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A NEW SOFTWARE PACKAGE FOR SEISMIC AND IMAGERY RECOGNITION.(U)
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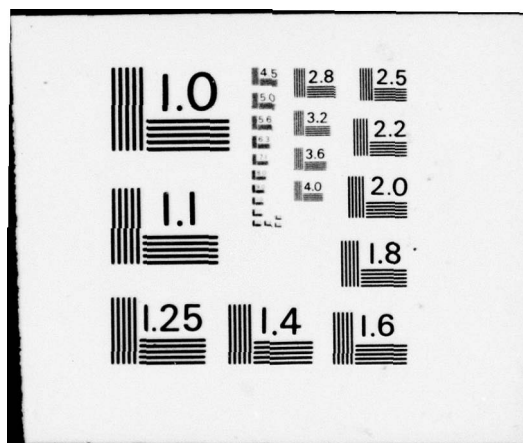
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(Dr. C. H. Chen, Principal Investigator)

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TR No. EE-76-4
September 7, 1976

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A NEW SOFTWARE PACKAGE FOR SEISMIC AND IMAGERY RECOGNITION

by

C. H. Chen
Electrical Engineering Department
Southeastern Massachusetts University
North Dartmouth, Massachusetts 02747

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.

ADDITIONAL INFORMATION

DATE	FILE NUMBER	☒
BY	FILE NUMBER	☐
REVIEWER	FILE NUMBER	☐
BY		
REVIEWER/AVAILABILITY STATE		
FILE	FILE NUMBER	FILE NUMBER
A		

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.

(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]

30-AUG-76

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]

30-AUG-76

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>

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>
HGH4 . LDA	21	24-MAY-72	<233>
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>

TOTL BLKS: 1444

TOTL FILES: 93

DIRECTORY DK0: [1, 1]

30-AUG-76

BADB . SYS	1	14-APR-70	<377>
MONLIB . CIL	175C	27-MAR-71	<377>
PIP . LDA	35C	26-MAR-71	<233>
FORTRN . 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>
FORTRN . 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>

TOTL BLKS: 1188

TOTL FILES: 22

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

LIBR V05A

SPSLIB. OBJ		28-AUG-76
SEQ.	NAME	VERSION
00001	SPSPRO	
00002	PRNTZ	
00003	TAPE	
00004	DL1110	
00005	WALCAL	
00006	SPSHIS	
00007	SPSEXW	
00008	SPSROT	
00009	SPSSHI	
00010	SPSHAN	
00011	SPSHAF	
00012	SPSLOU	
00013	SPSEXP	
00014	SPSLOG	
00015	SPSMOV	
00016	SPSNEG	
00017	SPSMUL	
00018	SPSADD	
00019	SPSP2R	
00020	SPSR2P	
00021	SPSA2B	
00022	SPSSET	
00023	SPSSIZ	
00024	SPSFFT	
00025	SPSBPA	
00026	SPSBNO	
00027	SPSELI	
00028	FFTIFT	
00029	WALSH	
00030	FSICO	
00031	FSQRT	
00032	FATAN	
00033	FLOG	
00034	FEXP	

LIBR V05A

SSPLIB. OBJ		24-AUG-76
SEQ.	NAME	VERSION
00001	DECONV	
00002	SIZE	
00003	FFOUR	
00004	FWT	
00005	REVBIT	
00006	NLOG	
00007	NEXP	
00008	UNWRAP	
00009	REMOVE	
00010	SET	
00011	FMIN	
00012	FMAX	
00013	SUM	
00014	MULT	
00015	DIVD	
00016	ADD	
00017	SUB	
00018	COPY	
00019	SWAP	
00020	AMPL	
00021	CONV	
00022	RE	
00023	IM	
00024	SHIFTR	
00025	SHIFTL	
00026	ROTR	
00027	ROTL	
00028	SINE	
00029	COSINE	
00030	TAPE	
00031	ZERO	
00032	NORM	
00033	AUTO	
00034	MARKEL	
00035	DISCR	
00036	NNR	
00037	SCAN	
00038	PROJ	
00039	KBLOT	
00040	KBPROJ	
00041	XYLOT	
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(1)
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:

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

FORTTRAN 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(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

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```

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,14,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.

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```

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'EAKK. 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
MAIN. 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 NNR 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

Hamming 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)

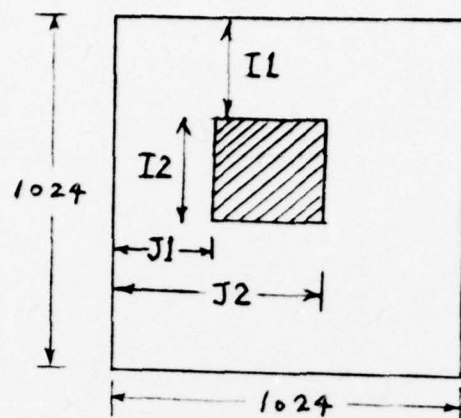
```

        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 1(300, 1200, U, NG)
        CALL XYINIT(B, 1)
        CALL SIZE(C, 2048)
        CALL CHSIZE(0.4, 90, 0)
        FORMAT(11)
        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)
        CALL IXPT(230, 0, 0)
        CALL XYCHAR(IA, 20)
        CALL IXPT(486, 0, 0)
        IF (IT.EQ. 1) GO TO 2
        CALL XYCHAR(IQ, 10)
        GO TO 3
        CALL XYCHAR(IX, 9)
        CALL IXPT(500, 0, 0)
        CALL IXPT(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 IXPT(N, 0, 0)
        IY=2190.0+(XMIN-X(1, I))*XS
        CALL IXPT(IY, 0, 0)
        DO 5 I=2, 1200
        IXX=I+I-2
        IY=2190.0+(XMIN-X(1, I))*XS
        CALL IXPT(IY, IXX, 1)
        CALL IXPT(N, IXX, 0)
        CALL IXPT(N, 0, 1)
        IF (IN.EQ. 1) GO TO 1
        CALL IXPT(2390, 0, 0)
        CALL IXPT(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 IXPT(N, 0, 0)
        DO 13 I=2, 1024
        IXX=4*I-4
        IY=4090.0-X(1, I)*XS
        CALL IXPT(IY, IXX, 1)
        CALL IXPT(4090, IXX, 0)
        CALL IXPT(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 /SWTCH/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 IXPT(IY, IX, 0)
0032      IPT=1
0033      GO TO 3
0034      5      IF(IPT. EQ. 1) CALL IXPT(IY, IX, 1)
0035      IPT=0
0036      3      CONTINUE
0037      CALL INPUT(IA, NPT)
0038      IF(IPT. EQ. 1) CALL IXPT(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:

SSWTCH, 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

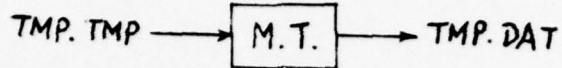
OPTIONS =/OP: 2

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)*

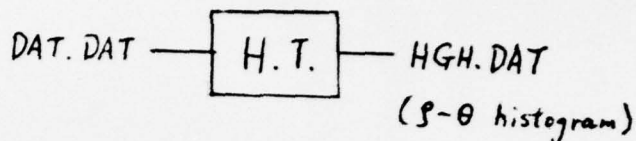
COMPILER ----- CORE			
PHASE	USED	FREE	
DECLARATIVES	00622	15026	
EXECUTABLES	00943	14705	
ASSEMBLY	01271	19017	

```

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)

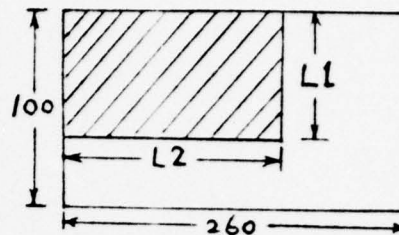
```

**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/' ',' ',' ',' ',' ','-','+', 'D', 'X', '*' /
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(I)
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      CONTINUE
0022          5      CONTINUE
0023          4      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 /SWTCH/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(11.EQ.INTERH) GO TO 17
        K3=K1
        K4=K2
        11=11+1
        N=IA(11)
        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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