad S2 = \sum G(f) \ln G(f)$$

FORTRAN V06.13

00:00:00

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```

0001      DIMENSION C(257),A(1200),X(2,1024)
0002      COMPLEX E(1024)
0003      EQUIVALENCE(E,X)
0004      CALL SETFIL(2,'FT1.DAT',IER,'DK',0)
0005      DEFINE FILE 2(323,4,U,NP)
0006      CALL SIZE(C,1024)
0007      DO 1 J=1,323
0008      DO 7 I=1,1024
0009      7   E(I)=(0.0,0.0)
0010      READ(1)A
0011      DO 2 I=1,1024
0012      2   X(1,I)=A(I)
0013      CALL FFOUR(E,1024,C,-1.0)
0014      SUM=0.0
0015      DO 5 I=2,512
0016      X(1,I)=CABS(E(I))
0017      SUM=SUM+X(1,I)
0018      5   CONTINUE
0019      S1=0.0
0020      S2=0.0
0021      DO 10 I=2,512
0022      TMP=X(1,I)/SUM
0023      IF(TMP.EQ.0.0) GO TO 10
0024      TEM=ALOG(TMP)
0025      S1=S1+TEM
0026      S2=S2+TMP*TEM
0027      10  CONTINUE
0028      WRITE(2,J)S1,S2
0029      1   CONTINUE
0030      9   CALL EXIT
0031      END
    
```

ROUTINES CALLED:

SETFIL, SIZE, FFOUR, CABS, ALOG, EXIT

OPTIONS =/OP:2

| BLOCK | LENGTH         |
|-------|----------------|
| MAIN. | 7349 (034552)* |

| **COMPILER ----- CORE** |       |       |
|-------------------------|-------|-------|
| PHASE                   | USED  | FREE  |
| DECLARATIVES            | 00622 | 15026 |
| EXECUTABLES             | 00953 | 14695 |
| ASSEMBLY                | 01207 | 19081 |

Seismic Program #3

This program computes the power cepstrum of seismic signature in steps:  
 seismic signature → FFT → ln of |normalized spectrum| → IFT → power cepstrum

FORTRAN V06.13

00:00:00

21-AUG-76

```

0001      DIMENSION C(257),A(1200),X(2,1024)
0002      COMPLEX E(1024)
0003      EQUIVALENCE(E,X)
0004      CALL SETFIL(3,'FT2.DAT',IER,'DK',0)
0005      DEFINE FILE 3(323,32,U,NP)
0006      CALL SIZE(C,1024)
0007      DO 1 J=1,323
0008      DO 7 I=1,1024
0009      7      E(I)=(0.0,0.0)
0010      READ(1)A
0011      DO 2 I=1,1024
0012      2      X(1,I)=A(I)
0013      CALL FFOUR(E,1024,C,-1.0)
0014      E(I)=(0.0,0.0)
0015      SUM=0.0
0016      DO 5 I=2,1024
0017      X(1,I)=CABS(E(I))
0018      X(1,I)=X(1,I)*X(1,I)
0019      SUM=SUM+X(1,I)
0020      X(2,I)=0.0
0021      5      CONTINUE
0022      DO 6 I=2,513
0023      JJ=1026-I
0024      X(1,I)=(X(1,I)+X(1,JJ))/(2.0*SUM)
0025      X(1,JJ)=X(1,I)
0026      6      CONTINUE
0027      DO 3 I=1,1024
0028      IF(X(1,I).EQ.0.0) GO TO 3
0029      X(1,I)=ALOG(X(1,I))
0030      3      CONTINUE
0031      CALL FFOUR(E,1024,C,1.0)
0032      WRITE(3/J)(X(1,I),I=1,16)
0033      1      CONTINUE
0034      9      REWIND 1
0035      CALL EXIT
0036      END
    
```

ROUTINES CALLED:

SETFIL, SIZE, FFOUR, CABS, ALOG, EXIT

OPTIONS =/OP:2

| BLOCK | LENGTH         |
|-------|----------------|
| MAIN. | 7427 (035006)* |

| **COMPILER ----- CORE** |       |       |  |
|-------------------------|-------|-------|--|
| PHASE                   | USED  | FREE  |  |
| DECLARATIVES            | 00622 | 15026 |  |
| EXECUTABLES             | 00953 | 14695 |  |
| ASSEMBLY                | 01239 | 19049 |  |

Seismic Program #4 Removal of spikes in the multichannel data tape.

```

0001      DIMENSION IA(1200), X(1024), Y(1024), SUM(17), S(16)
0002      CALL SETFIL(1, 'QXF. FBM', IER, 'DK', 0)
0003      DEFINE FILE 1(215, 32, U, NL)
0004      11      FORMAT(1X, I4, I7)
0005              X(1)=1. 0
0006      READ(6, 7)KK
0007      DO 15 I=2, 1024
0008      15      X(I)=X(I-1)+1. 0
0009      1      READ(6, 7)II
0010      7      FORMAT(I3)
0011              IF(II. EQ. 0) GO TO 13
0012              DO 20 I=1, II
0013      READ(2)IA
0014      KK=KK+1
0015      20      CONTINUE
0016      6      FORMAT(1X, I7)
0017      DO 4 I=1, 1024
0018      4      Y(I)=FLOAT(IA(I))
0019      10      CALL NEWPAG
0020      CALL KBPLOT(X, Y, 1024, 0, 1023, 0, 780)
0021      READ(6, 12)IN
0022      12      FORMAT(I4)
0023              IF(IN. EQ. -1) GO TO 8
0024              IF(IN. EQ. -2) GO TO 1
0025      CALL LINE(IN)
0026      IP=IN+68
0027      IF(IP. GT. 1024) IP=1024
0028      DO 25 I=IN, IP
0029      WRITE(6, 11)I, IA(I)
0030      25      CONTINUE
0031      CALL LINE(IP)
0032      24      READ(6, 12)IN
0033              IF(IN. EQ. 0) GO TO 10
0034      23      IF(IN. GE. 1023) GO TO 18
0035              IF(IN. LE. 2) GO TO 19
0036      Y(IN)=(Y(IN+2)+Y(IN+1)+Y(IN-1)+Y(IN-2))/4. 0
0037      IA(IN)=Y(IN)
0038      GO TO 24
0039      19      Y(IN)=Y(IN+1)
0040      IA(IN)=IA(IN+1)
0041      GO TO 24
0042      18      Y(IN)=Y(IN-1)
0043      IA(IN)=IA(IN-1)
0044      GO TO 24
0045      8      DO 3 I=1, 17
0046              SUM(I)=0. 0
0047              K=1025-I
0048              DO 3 J=1, K
0049              JJ=I+J-1
0050      SUM(I)=SUM(I)+Y(J)*Y(JJ)
0051      3      CONTINUE
0052      DO 2 I=1, 16
0053      S(I)=SUM(I+1)/SUM(1)
0054      2      CONTINUE
0055      WRITE(1'KK)S
0056      GO TO 1
0057      13      CALL EXIT
0058      END

```

ROUTINES CALLED:  
 SETFIL, FLOAT, NEWPAG, KBPLOT, LINE, EXIT

OPTIONS =/OP: 2

| BLOCK | LENGTH         |
|-------|----------------|
| MAIN  | 7216 (034140)* |

| **COMPILER   | ----- | CORE** |
|--------------|-------|--------|
| PHASE        | USED  | FREE   |
| DECLARATIVES | 00622 | 15026  |
| EXECUTABLES  | 01023 | 14625  |
| ASSEMBLY     | 01427 | 18861  |



Seismic Program #5

NNR classification program with learning sample selection  
and 1 learning sample per class.

FORTRAN V06.13

00:00:00

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PAGE

1

```

0001      DIMENSION X(323),Q(323),LS(323)
0002      CALL SETFIL(1,'QX1.DAT',IR,'DK',0)
0003      DEFINE FILE 1(323,646,U,NL)
0004      CALL SETFIL(3,'PQ2.DAT',IE,'DK',0)
0005      DEFINE FILE 3(323,1,U,NP)
0006      MS1=0
0007      DO 3 I=1,323
0008      READ(3'I)LS(I)
0009      3      CONTINUE
0010      DO 1 K=24,323
0011      IF(LS(K).EQ.2) GO TO 1
0012      READ(1'K)Q
0013      DO 2 I=1,181
0014      IF(LS(I).EQ.1) GO TO 2
0015      READ(1'I)X
0016      MS2=0
0017      DO 5 N=1,323
0018      LT=1
0019      IF(X(N).LE.Q(N)) LT=2
0020      IF(LT-LS(N))5,7,5
0021      7      MS2=MS2+1
0022      5      CONTINUE
0023      IF(MS2.LE.MS1) GO TO 2
0024      R3=FLOAT(MS2-2)/321.0
0025      WRITE(5,14)R3
0026      14     FORMAT(2X,'TOTAL CLAS. RATE',F9.4)
0027      WRITE(5,15)MS2,K,I
0028      15     FORMAT(10X'TMP. MAX. 'I4,2X'EAQK. SAMPLE'I4,2X'EXP. SAMPLE'I4)
0029      MS1=MS2
0030      2      CONTINUE
0031      1      CONTINUE
0032      CALL EXIT
0033      END
    
```

ROUTINES CALLED:  
SETFIL, FLOAT, EXIT

OPTIONS =/OP:2

| BLOCK | LENGTH         |
|-------|----------------|
| MAIN. | 2352 (011140)* |

| **COMPILER ----- CORE** |       |       |
|-------------------------|-------|-------|
| PHASE                   | USED  | FREE  |
| DECLARATIVES            | 00622 | 15026 |
| EXECUTABLES             | 00943 | 14705 |
| ASSEMBLY                | 01371 | 18917 |

Seismic Program #6

NNR classification program with 2 learning samples(selected) per class.

```

0001      DIMENSION X1(323),X2(323),Q2(323),Q1(323),LS(323)
0002      CALL SETFIL(1,'QX1.DAT',IR,'DK',0)
0003      DEFINE FILE 1(323,646,U,NL)
0004      CALL SETFIL(3,'PQ2.DAT',IE,'DK',0)
0005      DEFINE FILE 3(323,1,U,NP)
0006      MS1=0
0007      DO 3 K=1,323
0008      READ(3,K)LS(K)
0009      3      CONTINUE
0010      READ(6,6)I1,I2
0011      6      FORMAT(2I3)
0012      READ(1,I1)Q1
0013      READ(1,I2)X1
0014      DO 1 K=25,323
0015      IF(LS(K).EQ.2) GO TO 1
0016      READ(1,K)Q2
0017      DO 8 I=1,323
0018      IF(Q2(I).GT.Q1(I)) Q2(I)=Q1(I)
0019      8      CONTINUE
0020      DO 2 I=1,181
0021      IF(LS(I).EQ.1) GO TO 2
0022      READ(1,I)X2
0023      MS2=0
0024      DO 12 N=1,323
0025      IF(X2(N).GT.X1(N)) X2(N)=X1(N)
0026      12     CONTINUE
0027      DO 5 N=1,323
0028      LT=1
0029      IF(X2(N).LE.Q2(N)) LT=2
0030      IF(LT-LS(N))5,7,5
0031      7      MS2=MS2+1
0032      5      CONTINUE
0033      IF(MS2.LE.MS1) GO TO 2
0034      R3=FLOAT(MS2-4)/319.0
0035      WRITE(5,14)R3
0036      14     FORMAT(2X,'TOTAL CLAS. RATE',F9.4)
0037      WRITE(5,15)MS2,K,I
0038      15     FORMAT(10X'TMP. MAX. 'I4,2X'EAQK. SAMPLE'I4,2X'EXP. SAMPLE'I4)
0039      MS1=MS2
0040      2      CONTINUE
0041      1      CONTINUE
0042      CALL EXIT
0043      END

```

ROUTINES CALLED:  
SETFIL, FLOAT, EXIT

OPTIONS =/OP:2

| BLOCK | LENGTH         |
|-------|----------------|
| MAIN. | 3778 (016604)* |

| **COMPILER ----- CORE** |       |       |  |
|-------------------------|-------|-------|--|
| PHASE                   | USED  | FREE  |  |
| DECLARATIVES            | 00622 | 15026 |  |
| EXECUTABLES             | 01023 | 14625 |  |
| ASSEMBLY                | 01451 | 18837 |  |

Seismic Program #7

NNR classification program with 3 or more than 3 selected learning samples/class

```

0001      DIMENSION X1(323),X2(323),Q2(323),Q1(323),LS(323)
0002      CALL SETFIL(1,'QX1.DAT',IR,'DK',0)
0003      DEFINE FILE 1(323,646,U,NL)
0004      CALL SETFIL(2,'PQ2.DAT',IE,'DK',0)
0005      DEFINE FILE 2(323,1,U,NP)
0006      MS1=0
0007      DO 3 K=1,323
0008      READ(2,K)LS(K)
0009      3      CONTINUE
0010      READ(6,6)I1,I2,I3
0011      6      FORMAT(3I3)
0012      MM=I3*2
0013      TMP=FLOAT(323-MM)
0014      WRITE(5,10)I1,I2
0015      READ(1,I1)Q1
0016      READ(1,I2)X1
0017      I3=I3-2
0018      DO 4 J=1,I3
0019      READ(6,9)I1,I2
0020      9      FORMAT(2I3)
0021      WRITE(5,10)I1,I2
0022      10     FORMAT(2X,'EARTHQUAKE SAMPLE'I4,2X,'EXPLOSION SAMPLE'I4)
0023      READ(1,I1)Q2
0024      READ(1,I2)X2
0025      DO 4 K=1,323
0026      IF(Q1(K).GT.Q2(K)) Q1(K)=Q2(K)
0027      IF(X1(K).GT.X2(K)) X1(K)=X2(K)
0028      4      CONTINUE
0029      DO 1 K=24,323
0030      IF(LS(K).EQ.2) GO TO 1
0031      READ(1,K)Q2
0032      DO 8 I=1,323
0033      IF(Q2(I).GT.Q1(I)) Q2(I)=Q1(I)
0034      8      CONTINUE
0035      DO 2 I=1,181
0036      IF(LS(I).EQ.1) GO TO 2
0037      READ(1,I)X2
0038      MS2=0
0039      DO 5 N=1,323
0040      LT=1
0041      IF(AMIN1(X1(N),X2(N)).LE.Q2(N)) LT=2
0042      IF(LT-LS(N))5,7,5
0043      7      MS2=MS2+1
0044      5      CONTINUE
0045      IF(MS2.LT.MS1) GO TO 2
0046      R3=FLOAT(MS2-MM)/TMP
0047      WRITE(5,14)R3
0048      14     FORMAT(2X,'TOTAL CLAS. RATE',F9.4)
0049      WRITE(5,15)MS2,K,I
0050      15     FORMAT(10X'TMP. MAX. 'I4,2X'EAQK. SAMPLE'I4,2X'EXP. SAMPLE'I4)
0051      MS1=MS2
0052      2      CONTINUE
0053      1      CONTINUE
0054      CALL EXIT
0055      END

```

|                  |                            |
|------------------|----------------------------|
| ROUTINES CALLED: | SETFIL, FLOAT, AMIN1, EXIT |
| OPTIONS =/OP:2   |                            |
| BLOCK LENGTH     | 3974 (017414)*             |
| **COMPILER       | ----- CORE**               |
| PHASE            | USED FREE                  |
| DECLARATIVES     | 00622 15026                |
| EXECUTABLES      | 01023 14625                |
| ASSEMBLY         | 01523 18765                |

Seismic Program #8

Calculation of distance in feature space  
to be stored in computer for NMR classification  
program use.

```

0001 DIMENSION A(16), B(16), DT(323)
0002 CALL SETFIL(1, 'QXA.DST', IE, 'DK', 0)
0003 DEFINE FILE 1(323, 646, U, NL)
0004 CALL SETFIL(2, 'ATO.DAT', IR, 'DK', 0)
0005 DEFINE FILE 2(323, 32, U, NP)
0006 DO 3 I=1, 323
0007 READ(2, I) A
0008 DO 5 J=1, 323
0009 READ(2, J) B
0010 DO 5 K=1, 16
0011 TMP=A(K)-B(K)
0012 DT(J)=TMP*TMP
0013 CONTINUE
0014 WRITE(1, I) DT
0015 CONTINUE
0016 CALL EXIT
0017 END

```

ROUTINES CALLED:  
SETFIL, EXIT

OPTIONS =/OP: 2

| BLOCK | LENGTH        |
|-------|---------------|
| MAIN  | 921 (003462)* |

```

**COMPILER ----- CORE**
PHASE USED FREE
DECLARATIVES 00622 15026
EXECUTABLES 00863 14785
ASSEMBLY 01047 19241

```

Seismic Program #9

Two dimensional display based on two features.

```

0001 DIMENSION X(1, 314), Y(1, 314)
0002 BYTE EP, EQ, Z(1, 314)
0003 DATA EP, EQ, 'X', 'Q' /
0004 CALL SETFIL(1, 'SEX.RAN', IERR, 'DK', 0)
0005 DEFINE FILE 1(314, 2, U, NC)
0006 CALL SETFIL(2, 'ATC.DAT', IER, 'DK', 0)
0007 DEFINE FILE 2(314, 2, U, NP)
0008 CALL SETFIL(3, 'FFT.DAT', IR, 'DK', 0)
0009 DEFINE FILE 3(314, 4, U, NL)
0010 DO 1 I=1, 314
0011 READ(1, I) N1, N2
0012 Z(1, I)=EP
0013 IF(N1.EQ.1) Z(1, I)=EQ
0014 CONTINUE
0015 DO 2 I=1, 314
0016 READ(2, I) X(1, I)
0017 CONTINUE
0018 DO 3 I=1, 314
0019 READ(3, I) A, Y(1, I)
0020 CONTINUE
0021 CALL PROJ(X, Y, 1, 314, 2, Z)
0022 CALL EXIT
0023 END

```

ROUTINES CALLED:  
SETFIL, PROJ, EXIT

OPTIONS =/OP: 2

| BLOCK | LENGTH         |
|-------|----------------|
| MAIN  | 1688 (006460)* |

```

**COMPILER ----- CORE**
PHASE USED FREE
DECLARATIVES 00622 15026
EXECUTABLES 00943 14705
ASSEMBLY 01083 19205

```

Seismic Program #10

Subroutine PROJ for two dimensional display use.

```

0001      SUBROUTINE PROJ(X, Y, N1, N2, ID, Z)
0002      BYTE LINE(121), Z(N1, N2), M1, M2, M3
0003      REAL X(N1, N2), Y(N1, N2), XX(7)
0004      DATA M1, M2, M3/'*', 'Q', 'X'/
0005      DATA IBLK, IHOR, IVER, IPLUS/' ', '- ', '! ', '+ '/
0006      WRITE(5, 400)
0007      400      FORMAT(1H1)
0008      200      FORMAT(1X, 1PE10. 3, 6(10X, 1PE10. 3))
0009      300      FORMAT(1X, 1PE9. 2, 121A1)
0010      XMAX=X(1, 1)
0011      XMIN=XMAX
0012      YMAX=Y(1, 1)
0013      YMIN=YMAX
0014      DO 1 I=1, N1
0015      DO 1 J=1, N2
0016      IF(XMAX. LT. X(I, J)) XMAX=X(I, J)
0017      IF(XMIN. GT. X(I, J)) XMIN=X(I, J)
0018      IF(YMAX. LT. Y(I, J)) YMAX=Y(I, J)
0019      1      IF(YMIN. GT. Y(I, J)) YMIN=Y(I, J)
0020      K=66*IABS(ID)-5
0021      K=(K/10)*10
0022      YS=FLOAT(K)/(YMAX-YMIN)
0023      XS=(XMAX-XMIN)/120. 0
0024      J=0
0025      DO 2 I=1, 121, 20
0026      J=J+1
0027      2      XX(J)=(I-1)*XS+XMIN
0028      WRITE(5, 200)XX
0029      XS=120. 0/(XMAX-XMIN)
0030      DO 3 I=1, N1
0031      DO 3 J=1, N2
0032      X(I, J)=(X(I, J)-XMIN)*XS+1
0033      3      Y(I, J)=(Y(I, J)-YMIN)*YS+1. 5
0034      YS=(YMAX-YMIN)/FLOAT(K)
0035      K=K+2
0036      4      K=K-1
0037      IP=K-(K/10)*10
0038      LINE(1)=IBLK
0039      IF(IP. EQ. 1) LINE(1)=IHOR
0040      DO 5 I=2, 120
0041      5      LINE(I)=LINE(1)
0042      LINE(1)=IVER
0043      IF(IP. EQ. 1) LINE(1)=IPLUS
0044      DO 6 I=1, 121, 20
0045      6      LINE(I)=LINE(1)
0046      DO 7 I=1, N1
0047      DO 7 J=1, N2
0048      IF(Y(I, J). GE. 150. 0) GO TO 7
0049      IF(X(I, J). GE. 150. 0) GO TO 7
0050      IP=INT(Y(I, J))
0051      IF(IP. LT. K) GO TO 7
0052      JP=INT(X(I, J))
0053      IF(ID. LT. 0) GO TO 10
0054      IF(IP. NE. K) GO TO 7
0055      10      LP=LINE(JP)

```

|            |      |    |                                  |
|------------|------|----|----------------------------------|
|            | 0056 |    | LINE(JP)=Z(I, J)                 |
|            | 0057 |    | IF(LP. EQ. M2) GO TO 15          |
|            | 0058 |    | IF(LP. EQ. M3) GO TO 15          |
|            | 0059 |    | GO TO 16                         |
| Subroutine | 0060 | 15 | IF(LP. NE. LINE(JP)) LINE(JP)=M1 |
| PROJT      | 0061 | 16 | IF(LP. EQ. M1) LINE(JP)=M1       |
| continued. | 0062 | 7  | CONTINUE                         |
|            | 0063 |    | XS=(K-1)*YS+YMIN                 |
|            | 0064 |    | WRITE(5, 300)XS, LINE            |
|            | 0065 |    | IF(K. NE. 1) GO TO 4             |
|            | 0066 |    | WRITE(5, 200)XX                  |
|            | 0067 |    | RETURN                           |
|            | 0068 |    | END                              |

ROUTINES CALLED:  
IABS , FLOAT , INT

OPTIONS =/OP: 2

|       |     |           |
|-------|-----|-----------|
| BLOCK |     | LENGTH    |
| PROJT | 926 | (003474)* |

|                         |       |       |  |
|-------------------------|-------|-------|--|
| **COMPILER ----- CORE** |       |       |  |
| PHASE                   | USED  | FREE  |  |
| DECLARATIVES            | 00783 | 14865 |  |
| EXECUTABLES             | 01023 | 14625 |  |
| ASSEMBLY                | 01603 | 18685 |  |

|      |   |  |
|------|---|--|
| 0001 |   | DIMENSION IA(1200), X(1200), Y1(1200), Y2(1200), Z(1200) |
| 0002 |   | DEFINE FILE 1(300, 1200, U, NL)                          |
| 0003 |   | Z(1)=1. 0  |
| 0004 |   | DO 1 I=2, 1200   |
| 0005 | 1 | Z(I)=Z(I-1)+1. 0   |
| 0006 |   | DO 4 I=1, 1200   |
| 0007 |   | XX=FLOAT(I-1)  |
| 0008 |   | XX=6. 2832*XX/1199. 0                                    |
| 0009 | 4 | X(I)=0. 54-0. 46*COS(XX)                                 |
| 0010 |   | DO 5 J=1, 300  |
| 0011 |   | READ(1'J)IA  |
| 0012 |   | DO 9 I=1, 1200   |
| 0013 |   | Y1(I)=FLOAT(IA(I))                                       |
| 0014 |   | Y2(I)=X(I)*Y1(I)   |
| 0015 | 9 | IA(I)=Y2(I)  |
| 0016 |   | CALL NEWPAG  |
| 0017 |   | CALL KBPLOT(Z, Y1, 1200, 0, 1023, 391, 780)              |
| 0018 |   | CALL KBPLOT(Z, Y2, 1200, 0, 1023, 0, 390)                |
| 0019 |   | WRITE(6, 8)J   |
| 0020 | 8 | FORMAT(1X, I3)   |
| 0021 |   | WRITE(1'J)IA   |
| 0022 | 5 | CONTINUE   |
| 0023 |   | CALL EXIT  |
| 0024 |   | END  |

Siesmic Program #11

Hanning window  
computation.

ROUTINES CALLED:  
FLOAT , COS , NEWPAG, KBPLOT, EXIT

OPTIONS =/OP: 2

|       |       |           |
|-------|-------|-----------|
| BLOCK |       | LENGTH    |
| MAIN. | 12314 | (060064)* |

|                         |       |       |  |
|-------------------------|-------|-------|--|
| **COMPILER ----- CORE** |       |       |  |
| PHASE                   | USED  | FREE  |  |
| DECLARATIVES            | 00622 | 15026 |  |
| EXECUTABLES             | 00943 | 14705 |  |
| ASSEMBLY                | 01195 | 19093 |  |

Seismic Program #12 XY plotter display of a seismic signature and its Fourier amplitude spectrum.  
(Program XYHT)

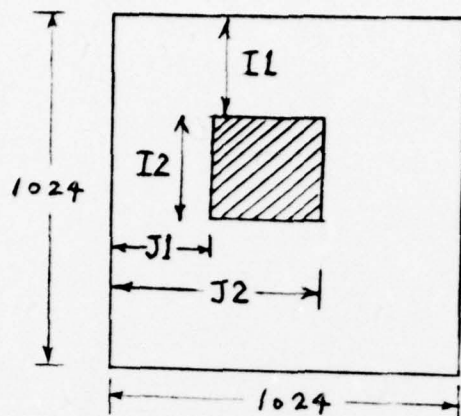
```

DIMENSION C(513), X(2, 2048), IB(1200), Y(2048)
COMPLEX E(2048)
BYTE IA(20), IX(9), IQ(10)
EQUIVALENCE (E, X)
DATA IX/'E', X/'P', L/'O', S/'I', O/'N' /
DATA IQ/'E', A/'R', T/'H', Q/'U', A/'K', 'E' /
DEFINE FILE I(300, 1200, U, NG)
CALL XYINIT(B, I)
CALL SIZE(C, 2048)
CALL CHSIZE(O, 4, 90, 0)
FORMAT(I1)
IC=0
1 READ(6, 6) IT
IF (IT.EQ. 2) GO TO 10
IN=0
DO 21 I=1, 2048
Y(I)=0. 0
READ(6, 15) IA
DO 20 J=1, 5
DO 9 I=1, 2048
X(1, I)=0. 0
X(2, I)=0. 0
IC=IC+1
READ(1'IC) IB
DO 16 I=1, 1200
X(1, I)=FLOAT(IB(I))
FORMAT(20A1)
15 CALL IXYPT(230, 0, 0)
23 CALL XYCHAR(IA, 20)
CALL IXYPT(486, 0, 0)
IF (IT.EQ. 1) GO TO 2
CALL XYCHAR(IQ, 10)
GO TO 3
2 CALL XYCHAR(IX, 9)
3 CALL IXYPT(500, 0, 0)
CALL IXYPT(2190, 0, 1)
XMAX=X(1, 1)
XMIN=XMAX
DO 4 I=1, 1200
IF (XMIN.GT. X(1, I)) XMIN=X(1, I)
4 IF (XMAX.LT. X(1, I)) XMAX=X(1, I)
XS=1690. 0/(XMAX-XMIN)
N=2190. 0+XMIN*XS
CALL IXYPT(N, 0, 0)
IY=2190. 0+(XMIN-X(1, I))*XS
CALL IXYPT(IY, 0, 0)
DO 5 I=2, 1200
IXX=I+I-2
IY=2190. 0+(XMIN-X(1, I))*XS
CALL IXYPT(IY, IXX, 1)
CALL IXYPT(N, IXX, 0)
CALL IXYPT(N, 0, 1)
IF (IN.EQ. 1) GO TO 1
CALL IXYPT(2390, 0, 0)
CALL IXYPT(4090, 0, 1)
CALL FFOUR(X, 2048, C, -1. 0)
XMAX=CABS(E(1))
DO 12 I=1, 1024
X(1, I)=CABS(E(I))
Y(I)=X(1, I)*X(1, I)+Y(I)
12 IF (XMAX.LT. X(1, I)) XMAX=X(1, I)
XS=1690. 0/XMAX
N=4090. 0-X(1, 1)*XS
CALL IXYPT(N, 0, 0)
DO 13 I=2, 1024
IXX=4*I-4
IY=4090. 0-X(1, 1)*XS
CALL IXYPT(IY, IXX, 1)
CALL IXYPT(4090, IXX, 0)
CALL IXYPT(4090, 0, 1)
IF (J.NE. 5) GO TO 20
IN=1
DO 22 I=1, 1024
X(1, I)=Y(I)
GO TO 23
22 CONTINUE
20 CALL XYEND
10 CALL EXIT
END

```

Image Program #1

Modified gradient computation and XY-plotter display of the modified gradient picture for the shaded area as shown below.



LIM is modified  
gradient threshold.

```

0001      DIMENSION IA(1024), IB(1024), IC(1024), ID(1024)
0002      COMMON /SWITCH/NO, N1, N2, N3, N4, N5, N6, N7, N8, N9, N10, N11, N12, N13, N14
0003      CALL SSWTCH(14, N14)
0004      IF(N14. EQ. 2) REWIND 1
0005      READ(6, 6) LIM, I1, I2, J1, J2
0006      6      FORMAT(I2, 4I3)
0007      IPT=0
0008      THR=FLOAT(LIM)
0009      THR=THR*THR*THR*THR
0010      CALL XYINIT(B, 1)
0011      IY=100
0012      DO 4 I=1, I1
0013      CALL READUN(IA, NPT)
0014      4      CONTINUE
0015      CALL INPUT(IA, NPT)
0016      CALL INPUT(IB, NPT)
0017      CALL INPUT(IC, NPT)
0018      DO 2 I=1, I2, 2
0019      IY=IY+10
0020      CALL INPUT(ID, NPT)
0021      IX=0
0022      DO 3 J=J1, J2
0023      IX=IX+10
0024      K1=IABS(IA(J)-ID(J+3))+IABS(IA(J+3)-ID(J))
0025      K2=IABS(IA(J+1)-ID(J+2))+IABS(IB(J+3)-IC(J))
0026      K3=IABS(IA(J+2)-ID(J+1))+IABS(IB(J)-IC(J+3))
0027      K4=IABS(IB(J+1)-IC(J+2))+IABS(IB(J+2)-IC(J+1))
0028      VALUE=FLOAT(K1*K2)*FLOAT(K3*K4)
0029      IF(VALUE. LE. THR) GO TO 5
0030      IF(IPT. EQ. 1) GO TO 3
0031      CALL IXYPT(IY, IX, 0)
0032      IPT=1
0033      GO TO 3
0034      5      IF(IPT. EQ. 1) CALL IXYPT(IY, IX, 1)
0035      IPT=0
0036      3      CONTINUE
0037      CALL INPUT(IA, NPT)
0038      IF(IPT. EQ. 1) CALL IXYPT(IY, IX, 1)
0039      IY=IY+10

```



Image program #1 continued.

```
0040          JJ=J2+1
0041          IPT=0
0042          DO 7 J=J1, J2
0043          JJ=JJ-1
0044          K1=IABS(IB(JJ)-IA(JJ+3))+IABS(IB(JJ+3)-IA(JJ))
0045          K2=IABS(IB(JJ+1)-IA(JJ+2))+IABS(IC(JJ+3)-ID(JJ))
0046          K3=IABS(IB(JJ+2)-IA(JJ+1))+IABS(IC(JJ)-ID(JJ+3))
0047          K4=IABS(IC(JJ+1)-ID(JJ+2))+IABS(IC(JJ+2)-ID(JJ+1))
0048          VALUE=FLOAT(K1*K2)*FLOAT(K3*K4)
0049          IF(VALUE.LE.THR) GO TO 8
0050          IF(IPT.EQ.1) GO TO 9
0051          CALL IXYPT(IY, IX, 0)
0052          IPT=1
0053          GO TO 9
0054      8      IF(IPT.EQ.1) CALL IXYPT(IY, IX, 1)
0055          IPT=0

0056      9      IX=IX-10
0057      7      CONTINUE
0058          IF(IPT.EQ.1) CALL IXYPT(IY, IX, 1)
0059          DO 10 J=1, 1024
0060          ITM=IC(J)
0061          IC(J)=IA(J)
0062          IB(J)=ID(J)
0063      10      IA(J)=ITM
0064      2      CONTINUE
0065          CALL XYEND
0066          CALL EXIT
0067          END
```

ROUTINES CALLED:

SSWTCB, FLOAT, XYINIT, READUN, INPUT, IABS, IXYPT  
XYEND, EXIT

OPTIONS =/ON, /OP: 2

| BLOCK  | LENGTH         |
|--------|----------------|
| MAIN.  | 5023 (023476)* |
| SWITCH | 15 (000036)    |

\*\*COMPILER ----- CORE\*\*

| PHASE        | USED  | FREE  |
|--------------|-------|-------|
| DECLARATIVES | 00622 | 15026 |
| EXECUTABLES  | 01126 | 14522 |
| ASSEMBLY     | 01456 | 18832 |

Image Program #2

Subroutine HST to plot histogram of array X(N) on line printer(N=array length).

```

0001      SUBROUTINE HST(X,N)
0002      BYTE LINE(121),TM(121)
0003      REAL X(N),XX(7)
0004      DATA IBLK, IVER, ISTR/' ','!', '*'/
0005      200  FORMAT(1X, 1PE10. 3, 6(10X, 1PE10. 3))
0006      300  FORMAT(1X, I3, 1X, 121A1)
0007      XMAX=X(1)
0008      XMIN=XMAX
0009      DO 1 I=1,N
0010      IF(XMAX.LT.X(I)) XMAX=X(I)
0011      1    IF(XMIN.GT.X(I)) XMIN=X(I)
0012      XS=(XMAX-XMIN)/120. 0
0013      J=0
0014      DO 2 I=1, 121, 20
0015      J=J+1
0016      2    XX(J)=(I-1)*XS+XMIN
0017      WRITE(5, 200)XX
0018      XS=120. 0/(XMAX-XMIN)
0019      DO 3 I=1, N
0020      3    X(I)=(X(I)-XMIN)*XS+1
0021      LINE(1)=IBLK
0022      DO 5 I=2, 120
0023      5    LINE(I)=LINE(1)
0024      LINE(1)=IVER
0025      DO 6 I=1, 121, 20
0026      6    LINE(I)=LINE(1)
0027      DO 7 I=1, N
0028      IP=INT(X(I))
0029      IF(IP.LE. 1) GO TO 7
0030      DO 8 J=1, IP
0031      8    TM(J)=LINE(J)
0032      DO 4 J=1, IP
0033      4    LINE(J)=ISTR
0034      WRITE(5, 300)I, LINE
0035      DO 9 J=1, IP
0036      9    LINE(J)=TM(J)
0037      7    CONTINUE
0038      WRITE(5, 200)XX
0039      RETURN
0040      END

```

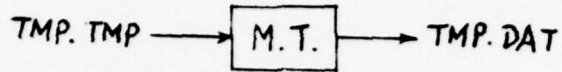
ROUTINES CALLED:  
INT

OPTIONS =/OP: 2

| BLOCK | LENGTH        |
|-------|---------------|
| COPY  | 572 (002170)* |

| **COMPILER ----- CORE** |       |       |
|-------------------------|-------|-------|
| PHASE                   | USED  | FREE  |
| DECLARATIVES            | 00783 | 14865 |
| EXECUTABLES             | 00863 | 14785 |
| ASSEMBLY                | 01347 | 18941 |

Image Program #3 Midpoint transform



```

0001      DIMENSION IA(120,120),B(120)
0002      CALL SETFIL(1,'TMP.DAT',IER,'DK',0)
0003      DEFINE FILE 1(120,240,U,NP)
0004      CALL SETFIL(2,'TMP.TMP',IERR,'DK',0)
0005      DEFINE FILE 2(120,120,U,NL)
0006      DO 1 I=1,120
0007      READ(2'I')(IA(I,J),J=1,120)
0008      1  CONTINUE
0009      I1=1
0010      DO 2 I=2,119
0011      II=I+1
0012      IF(I.GT.60) I1=II-120
0013      I2=I-1
0014      J1=1
0015      DO 3 J=2,119
0016      JJ=J+J
0017      B(J)=0.0
0018      IF(J.GT.60) GO TO 7
0019      J2=JJ-1
0020      GO TO 6
0021      7  J1=JJ-120
0022      J2=120
0023      6  DO 4 M=I1,I2
0024      MM=II-M
0025      DO 4 N=J1,J2
0026      NN=JJ-N
0027      B(J)=B(J)+FLOAT(IA(M,N))*FLOAT(IA(MM,NN))
0028      4  CONTINUE
0029      DO 5 N=J1,J
0030      NN=JJ-N
0031      5  B(J)=B(J)+FLOAT(IA(I,N))*FLOAT(IA(I,NN))
0032      9  LL=(I2-I1+1)*(J2-J1+1)+1
0033      LL=LL+(J2-J1)/2
0034      B(J)=B(J)/FLOAT(LL)
0035      3  CONTINUE
0036      WRITE(1'I')B
0037      2  CONTINUE
0038      CALL EXIT
0039      END
  
```

ROUTINES CALLED:  
SETFIL, FLOAT, EXIT

OPTIONS =/OP: 2

| BLOCK | LENGTH          |
|-------|-----------------|
| MAIN. | 29509 (163212)* |

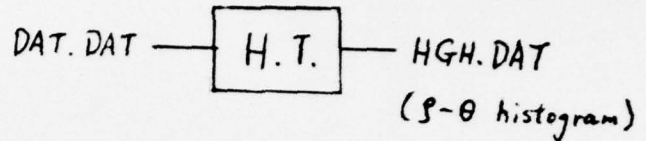
| **COMPILER ----- CORE** |       |       |  |
|-------------------------|-------|-------|--|
| PHASE                   | USED  | FREE  |  |
| DECLARATIVES            | 00622 | 15026 |  |
| EXECUTABLES             | 00943 | 14705 |  |
| ASSEMBLY                | 01271 | 19017 |  |

```

0001      DIMENSION IA(256), IB(256), IC(256), ID(256), IG(36), IPA(400, 36)
0002      CALL SETFIL(1, 'DAT.DAT', IER, 'DK', 0)
0003      DEFINE FILE 1(256, 256, U, NP)
0004      CALL SETFIL(2, 'HGH.DAT', IRR, 'DK', 0)
0005      DEFINE FILE 2(400, 36, U, NL)
0006      RAD=0. 017453292519943
0007      READ(6, 6) LIM
0008      6      FORMAT(I3)
0009      DO 1 I=1, 400
0010      DO 1 J=1, 36
0011      1      IPA(I, J)=0
0012      THR=FLOAT(LIM)
0013      DO 2 I=1, 253
0014      READ(1' I) IA
0015      II=I+1
0016      READ(1' II) IB
0017      II=II+1
0018      READ(1' II) IC
0019      II=II+1
0020      READ(1' II) ID
0021      DO 3 J=1, 253
0022      K1=IABS(IA(J)-ID(J+3))+IABS(IA(J+3)-ID(J))
0023      K2=IABS(IA(J+1)-ID(J+2))+IABS(IB(J+3)-IC(J))
0024      K3=IABS(IA(J+2)-ID(J+1))+IABS(IB(J)-IC(J+3))
0025      K4=IABS(IB(J+1)-IC(J+2))+IABS(IB(J+2)-IC(J+1))
0026      VALUE=FLOAT(K1*K2)*FLOAT(K3*K4)
0027      VALUE=SQRT(VALUE)
0028      VALUE=SQRT(VALUE)
0029      IF(VALUE LE THR) GO TO 3
0030      DO 7 N=1, 36
0031      ANG=RAD*5. 0*FLOAT(N-1)
0032      C=COS(ANG)
0033      S=SIN(ANG)
0034      LINE=FLOAT(J)*C+FLOAT(254-I)*S
0035      LINE=(LINE+401)/2
0036      IPA(LINE, N)=IPA(LINE, N)+1
0037      7      CONTINUE
0038      3      CONTINUE
0039      2      CONTINUE
0040      DO 8 I=1, 400
0041      DO 9 J=1, 36
0042      IG(J)=IPA(I, J)
0043      9      CONTINUE
0044      WRITE(2' I) IG
0045      8      CONTINUE
0046      CALL EXIT
0047      END

```

Image Program #4 Hough transform



$$\rho = x \cos \theta + y \sin \theta$$

ROUTINES CALLED:

SETFIL, FLOAT, IABS, SQRT, COS, SIN, EXIT

OPTIONS =/OP:2

| BLOCK | LENGTH          |
|-------|-----------------|
| MAIN  | 31653 (173512)* |

```

**COMPILER ----- CORE**
  PHASE      USED  FREE
DECLARATIVES 00622 15026
EXECUTABLES  01103 14545
ASSEMBLY     01415 18873

```

Image Program #5

To plot the picture after Hough transform on the screen of key-board.  
LIM is the modified gradient threshold. LIN is the threshold of Hough transform.

```

0001      DIMENSION IA(256),IB(256),IC(256),ID(256),IPA(400,36),M(253)
0002      REAL R1(36),R2(36)
0003      CALL SETFIL(1,'DAT.DAT',IER,'DK',0)
0004      DEFINE FILE 1(256,256,U,NP)
0005      CALL SETFIL(2,'HGH.DAT',IRR,'DK',0)
0006      DEFINE FILE 2(400,36,U,NL)
0007      RAD=0.017453292519943
0008      RAD=RAD*5.0
0009      READ(6,6)LIM,LIN
0010      6      FORMAT(2I3)
0011      DO 10 N=1,36
0012      ANG=RAD*FLOAT(N-1)
0013      R1(N)=COS(ANG)
0014      R2(N)=SIN(ANG)
0015      10     CONTINUE
0016      DO 1 I=1,400
0017      READ(2'I)(IPA(I,J),J=1,36)
0018      1      CONTINUE
0019      THR=FLOAT(LIM)
0020      IY=0
0021      DO 2 I=1,253
0022      IY=IY+2
0023      READ(1'I)IA
0024      II=I+1
0025      READ(1'II)IB
0026      II=II+1
0027      READ(1'II)IC
0028      II=II+1
0029      READ(1'II)ID
0030      IX=1023
0031      DO 3 J=1,253
0032      IX=IX-2
0033      K1=IABS(IA(J)-ID(J+3))+IABS(IA(J+3)-ID(J))
0034      K2=IABS(IA(J+1)-ID(J+2))+IABS(IB(J+3)-IC(J))
0035      K3=IABS(IA(J+2)-ID(J+1))+IABS(IB(J)-IC(J+3))
0036      K4=IABS(IB(J+1)-IC(J+2))+IABS(IB(J+2)-IC(J+1))
0037      VALUE=FLOAT(K1*K2)*FLOAT(K3*K4)
0038      VALUE=SQRT(VALUE)
0039      VALUE=SQRT(VALUE)
0040      M(J)=0
0041      IF(VALUE.LE.THR) GO TO 3
0042      M(J)=1
0043      CALL FSTPNT(IX,IY)
0044      3      CONTINUE
0045      IX=508
0046      DO 4 J=1,253
0047      IX=IX-2
0048      IF(M(J).EQ.0) GO TO 4
0049      T1=FLOAT(J)
0050      T2=FLOAT(254-I)
0051      DO 7 N=1,36
0052      LINE=T1*R1(N)+T2*R2(N)
0053      LINE=(LINE+401)/2
0054      IF(IPA(LINE,N).LE.LIN) GO TO 7
0055      CALL FSTPNT(IX,IY)

```

Image program #5 continued.

```
0056          GO TO 4
0057    7      CONTINUE
0058    4      CONTINUE
0059    2      CONTINUE
0060          CALL EXIT
0061          END
```

ROUTINES CALLED:

```
SETFIL, FLOAT, COS, SIN, IABS, SQRT, FSTPNT
EXIT
```

OPTIONS =/OP:2

```
BLOCK      LENGTH
MAIN.     32334 (176234)*
```

```
**COMPILER ----- CORE**
      PHASE      USED  FREE
DECLARATIVES 00622 15026
EXECUTABLES  01183 14465
ASSEMBLY     01479 18809
```

Image Program #6

To plot the original gradient picture histogram on the screen of key-board.

```
0001          DIMENSION IA(150), IB(150), HST(300)
0002          CALL SETFIL(1, 'TEM. TEM', IER, 'DK', U)
0003          DEFINE FILE 1(128, 150, U, NP)
0004          DO 6 I=1, 300
0005    6      HST(I)=0.0
0006          READ(1'1) IA
0007          DO 2 I=2, 128
0008          READ(1'1) IB
0009          DO 3 J=1, 149
0010          KK=IABS(IA(J)-IB(J+1))+IABS(IA(J+1)-IB(J))
0011          KK=KK+1
0012          HST(KK)=HST(KK)+1.0
0013    3      CONTINUE
0014          DO 5 J=1, 150
0015    5      IA(J)=IB(J)
0016    2      CONTINUE
0017          CALL HST(HST, 300)
0018          CALL EXIT
0019          END
```

ROUTINES CALLED:

```
SETFIL, IABS, COPY, EXIT
```

OPTIONS =/OP:2

```
BLOCK      LENGTH
MAIN.     1441 (005502)*
```

```
**COMPILER ----- CORE**
      PHASE      USED  FREE
DECLARATIVES 00622 15026
EXECUTABLES  00863 14785
ASSEMBLY     01091 19197
```

```

0001      DIMENSION A(16)
0002      CALL SETFIL(1,'QXF.FAT',IE,'DK',0)
0003      DEFINE FILE 1(1075,32,U,NL)
0004      DO 3 J=1,1075
0005      READ(1'J)A
0006      WRITE(3)A
0007      3  CONTINUE
0008      END FILE 3
0009      CALL EXIT
0010      END

```

Image Program #7  
Transfer of data  
from disk to the  
tape.

ROUTINES CALLED:  
SETFIL, EXIT

OPTIONS =/OP: 2

| BLOCK | LENGTH        |
|-------|---------------|
| MAIN. | 139 (000426)* |

```

**COMPILER ----- CORE**
      PHASE      USED  FREE
DECLARATIVES 00622 15026
EXECUTABLES  00783 14865
ASSEMBLY     00959 19329

```

```

0001      DIMENSION IA(1024), IB(150)
0002      COMMON /SWITCH/NO, N1, N2, N3, N4, N5, N6, N7, N8, N9, N10, N11, N12, N13, N14
0003      CALL SSWTCH(14, N14)
0004      IF(N14 EQ 2) REWIND 1
0005      CALL SETFIL(1,'TEM.TEM',IER,'DK',0)
0006      DEFINE FILE 1(128,150,U,NP)
0007      READ(6,6)J1, I1
0008      6  FORMAT(2I3)
0009      DO 1 I=1, I1
0010      CALL READUN(IA, NPT)
0011      1  CONTINUE
0012      DO 2 I=1, 128
0013      CALL INPUT(IA, NPT)
0014      DO 3 J=1, 150
0015      JJ=J+J1
0016      IB(J)=IA(JJ)
0017      3  CONTINUE
0018      WRITE(1'I)IB
0019      2  CONTINUE
0020      CALL EXIT
0021      END

```

Image Program #8  
Transfer of data  
from tape to disk.

ROUTINES CALLED:  
SSWTCH, SETFIL, READUN, INPUT, EXIT

OPTIONS =/OP: 2

| BLOCK  | LENGTH         |
|--------|----------------|
| MAIN.  | 2554 (011764)* |
| SWITCH | 30 (000074)    |

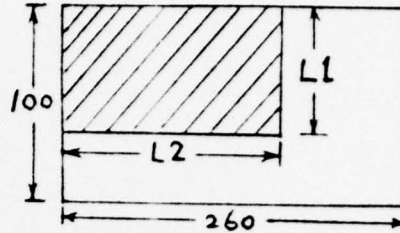
```

**COMPILER ----- CORE**
      PHASE      USED  FREE
DECLARATIVES 00622 15026
EXECUTABLES  01046 14602
ASSEMBLY     01148 19140

```

Image Program #9

8-level line-printer plot. K(7) corresponds to 7 boundary levels(thresholds) needed to requantize 256 levels to 8 levels for line-printer display of shaded portion as shown.



```

0001      DIMENSION IA(130), IB(8), LINE(130), K(7)
0002      DATA IB/' ', ' ', ' ', ' ', ' ', ' ', ' ', ' '
0003      CALL SETFIL(2, 'GRD DAT', IERR, 'DK', 0)
0004      DEFINE FILE 2(100, 260, U, LIN)
0005      READ(6, 3) L1, L2
0006      3  FORMAT(2I3)
0007      READ(6, 2) K
0008      2  FORMAT(7I3)
0009      DO 4 I=1, L1
0010      READ(2'I) IA
0011      WRITE(5, 8)
0012      8  FORMAT(1X)
0013      DO 5 J=2, 8
0014      DO 6 L=1, L2
0015      LINE(L)=IB(1)
0016      IF(IA(L)-K(J-1))6, 7, 7
0017      7  LINE(L)=IB(J)
0018      6  CONTINUE
0019      WRITE(5, 9) LINE
0020      9  FORMAT('+', 130A1)
0021      5  CONTINUE
0022      4  CONTINUE
0023      CALL EXIT
0024      END
    
```

ROUTINES CALLED:  
SETFIL, EXIT

OPTIONS =/OP: 2

| BLOCK | LENGTH        |
|-------|---------------|
| MAIN. | 804 (003110)* |

| **COMPILER ----- CORE** |             |
|-------------------------|-------------|
| PHASE                   | USED FREE   |
| DECLARATIVES            | 00622 15026 |
| EXECUTABLES             | 00863 14785 |
| ASSEMBLY                | 01151 19137 |



Image Program #10

5-level line printer display of modified gradient picture for picture segment stored in disk.

```

DIMENSION IA(128),IB(128),IC(128),ID(128),IR(125),K(3)
BYTE IP(5),LINE(125)
INTEGER IR(125)
DATA IP/' ','+', 'M', 'O', 'X'/
CALL SETFIL(2, 'FI2.DAT', IERR, 'DK', 0)
DEFINE FILE 2(65, 128, U, LIN)
READ(6, 2)K
2  FORMAT(3I3)
   READ(2'1)IA
   READ(2'2)IB
   READ(2'3)IC
   DO 4 J=4, 65
   READ(2'1)ID
   WRITE(5, 8)
8  FORMAT(1X)
   DO 6 L=1, 125
   K1=IABS(IA(L)-ID(L+3))+IABS(IA(L+3)-ID(L))
   K2=IABS(IA(L+1)-ID(L+2))+IABS(IB(L+3)-IC(L))
   K3=IABS(IA(L+2)-ID(L+1))+IABS(IC(L+3)-IB(L))
   K4=IABS(IB(L+1)-IC(L+2))+IABS(IB(L+2)-IC(L+1))
   VALUE=FLOAT(K1*K2)*FLOAT(K3*K4)
   VALUE=SQRT(VALUE)
   IR(L)=SQRT(VALUE)
6  CONTINUE
   DO 10 L=1, 125
   LINE(L)=IP(1)
   DO 10 J=2, 4
   IF(IR(L)-K(J-1))10, 10, 7
7  LINE(L)=IP(J)
10 CONTINUE
   WRITE(5, 9)LINE
9  FORMAT('+', 4X, 125A1)
   DO 5 J=1, 125
   IF(LINE(J).EQ.IP(4)) LINE(J)=IP(5)
   IF(LINE(J).NE.IP(5)) LINE(J)=IP(1)
5  CONTINUE
   WRITE(5, 9)LINE
   DO 3 J=1, 128
   IA(J)=IB(J)
   IB(J)=IC(J)
3  IC(J)=ID(J)
4  CONTINUE
   CALL EXIT
   END

```

```

DIMENSION A(8,9,9), IA(1024), IB(1024), L(7)
COMMON /SWITCH/NO, N1, N2, N3, N4, N5, N6, N7, N8, N9, N10, N11, N12, N13, N14
CALL SSWTCH(14, N14)
IF(N14.EQ.2) REWIND 1
CALL SETFIL(2, 'COL. TEM', IE, 'DK', 0)
DEFINE FILE 2(64, 128, U, NN)
ISUB=0
LINE=0
INTERV=128
READ(6, 999)L
999  FORMAT(7I3)
14   DO 1 I=1,8
      DO 1 J=1,9
      DO 1 K=1,9
1     A(I, J, K)=0.0
      LINE=LINE+1
      CALL INPUT(IA, NPT)
      LL=0
      DO 50 I=1,8
      K2=9
      DO 51 J=1, 128
      LL=LL+1
      N=IA(LL)
      CALL LEVEL(N, L, 7, K1)
      A(I, K2, K1)=A(I, K2, K1)+1.0
      K2=K1
51   CONTINUE
50   CONTINUE
16   IF(LINE.EQ.INTERV) GO TO 39
      CALL INPUT(IB, NPT)
      II=0
      KC=0
      INTERH=0
      GO TO 12
17   A(KC, K1, K2)=A(KC, K1, K2)+1.0
      IF(II.EQ.1024) GO TO 37
12   II=II+1
      K3=9
      K4=9
      N=IA(II)
      KC=KC+1
      INTERH=INTERH+128
18   IF(N-L(1))26, 19, 19
19   IF(N-L(2))27, 20, 20
20   IF(N-L(3))28, 21, 21
21   IF(N-L(4))29, 22, 22
22   IF(N-L(5))30, 23, 23
23   IF(N-L(6))31, 24, 24
24   IF(N-L(7))32, 25, 25
25   K1=8
      GO TO 33
26   K1=1
      GO TO 33
27   K1=2
      GO TO 33
28   K1=3
      GO TO 33
29   K1=4
      GO TO 33
30   K1=5
      GO TO 33
31   K1=6
      GO TO 33
32   K1=7
33   N1=IB(II)

```

Image Program #11  
This program computes  
the co-occurrence matrix  
of a 1024x1024 picture.

Image Program #11  
continued.

```

60      IF(N1-L(1))68,61,61
61      IF(N1-L(2))69,62,62
62      IF(N1-L(3))70,63,63
63      IF(N1-L(4))71,64,64
64      IF(N1-L(5))72,65,65
65      IF(N1-L(6))73,66,66
66      IF(N1-L(7))74,67,67
67      K2=8
        GO TO 75
68      K2=1
        GO TO 75
69      K2=2
        GO TO 75
70      K2=3
        GO TO 75
71      K2=4
        GO TO 75
72      K2=5
        GO TO 75
73      K2=6
        GO TO 75
74      K2=7
75      A(KC,K4,K1)=A(KC,K4,K1)+1.0
        A(KC,K4,K2)=A(KC,K4,K2)+1.0
        A(KC,K4,K3)=A(KC,K4,K3)+1.0
        A(KC,K3,K2)=A(KC,K3,K2)+1.0
        IF(II.EQ.INTERH) GO TO 17
        K3=K1
        K4=K2
        II=II+1
        N=IA(II)
        GO TO 18
37      DO 38 I=1,1024
38      IA(I)=IB(I)
        LINE=LINE+1
        GO TO 16
39      DO 40 I=1,8
        ISUB=ISUB+1
        WRITE(2'ISUB)((A(I,J,K),K=1,8),J=1,8)
40      CONTINUE
        INTERV=INTERV+128
        IF(LINE.GE.1024) GO TO 100
        GO TO 14
100     CALL EXIT
        END

```

```

        DIMENSION A(8,8),B(64)
        DEFINE FILE 1(64,128,U,MM)
        READ(6,5)IFILE
5       FORMAT(I2)
        WRITE(5,6)IFILE
6       FORMAT(3X,'FILE NUMBER',2X,I2)
        DO 1 I=1,64
        READ(1'I)A
        SUM=0.0
        DO 2 J=1,8
        DO 3 K=1,8
        TEM=FLOAT(IABS(J-K))
        SUM=SUM+TEM*TEM*TEM*ALOG(A(K,J)+A(J,K)+1.0)
3       CONTINUE
2       CONTINUE
        B(I)=SUM
1       CONTINUE
        WRITE(5,4)B
4       FORMAT((3X,8(1X,1PE10.3)))
        END

```

Image Program #12  
This program tabulates  
the texture measure  
$$\sum_i \sum_j |i-j|^3 t_n(n_{ij}+1)$$
  
in 8x8 array.

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