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LEAP:
Local Earthquake Analysis Programs on VAX/VMS for Southern California Seismic Network Data

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PREFACE

This manual is intended for those wanting to use Caltech-USGS Southern California Network data with access to the VAX/VMS system. It includes a detailed description of the usage of each program or procedure available, an example run of each program, and step-by-step instructions for specific tasks that are most often of interest to users. For those procedures that require a special CUSP directory structure, there is a short section on the error tracking system.

The manual does not attempt to explain the fine details and workings of each program, only how to use them.

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I. INTRODUCTION TO CUSP

CUSP stands for Caltech-USGS Seismic Processing system. CUSP comprises a group of programs written by Carl Johnson and modified by Bob Dollar, Peter Johnson, Kate Hutton, Doug Given, and Allan Walter. Many auxillary programs to access and manipulate the processed data have also been written by various authors and are available to interested users. The CUSP system and auxillary programs are located on the VAX4300 server at the Seismological Laboratory at Caltech.To set up an account on the VAX4300, talk to either Doug Given or Steve Bryant. CUSP programs require a specific directory structure and a group of system logicals to operate. The auxillary programs do not require a specific directory structure and make up the bulk of programs included in this reference. The logicals and abbreviations needed for these programs have been defined in LEAP$DISK:[LEAP]LEAP_INI.COM on the VAX4300 and can be executed by typing LEAP.

Each earthquake that is processed is given what is called a CUSP ID number in the form of Xcuspid (5 - 7 digits, depending on which computer the data originated). There are three main types of data files used in most of the described programs which contain earthquake information:

1) catalog data
2) phase data
3) digital seismograms

CATALOG DATA for each month is kept on-line in a file called a CAT.KIN. Since this file is readable only with CUSP programs in a special CUSP directory structure, for convenience a CAT.BIN (a binary file) and a CAT.LIS (an ASCII file) are made from the CAT.KIN. All of the catalog data (see below) are kept in the subdirectory CAT$ROOT:[CAT]. Each month's catalog is also kept in a subdirectory by month. After the month is finalized (all events have been located and processed), this file is found in the [MEMS] directory tree (either MEM1$:[yr/mth] or MEM2$:[yr/mth], depending on the date). While the month is still actively being processed, the data is found in CAT$DISK:[CITNET.yr.yr/mth]. The original catalog file in each directory is called CAT.KIN. It is a binary database structured file. The CAT.BIN, and CAT.LIS files are derived from the CAT.KIN; the CAT.BIN is an ordinary binary file, and the CAT.LIS is an ASCII version. A catalog of the entire collection of CAT.BIN's is kept current in CAT$ROOT:[CAT]. This directory contains .BIN files by year instead of by month. Non-finalized events may be included in this file. It is the source **CATREAD** uses when searching for events. It holds data for 1932 – present.

PHASE DATA for each event is kept on-line in a non-ASCII database-structured file called Xcuspid.MEM. The .MEM files for each month's events are kept in the subdirectory for that month (same place as the CAT.KIN for that month). After all events for a month have been located and finalized (all the routine processing has been completed), the .MEM files are moved to another subdirectory under the [MEMS] directory tree (either MEM1$:[yr/mth] or MEM2$:[yr/mth], depending on the date) from which they can be copied for use. They are also backed up onto a magnetic tape called a FREEZE tape and can then be accessed by a procedure called **RDFRZ** or **THAW**. The .MEM file can be translated into an ASCII file with **MEMDCK** or **MAKEPHAS**. **MEMDCK** produces a file with a CUSP ID prefix and a .DCK suffix that contains information other than just phase data. **MAKEPHAS** produces a file with a .P suffix that contains only phase data, and an optional file with a .D1 suffix that contains information about the digital record for each station. Also, for 1960 – 1980 (before CUSP came into existence) ASCII data for each event is available from magnetic tape (CEDAR tapes). **GETMEM** can be used to obtain the .MEM files.

DIGITAL SEISMOGRAMS for each event are kept on-line for a few days in a binary file called Xcuspid.GRM. After each event is located, its .GRM file is copied to the Southern California Earthquake Center Data Center (SCECDC) mass storage system where it can be copied for use with **GETSEIS**. It is also put onto a magnetic tape called an ARCHIVE tape. (However, these tapes are labeled CUSP BACKUP tapes.) The data can then be accessed by a procedure called **ARKREAD**. The original .GRM file has a block size of 512. When it is put on the ARCHIVE tape it resides there with a block size of 7200. The seismograms can then be copied from the tape into a file with a CUSP ID prefix and a .GRM suffix with a block size of 512 again using **ARKREAD**. If you want to use the seismogram data outside of CUSP, you will also need a .D1 file which contains the information about where each station record begins and ends in the sequential .D2 or .GRM file. The .D1 file is obtained from the .MEM file using **MAKEPHAS**. The U.S.G.S. Office at Menlo Park uses the shadowcard format rather than the .D1 and .P formats. ARCHIVE tapes are available from April 1981 – present. For 1977 – 1980, the seismograms are stored in CEDAR format tapes — see discussion under **CDREV**.

II. GETTING STARTED

To use the programs in this manual, login to your account on the VAX4300 server. Then type:

LEAP

Typing **LEAP** will execute a command file called LEAP_INI.COM that sets up all the symbols and logicals needed to use any of the programs or procedures in this manual with the exception of **QED, MEMDCK, TIMIT, TO_SAC, TO_AH, TO_SEGY,** and **TO_XDR.** If you need to use one of these six applications, you will need to consult with Doug Given or Steve Bryant in order to get a more specific CUSP directory structure.

Symbols are defined in LEAP$DISK:LEAP_INI.COM so that all programs and procedures can be run by typing in only the name of the procedure.

III. SUMMARY OF PROCEDURES

Reading catalogs:	CATREAD SEISMIC GETRTP
Getting .MEM (event & archive info.) files:	*MEMDCK
Getting .GRM (seismogram) files:	CDREV GETSEIS *TO_AH *TO_SAC *TO_SEGY *TO_XDR
Getting .P (phase) files:	MAKEPHAS
Plotting seismograms:	WAVE *QED RECSEL STRECKPLOT *TIMIT
Manipulating seismograms:	DECODE2/DECODE4 GETCUSP GETREC GRMCHOP FBA STRECK STRECKWA DINST
Locating events:	ABC CLEANP HYPOINVERSE MAGADD(C)
Focal mechanisms:	FPFIT FPPAGE FPPLOT FOCPLAY
Plotting maps, etc.:	QPLOT SEISMIC SIFT

* a CUSP program which requires a CUSP environment. If in a CUSP environment, type CHELP for more information on these and many other available programs and procedures.

IV. HELPFUL TIPS

1. For help with any CUSP programs (if you have a CUSP account only), type **CHELP** ("program name") after typing **CUSP**.

2. To make a hardcopy of a batch.plt file on the VAX4300:

```
$VIEWERLW
$HELP                          (to see options)
$PLOT BATCH.PLT
$EXIT
$PSPRINT filename.ps           (3rd floor Imagen in Seismo. Lab.)
        or
$LW/POSTfilename.ps            (2nd floor USGS Laserwriter)
```

3. Archive tapes (CUSP backup tapes) 6250 bpi density
   Freeze tapes 6250 bpi "
   CEDAR tapes 800 bpi "

4. For programs that are run in a CUSP environment, the following files are needed in your directory:

```
CUSP.KIN
CAT.KIN
```

and can be created by typing **CUSPKIN** for a CUSP.KIN and **CATKIN** for a CAT.KIN.

5. Notice when Xcuspid is needed versus cuspid without the X.

6. If you create a .D1 file from some old .MEM files, the top several lines may be messed up. If it contains a negative number and looks something like this:

```
015100.000 88   3 23 17 38  45.21  6465691
TIME  0 36789552   3200  8765432
ADL   1 36789552   3200 -8765431
```

change it like this:

8765432 - 8765431 = 1, therefore...

```
015100.000 88   3 23 17 38 45.21  6465691
TIME  0 36789552  3200    0
ADL   1 36789552  3200    1
```

V. STEP-WISE PROCEDURES FOR SPECIFIC TASKS

1. Finding an event or getting the CUSP ID # for a specific event.

a) Use **CATREAD** and input spatial, time, and magnitude limits such that the output file will contain your event. Be sure to select Caltech format to get the CUSP id #'s in the listing. Then select your event in the output file (default is QUAKE.DCK).

2. Getting phase data for an event.

a) Get the CUSP id for the event (#1 above).

b) Use GETMEM to copy the .MEM file to your directory.

or

Get the .MEM file(s) for your event(s). For recent events (within a few months) the data will still be in the monthly directory (ie.: DIR$DATA:[yr.yr/mth]) where "yr/mth" is the year and abbreviated month (three letters) in which the earthquake occurred. If the monthly directory no longer contains .MEM files, then they have been permanently moved to the either MEM1$:[MEM.yr/mth] or MEM2$:[MEM.yr/mth], depending on the date (see chart on Timing room wall or Lisa Wald). If you have only one or two events, you can do the next step either of the following ways. If you have many events, it is best to choose the second method.

Use a regular COPY command to copy the .MEM file into your directory. For example, if the event occurred on February 12, 1988, you would type:

COPY MEM1$:[MEM.88FEB]Xcuspid.MEM *.*

or

Create a DIR.DAT file with a list of the selected events' CUSP id #s. Then define CUSP$IN to be the monthly directory in which your events reside. For example, if your events occurred in May of 1988, type:

DEFINE CUSP$IN MEM1$:[MEM.88FEB]

When you run **MAKEPHAS** the default input source directory will be what is defined to be CUSP$IN, if it has been defined. If not, the default will be the current directory.

c) Use **MAKEPHAS** to create a .P file which contains phase data.

3. Making a seismicity map.

a) Use **CATREAD** and choose the appropriate spatial, time, and magnitude limits for the map of interest. Choose the plotting format for the output file.

b) Use **QPLOT** to create the map with QUAKE.PLT as the input file of the earthquake locations.

or

a) Use **SEISMIC.**

4. Plotting records or record sections for an event.

a) Follow steps a-b for getting phase data for an event (2).

b) Create the .D1 file for your event. Use **MAKEPHAS** to create the .D1 and .P files. Remember to create a DIR.DAT file with the CUSP id # of your event. If you want additional information about the event, run **MEMDCK** to create a .DCK file.

c) Get the .GRM file for the event. Type **"GETSEIS cuspid#" while you are logged into BIGONE only**, or obtain the appropriate ARCHIVE tape from the Seismo. Lab. Computer room. Hang the tape and use **ARKREAD** to obtain a .GRM file.

d) Plot the records with any of the available plotting programs, or use **GETCUSP** to create an ASCII or binary file and write your own plotting program.

5. Plotting strong motion records only.

a) Follow steps a-c for plotting records or record sections (4).

b) Use **FBA** to create a new .D1-type file that ``points" to only the FBA stations.

c) Use any of the available plotting programs to plot the FBA stations such as **RECSEL**.

or

a) Use **GETCUSP** to create an ASCII or binary file and write your own plotting program.

6. Relocating an event.

a) Follow steps a-c for getting phase data (2).

b) Use **ABC** to put stations in alphabetical order in the **.P** file and **CLEANP** to delete repetitive stations.

c) Use **HYPOINVERSE** to locate the event from the **.P** file and create the other input files you need for **FPFIT** if a focal mechanism is desired.

7. Making a focal mechanism.

a) Follow steps a-c for getting phase data (2).

b) (OPTIONAL) Use **MAGADDC** to add the magnitude to the **.C** file if you want the magnitude to appear on the plot.

c) Use **FPFIT** to determine the focal mechanism from first motions.

d) Use **FPPAGE** or **FPPLOT** to plot the focal mechanisms.

8. Plotting broad-band TERRAscope data.

a) Copy the event file into your directory by typing:

$copy terra1$:[ftp.pub.gopher.$rtp.'yrmth']'eventid' *.* RTP events

or

$copy terra1$:[ftp.pub.gopher.$iris.'yrmth']'eventid' *.* Teleseismic events

where 'yrmth' is the two-digit year and two-digit month of interest, and 'eventid' is the event filename.

b) Run **DECODE2** or **DECODE4** depending on the station and the date of the event. All current data requires **DECODE4**, but older data may require **DECODE2**. (see Egill Hauksson or Lisa Wald for more information.

c) Run **STRECK**, **STRECKWA**, or **STRECKPLOT**.

VI. PROGRAMS & COMMAND PROCEDURES

program by Lucy Jones — **ABC**

Purpose: To put the stations in the phase file (.P file) in alphabetical order.

Source Code: LEAP$DISK:[LEAP.PHASE]ABC.COM

Description: **ABC** is a command procedure that simply puts the stations in the phase file in alphabetical order. CUSP data often includes multiple readings from the same station site. For instance, CUSP records a vertical and east-west short period and three Streckeisen components all from the PAS site. Using multiple readings in **HYPOINVERSE** overweights that station in the location procedures. After using ABC to put the stations in alphabetical order, the file can be manually edited to remove all but one P and one S reading for each station, or **CLEANP** can be run to do the same.

Input Files: Xcuspid.P (or filename.P)

Output Files: Xcuspid.P

Common Errors: Do not put the .P suffix on the event name when running the program.

Example run:

```
$ABC X1102747
FORTRAN STOP
$
```

CATDCK

program by Steve Bryant

Purpose: To further filter the output file from **CATREAD** including a depth filter, with the option also to make a DIR.DAT file for use with **MAKEPHAS.**

Source Code: LEAP$DISK:[LEAP.GET]CATDCK.FOR

Description: **CATDCK** is a procedure which takes the output file from **CATREAD** and allows events to be filtered out by all the same parameters used in **CATREAD** plus by depth. It also includes an option to create a file called DIR.DAT for use with **MAKEPHAS.**

Input Files: QUAKE.DCK (or output file from **CATREAD**)

Output Files: user's choice

Common Errors: If you do not choose the R option between filters or options, the output information will be appended together in one file.

Example run:

```
$CATDCK
INPUT FILE NAME: 20 CHARACTER MAXIMUM
VENTURA.DCK
OUTPUT FILE NAME: 20 CHARACTER MAXIMUM
QUAKE.DCK

Options:
Y -- Search by year, month, and day
M -- Search by magnitude
Q -- Search by quality - A,B,C...
D -- Search by depth
R -- Re-define input & output files
C -- Create makephas cuspid file
S -- Stop program

Select option:
D
DEPTH OPTION
Minimum depth
15.0
Maximum depth
20.0

Options:
Y -- Search by year, month, and day
M -- Search by magnitude
Q -- Search by quality - A,B,C...
D -- Search by depth
R -- Re-define input & output files
C -- Create makephas cuspid file
S -- Stop program

Select option:
R
INPUT FILE NAME: 20 CHARACTER MAXIMUM
QUAKE.DCK
OUTPUT FILE NAME: 20 CHARACTER MAXIMUM
DIR.DAT

Options:
Y -- Search by year, month, and day
M -- Search by magnitude
Q -- Search by quality - A,B,C...
D -- Search by depth
R -- Re-define input & output files
C -- Create makephas cuspid file
S -- Stop program

Select option:
C
CREATE MAKEPHAS FILE OPTION
Makephas file DIR.DAT          created

Options:
Y -- Search by year, month, and day
M -- Search by magnitude
Q -- Search by quality - A,B,C...
D -- Search by depth
R -- Re-define input & output files
C -- Create makephas cuspid file
S -- Stop program

Select option:
S
FORTRAN STOP
$
```

Purpose: To get catalog data which fit specific requirements.

Source Code: LEAP$DISK:[LEAP.GET]CATREAD.FOR

Description: **CATREAD** will select events from the CIT database which satisfy requirements chosen interactively by the user in the following categories and output one or two files, depending on the choice for the first category:

•Caltech or **HYPOINVERSE** plotting format.
•Caltech format includes the cusp id #, the plotting format does not and is intended for plotting with **QPLOT**.
•Time interval
•Spatial limits – by latitude and longitude bounds or vertices of a polygon. Default area will encompass Southern California.
•Minimum and maximum magnitude
•Qualities (of location) desired
•No quarries, only quarries, or all events.

The time searched is up to but not including the ending day. Pick the pinked catalog if you want accurate magnitudes or gap data. Pick the qtape catalog if you want to pull from a larger database of events which includes more smaller events. The pinked and qtape catalogs are different only for 4/81 – 2/83.

Input Files: none

Output Files:
QUAKE.PLT (default) plotting format
QUAKE.DCK (default) Caltech format

Common Errors: none

Example run:

```
$CATREAD

THIS PROGRAM WILL SELECT EVENTS FROM THE
CIT DATABASE BY TIME, LOCATION, MAGNITUDE
AND QUALITY. THE EVENTS CAN BE WRITTEN IN 2
FORMS
- CIT AND/OR HYPOINVERSE PLOTTING FORMAT IN
FILES YOU NAME. THE PROGRAM WILL ASK YOU
FOR ALL THE NECESSARY PARAMETERS.

WHICH CATALOG DO YOU WANT TO SEARCH -
PINKED CATALOG (P) WITH CORRECT
MAGNITUDES FOR THE LARGE EARTHQUAKES,
OR THE QTAPE CATALOG (Q) WITH MORE SMALL
EARTHQUAKES.
[CR=P]?
Q

DO YOU WANT CALTECH ("C"), PLOTTING ("P") OR
BOTH ("B") FORMATS?
[CR=C]?
C

CALTECH FILE
[CR=QUAKE.DCK]?

BEGINNING YEAR [CR=1981]?
1986
MONTH [CR=1]?
DAY [CR=1]?
ENDING YEAR [CR=1986]?
1987
MONTH [CR=1]?
DAY [CR=1]?

HOW WILL YOU DEFINE THE SPATIAL LIMITS - BY
LATITUDE AND LONGINTUDE BOUNDS (B) OR BY
THE VERTICES OF A POLYGON (P)?
[CR=B]?
SOUTH LATITUDE LIMIT [CR=32.000]?
NORTH LATITUDE LIMIT [CR=36.500]?
EAST LONGITUDE LIMIT [CR=114.00]?
WEST LONGITUDE LIMIT [CR=122.00]?

MINIMUM MAGNITUDE [CR=0.00000E+00]?
4.0
MAXIMUM MAGNITUDE [CR=10.000]?
6.0

ENTER QUALITIES WANTED
ENTER ALL FOR ALL EVENTS
ABC FOR SOME SUBSET
[CR=ALL]?

ENTER N FOR NO QUARRIES
Q FOR ONLY QUARRIES
B FOR ALL EVENTS
[CR=N]?

READING CATALOGUE FOR 86
READING CATALOGUE FOR 87
FORTRAN STOP
$
```

CDREV

program by Egill Hauksson

Purpose: To extract the digital seismograms for one earthquake from the multi-event seismogram files created by the CEDAR system (the Caltech system from 1977 to 1980).

Source Code: LEAP$DISK:[LEAP.GET]CDREV.FOR

Description: **CDREV** creates single event digital seismogram files for CEDAR system earthquakes (Caltech 1977--1980) to be read by **WAVE** or other plotting routines. The CEDAR events were recorded in very large files (upto 25,000 blocks long) containing 10 to 15 earthquakes per file. This files are stored on "PEST" tapes that are kept in Room 055. To get a CEDAR event file:

1. Find the name of the file which has the earthquake. Look up the event in the log books kept in the timing room on the second floor of the South Mudd building. The earthquakes are in chronological order and are grouped by the name of the file in which they are recorded. These names will be of the form J-14, N-23, etc.

2. Find the tape with the event. The back three rows of magnetic tapes in Room 055 hold CEDAR tapes by year (1977, 1978, 1979, and Jan-May 1980). Written by hand on the side of each tape are the names of the files recorded on that tape. There are 2 to 8 files per tape. Look at the labels on the tapes to find the file name that you found in the log book. This is not as tedious as it sounds since the files are in order on the tapes so usually only a few tapes bracketing the one you want need to be looked at to find it.

3. Read the file off the tape with **TAPECOPY**. Use a block size of 7174 bytes, with no stripping trailing zeroes and no translation. The file will be long (10,000–25,000 blocks) and will contain many earthquakes.

4. Run **CDREV** to extract from the large file, the one earthquake that you want. **CDREV** will read the date and time of each earthquake in the file and ask you if you want to save it. If you answer 'y', it will create a new file containing only that earthquake. If you answer 'n', it will skip that earthquake and read the next one. If you answer 'q', it will quit reading the file and stop.

Input Files: filename.DAT read from a CEDAR tape by **TAPECOPY**

Output Files: 7#########.DAT records for one event

Common Errors: none

Example run:

```
$CDREV
Enter : binary filename e.g.    event01.dat
EVENT01.DAT

EVENT01.DAT
file3:          7806041202.dat
Do you want to keep this file ?  [y/n] or q
Y

####

file3:          7806041356.dat
Do you want to keep this file ?  [y/n] or q
Q

$
```

Purpose: To interactively remove duplicate phase picks from a .P file in preparation for running **FPFIT** or **FOCPLAY.**

Source Code: LEAP$DISK:[LEAP.PHASE]CLEANP.COM

Description: **CLEANP** should be run after **ABC** is run. **CLEANP** looks for duplicate station names in the .P file, shows you the lines, and then gives you the chance to delete one of the lines and change the weight assigned to a pick. This allows a better quality focal mechanism to be determined when running **FPFIT** or **FOCPLAY.**

Input Files: Xcuspid.P

Output Files: Xcuspid.P

Common Errors: none

Example run:

```
$CLEANP X2049932
EWC   IPU0   9205010000   11.77          VHZ
EWC          9205010000   13.81IS 2      VLN
ELIMINATE LINES? (1?,2?, OR NONE(0?)) [CR=0]?
CHANGE THE WEIGHT FOR A READING?
[CR=N]?

FORTRAN STOP
$
```

DECODE2/DECODE4 — program by Joe Steim, modified by Lisa Wald

Purpose: To read the compressed binary SEED format of data files from the TERRAscope stations as obtained directly with KERMIT or as copied from the GOPHER or BADGER directories, and output an ASCII file readable by **STRECK, STRECKWA**, and **STRECKPLOT.**

Source Code: LEAP$DISK:[LEAP.TERRA]DECODE2 (4).COM

Description: **DECODE2(4)** takes the compressed binary SEED format data files either obtained directly from KERMIT or as copied from the GOPHER or BADGER directories and does two things. First it reformats the structure of the file for VMS,and then it reads the data file and writes out an ASCII file that can be used in **STRECK, STRECKWA, STRECKPLOT**, or any other program written to read the ASCII data format.

Input Files: TERRAscope data file

Output Files: user's choice

Common Errors: input and output filenames not specified on the command line

Example run:

```
$DECODE4 PASVBB.DAT PASVBB.OUT

ENTER THE INPUT FILE NAME
pasvbb.out
ENTER THE OUTPUT FILE NAME
pasvbb.ascii
PAS  1992 Julian day=168 12:18:28 VBB  20.00
PAS  1992 Julian day=168 12:19:21 VBB  20.00
PAS  1992 Julian day=168 12:19:40 VBB  20.00

ENTER YEAR, JULIAN DAY, HOUR, MIN, SEC
example: 1990 124 23 34 2
1992 168 12 19 45

Year is 1992  Month is  6  Day is 16

# of points = 11378     9566     9766
ENTER # OF DATA POINTS TO SAVE (max.=30,000)
5000
FORTRAN STOP
$
```

Purpose: To remove instrument response from CUSP seismograms.

Source Code: LEAP$DISK:[LEAP.SEIS]DINST.FOR

Description: **DINST** reads seismograms using the .GRM and .D1 files. Time series are filtered and the instrument response removed in the frequency domain with a subroutine which calculates the poles and zeroes for the various VCO's and discriminators used in the Southern California Network. The low-pass and and high-pass filters are set by the user. The filters can be either zero or non-zero phase. Zero phase filters insure no phase shift in the result, but tend to put non-causal precursors on the signals.

Instrument constants for each station are read from the file RESPONSE.IN. This file can be created by reformatting (using USER$DISK: [MORI. CALPULSE] PC2RESPONSE) files created by **dBASE III** on the USGS PC. If just a few stations are to be processed, the program can be speeded up considerably by using abbreviated .D1 files, which can be made with USER$DISK: [MORI.PROG]D1MOD.

COMMON.INC is a file which has been included and compiled with the source file. It includes a limit on the number of stations and the number of points per record. If you need to change the limit on the # of stations or points per record, then you will have to copy this file and the source file from LEAP$DISK:[LEAP.SEIS] into your directory, edit COMMON.INC, and then recompile it using FORDINST.COM in LEAP$DISK:[LEAP.SEIS] by typing @LEAP$DISK: [LEAP.SEIS] **FORDINST**. Otherwise do not worry about this input file. The default is set to 160 stations and 20,000 points.

Input Files:
Xcuspid.D1
Xcuspid.GRM
RESPONSE.IN

Output Files:
Xcusp.DEC the deconvolved record
Xcusp.D the new .D1 file

Common Errors: See common errors under **RECSEL.**

Example run:

```
$ DINST
Enter data type: CIT, or CSP(cusp format)
CIT
enter event name
X134849
X134849
3  62.50300     87   11   24      1    52
45.10000      86097257
read dmux data

Enter station name (CAPITALS)
ALL = all stations
END = end of list   *** = start list over
ALL

ENTER TIME OFFSET
15.

ENTER TIME LENGTH
60.

Enter station name (CAPITALS)
ALL = all stations
END = end of list   *** = start list over
END

WRITE TO .GRM (G) OR MY (M) FORMAT?
G

ENTER FREQ. FOR HIGH-PASS FILTER
ENTER 0 FOR DEFAULT, WHICH IS A
2ND ORDER FILTER AT 0.3 HZ
0

ZERO-PHASE FILTER? Y OR N
Y

ENTER FREQ. FOR LOW-PASS FILTER
ENTER 0 FOR DEFAULT, WHICH IS A
2ND ORDER FILTER AT 15 HZ
0

ENTER PERCENT TO TAPER, USUALLY 10 %
10.

EWCZ
NFFT IS:     4096
62162.23
NO. OF FREQUENCY PTS IN RESPONSE:    2049

COYZ
NFFT IS:     4096
85232.75
NO. OF FREQUENCY PTS IN RESPONSE:    2049
FORTRAN STOP
$
```

Purpose: To enable a plot to be made of records from the Force Balance Accelerometer (strong ground motion) stations only.

Source Code: LEAP$DISK:[LEAP.SEIS]FBA.FOR

Description: FBA is a program that reads a .D1 file and creates a new file with only the information to plot the FBA stations. In order to then plot the FBA records, FBA.OUT must be renamed Xcuspid.D1 again. Be careful not to delete the original .D1 file if you think you may need it.

Input Files: Xcuspid.D1

Output Files: FBA.OUT

Common Errors: If the .D1 file is created from the .MEM file using **MEMDCK** and **HYPARK** (an old procedure which is not discussed in this manual), the station names will not contain the component as the 4th letter, and FBA will not be able to distinguish FBA stations from other types of stations.

Example run:

```
$FBA
ENTER CUSP ID FOR EVENT (with the X)
X743060
FORTRAN STOP
$
```

Purpose: To plot first motion data on a focal sphere and interactively choose two perpendicular fault planes.

Source Code: LEAP$DISK:[LEAP.PHASE]FOCPLAY.FOR

Description: **FOCPLAY** is an interactive graphics programs for plotting first motion data and fault plane solutions. It is derived from several programs by many people including Whitcomb, Garrimony, Pechmann, Hauksson, Kanamori and Heaton. This program will plot first motions for local recordings of earthquakes on a lower hemisphere stereo projection on the screen of an graphics terminal and allow the user to interactively pick nodal planes for a focal mechanism. The user can choose whether to plot station names, and whether to enter the focal mechanism with the strike of both planes, or with strike, dip and rake. The nodal planes are picked either with cursors or by entering numeric values. Any number of focal mechanisms from one or more files may be plotted in one run of this program---a fresh sphere and first motions will be brought up for each mechanism. The input data file is a polarity file (.POL) from **FPFIT**.

The program begins with a series of set-up questions. After these questions, the first motions will be plotted and then the cursors will appear on the screen. At this point, the user inputs a test focal mechanism and the program will plot it on the focal sphere with the data. If you chose rake (0) in the setup, you enter strike, dip and rake of one plane and the program will solve for the orientation of the second plane. The strikes and dips of both planes and the rake will be plotted below the mechanism. The conventions are 0 = north, 270= west, etc.; the strike should be 90 degrees COUNTERCLOCKWISE from the dip direction. Thus for a plane striking east-west and dipping 70 degrees to the north enter 270 70. The convention for the rake is 0=left-lateral, 180=right-lateral, 90=thrust, 270=normal. If you chose 2 planes (1) in the setup, you enter the strike and dip of one plane and the strike of the second plane. The program will solve for the rake on the first plane and the dip on the second plane. The strikes and dips of both planes and the rake will be plotted below the mechanism. The conventions are as described above. There is an inherent 180 degree uncertainty in the rake since given only strike, dip and strike the program cannot discriminate right-lateral from left-lateral. If you get a message that the two planes are not perpendicular, enter a strike 180 degrees away - i.e., switch 60 to 240, 0 to 180, etc.

When the cursors appear, there are three ways of entering focal mechanisms. If you type:
I
you then type in numerical values. No prompt will appear so that the screen will not get cluttered. If you chose rake (0) above, enter the strike dip and rake of one plane. If you chose 2 planes (1), enter the strike and dip of one plane and the strike of the second plane.
O
will plot the old mechanism. This is a default value for the first time or the mechanism from the last plot for later plots.
Anything else
The angle defined by the location of the cursors with respect to the center of the focal sphere when you type any other key defines the strike of the first plane. You then type in the dip of that plane and it will be drawn. The cursors will then reappear to enter the strike of the second plane (if you chose 2 planes) or the rake (if you chose rake). The second plane is entered like the first. The cursors don't work really well with rake - but what you mark with the cursors is the position on the first plane where the two planes should intersect.

After the focal mechanism is plotted, you can choose to replot the earthquake, plot a new earthquake from the same file, open a new file, or stop. See FOCPLAY.DOC in LEAP$DISK:[LEAP.DOC] for more information.

Input Files: Xcuspid.POL from **FPFIT**

Output Files: BATCH.PLT (or choice, if making hard paper copy)

Common Errors: After picking the first plane with the cursors the program will wait without prompting for the dip of that plane to be typed in (as numbers, not with the cursor).

Example run:

```
$FOCPLAY

Plot options available:

1 = Terminal only
2 = Batch only
3 = Preview and prompt (1 & 2)
4 = No plots

Option? [I20;CR=3]?
1

Terminals available:

1 = Tektronix 4010 (1024 points)
2 = Tektronix 4014 (4096 points)
3 = Retrographics VT640 (VT100)
4 = Megatek 3355
5 = Megatek 7255
6 = Envision 220
7 = Wyse WY-99GT
8 = Jupiter 7
9 = DEC VT240 (in 4014 mode)

Device? [I20;CR=3]?
6

Enter seconds to pause after each
plot (-1=wait for CR) [CR=-1]?

Enter simulated screen height (in.) [F20.0; CR=8.0000]?

IOPT=1, THEN FIRST-MOTIONS AND STATION NAMES
IOPT=2, THEN FIRST-MOTIONS AND NODAL LINES
IOPT=3, THEN FIRST-MOTIONS, STATION NAMES, AND NODAL LINES
IOPT=4, NODAL LINES ONLY -- P&T AXES LABELED
IOPT  [CR=2]?

ENTER RAKE (0) OR 2 PLANES (1)  [CR=0]?

SYMBOLS (0) OR CIRCLES (1)  [CR=0]?

file name
[CR=HQUAKE.POL]?
WHIT.POL
$
```

Purpose: To determine focal mechanisms from the first motions at local stations.

Source Code: LEAP$DISK:[LEAP.PHASE]FPFIT.FOR

Description: FPFIT finds the double-couple fault-plane solution that best fits a given set of observed first motion polarities for an earthquake. The program uses a grid search to find the source model that minimizes the normalized, weighted sum of first-motion polarity discrepancies. The program also finds alternative solutions which have relatively small misfits. For each of these acceptable solutions, the uncertainty in the model parameters (strike, dip, and rake) is estimated, and this set is used in **FPPLOT** to display the range of P- and T-axis orientations consistent with the data. Note that non-double-couple solutions are not considered in the program. Also, data errors, unmodeled refractions, and oversimplified layer boundaries may result in incorrect solutions.

The program may be run interactively or from a command file. If the command file is named FPFIT.INP and it is in the current directory, it will be read automatically when the program is run. It is best to copy the example command file from LEAP$DISK:[LEAP.INPUT]FPFIT.INP and edit it as you wish for the input and output file names. The reason for this is that it contains commands that correct polarity reversals and that delete horizontal component records. These command lines are the ones that start with **REV** and **KIL**. Whenever information about polarity reversals is obtained, the FPFIT.INP file in LEAP$DISK:[LEAP.INPUT] will be updated. It might be wise to recopy this file each time FPFIT is run to be sure of having the most current information.

All commands are three letters long and are usually followed by one or more parameters or file names. Type **HEL** for useful information. All parameters will automatically be set to default values except file names. Note: **FOR 2** means HYPOINVERSE format. To create the focal mechanism and the associated output files, type **FPS** at the prompt. To exit the program type STO. See USGS Open-File Report No. 85-739 for more detailed documentation about the program.

Input Files:

FPFIT.INP (default)	optional command file
Xcuspid.C (or filename.C)	from HYPOINVERSE output(contains azimuths and angles of incidence)

Output Files:

Xcuspid.OUT	residuals file
Xcuspid.FPS	solution file
Xcuspid.POL	graphic plot file

Common Errors: Name of input file in directory is different than that in the command file.

Example run:

```
$FPFIT
FPFIT USES 3-LETTER COMMANDS, WHICH CAN BE FOLLOWED BY
PARAMETERS IN FREE-FORMAT, OR WHICH DISPLAY CURRENT VALUES
& GENERATE PROMPTS.

TYPE "HEL" FOR INFORMATION ON AVAILABLE COMMANDS.
YES?

FPS
#      ORIGIN TIME          LOCATION              DEPTH        MAG
DDR    DIP     RAKE  CNVRG
-----  ------------------  --------------------  -------      ----
----   ----    ------  ------
1        860708 2236 25.10     34- 2.02 116-40.45    12.15        0.00
165    30        70       NO

YES?
STO
FORTRAN STOP
$
```

FPPAGE — program by P. Reasenberg and D. Oppenheimer

Purpose: To plot up to 42 fault plane solutions calculated by **FPFIT** on a single page.

Source Code: LEAP$DISK:[LEAP.PHASE]FPPAGE.FOR

Description: **FPPAGE** is an interactive plotting program for plotting up to 42 focal mechanisms as determined by **FPFIT** on one page. Each fault plane solution is represented by a lower-hemisphere equal-area projection. Compressional rays are depicted as solid circles, and dilatational rays as open circles. Plotting of the first motion symbols may be suppressed. P- and T-axes of the solution are plotted. If first motion plotting is suppressed, only the T-axis is plotted. See USGS Open-File Report No. 85-739 for more detailed documentation.

Input Files: xcuspid.POL from **FPFIT**

Output Files: BATCH.PLT (or choice, if making hard paper copy)

Common Errors: none

Example run:

```
$FPPAGE
FILE FOR HYPOCENTER INPUT:
[CR=NONE]?
HQUAKE.POL

PLOT EVENT HEADERS AS NUMBERS (N) OR DATES (D)?
[CR=D]?
N

ENTER NUMBER OF MECHANISMS TO SKIP
(INCLUDING MULTIPLE SOLUTIONS): [CR=0]?

ENTER NUMBER OF MECHANISMS TO PLOT (0=ALL): [CR=0]?

PLOT MULTIPLE SOLUTIONS (Y OR N)?
[CR=Y]?

PLOT FIRST MOTION DATA (Y OR N)?
[CR=Y]?

PLOT COMPRESSION SYMBOL AS "+" (=0)
OR SOLID CIRCLE (=1)? [CR=0]?
1

Plot options available:
1 = Terminal only
2 = Batch only
3 = Preview and prompt (1 & 2)
4 = No plots

Option? [I20;CR=3]?
2

Batch devices available:
1 = Disk file

Device? [I20;CR=1]?

Enter name for plot file [CR=Batch.plt     ]

MAXIMUM PLOT SIZE =  2.000000  X  10.50000
FORTRAN STOP
$
```

Purpose: To plot all acceptable fault plane solutions calculated by **FPFIT**, one per page.

Source Code: LEAP$DISK:[LEAP.PHASE]FPPLOT.FOR

Description: **FPPLOT** is an interactive plotting program for displaying the fault plane solutions determined by **FPFIT**. Each solution is plotted on a separate page. Each 5.75" diameter circle is a lower-hemisphere equal-area projection of the fault plane solution and first-motion data. Compressional rays are represented by plus symbols, dilatational rays by open circles. Upgoing rays are indicated by boldface symbols, downgoing rays with light-lined symbols. The size of the symbol can be proportional to the observation weight associated with the ray. Discrepant observations are listed in a table to the right of the focal mechanism. A 2.5" diameter circle in the bottom right is a lower-hemisphere equal-area projection showing the P- and T-axes for all the acceptable solutions with the best solution in boldface. See USGS Open-File Report No. 85-739 for more detailed documentation.

Input Files: Xcuspid.POL from **FPFIT**

Output Files: BATCH.PLT (or choice, if making hard paper copy)

Common Errors: none

Example run:

```
$FPPLOT
FILE FOR HYPOCENTER INPUT:
[CR=NONE]?
X746395.POL

PLOT STATION NAMES (Y OR N)?
[CR=Y]?

PLOT SYMBOL SIZE PROPORTIONAL TO WEIGHTS (Y OR N)?
[CR=Y]?

MENU OF PLOT OPTIONS
A = PLOT ALL MECHANISMS
D = REQUEST MECHANISMS BY DATE & ORIGIN TIME
N = REQUEST MECHANISMS BY SEQUENCE NUMBER
        (INCLUDING MULTIPLES)

ENTER PLOT SEQUENCE OPTION:
[CR=A]?

ENTER NUMBER OF MECHANISMS TO SKIP
(INCLUDING MULTIPLE SOLUTIONS):  [CR=0]?

Plot options available:
1 = Terminal only
2 = Batch only
3 = Preview and prompt (1 & 2)
4 = No plots

Option? [I20;CR=3]?
2

Batch devices available:
1 = Disk file

Device? [I20;CR=1]

Enter name for plot file [CR=Batch.plt    ]
$
```

GETCUSP

program by Jim Mori

Purpose: To convert .GRM files into an ASCII or binary format with the option to pick selected stations, select a time window, and change the sampling rate of the data.

Source Code: LEAP$DISK:[LEAP.SEIS]GETCUSP.FOR

Description: GETCUSP allows the .GRM file to be converted into an ASCII file or a binary file so that it can be used with programs outside of CUSP. In addition, there are several options. You may opt to correct for different start times for each trace, and you can select a time window by inputting the offset time and the length of the record desired. There is an option to output all stations, all low gain stations, all high gain stations, all FBA stations, all TERRAscope stations (those that have been merged into the .MEM file), or a select set of stations listed in a file called GETCUSP.IN that you can create. The sampling interval in the output file may also be changed from the original 100 samples/sec.

Input Files: Xcuspid.GRM

Output Files: user's choice

Common Errors: none

Example run:

```
$GETCUSP
ENTER CUSP ID (WITHOUT X)
2049932
LENGTH OF TRACE IS  65.50  SEC
NO. OF STATIONS IS                15
TRIGGER TIME IS  1992  4 30 23 59  54.84
CORRECT FOR DIFFERENT START TIMES? Y OR N
Y

Enter station name (CAPITALS)
MAKE SURE TO INCLUDE COMP.: V,Z,I...
END = end of list   *** = start list over

ALL = all stations
 ALLZ = all low gain stations
  ALLV = all high gain stations
   ALLF =  all FBA stations
    ALLT = all Terrascope stations
     FILE = read stations from GETCUSP.IN

ALLZ
ENTER TIME OFFSET
10.
ENTER TIME LENGTH
40.

Enter station name (CAPITALS)
MAKE SURE TO INCLUDE COMP.: V,Z,I...
END = end of list   *** = start list over
END
ENTER NAME OF OUTPUT FILE
LOWGAINS.SEIS
IS THIS BINARY? Y OR N
Y

THE SAMPLE INTERVAL IS  0.01 (SEC)
DECIMATE DATA ? Y OR N
Y
ENTER NEW SAMPLE INTERVAL
.1
TPCVHZ
WWVBT
COYVHZ
FRGVHZ
BRAVLZ
FRKVHZ
SMOVHZ
PSPVHZ
KEEVHZ
BATVHZ
BONVHZ
RMRVHZ
BC2VHZ
CO2VHZ
TIMET
FORTRAN STOP
$
```

Purpose: To copy .MEM files into your default directory.

Source Code: LEAP$DISK:[LEAP.MASS]GETMEM.C

Description: **GETMEM** is a command procedure that determines where the .MEM file of interest is on the on-line system and then copies the .MEM file to your directory.

Input Files: none

Output Files: Xcuspid.MEM

Common Errors: none

Example run:

```
$GETMEM 1049061
Retrieving .MEM file
$
```

GETREC

program by Jim Mori

Purpose: To select station records and time windows from the seismograms of an event for plotting.

Source Code: LEAP$DISK:[LEAP.SEIS]GETREC.FOR

Description: **GETREC** is a program that allows users to select individual station records and time windows for each record of a particular event for plotting. The selection information for all stations is then put into a sequential ASCII file for further processing. You must have already looked at each record you are interested in with some plotting program such as **WAVE** or **RECSEL** in order to select an appropriate time window. Time is in seconds.

COMMON.INC is a file which has been included and compiled with the source file. It includes a limit on the number of stations and the number of points per record. If you need to change the limit on the number of stations or points per record, then you will have to copy this file and the source file from LEAP$DISK:[LEAP.SEIS] into your directory, edit COMMON.INC, and then recompile it using FORGETREC.COM in LEAP$DISK:[LEAP.SEIS] by typing **@LEAP$DISK:[LEAP.SEIS] FORGETREC**. Otherwise do not worry about this input file. The default is set to 160 stations and 20,000 points.

Input Files: Xcuspid.GRM
Xcusp.D1

Output Files: user's choice

Common Errors: See errors under **RECSEL**.

Example run:

```
$GETREC
Enter data type: CIT, or CSP(cusp format)
CSP
enter event name
X746395
X746395
15     100.0000     88     3     23          17     38
45.21000     6465691

read dmux data

Enter station name (CAPITALS)
END = end of list   *** = start list over
WHS

ENTER TIME OFFSET
10.
ENTER TIME LENGTH
30.

Enter station name (CAPITALS)
END = end of list   *** = start list over
END

ENTER NAME OF OUTPUT FILE
TEST.OUT
FORTRAN STOP
$
```

Purpose: To extract an ASCII format catalog from the binary catalog files created by the Southern California RTP.

Source Code: CUSP$DSK:[SOCAL.MODULES.CATALOG]CATTAIL.FOR

Description: **GETRTP** reads the binary files created by CUSP using data from the Southern California RTP (real-time processor---i.e., automatic locations of recent earthquakes) and creates an ASCII file with that information. All earthquakes catalogued by the RTP (those that passed the criteria for being ``real'') in the last 15 days are included in the output file if you just type **GETRTP**. If you type **GETRTP #**, # being a number of days from the present, the output file will include all events in the last number of days that were specified.

Input Files: none

Output Files: RTP.DAT

Common Errors: none

Example run:

```
$GETRTP
FORTRAN STOP
$
```

GETSEIS

program by Rob Clayton and Katrin Douglass

Purpose: To obtain a .GRM file from the mass storage system.

Source Code: LEAP$DISK:[LEAP.MASS]GETSEIS.COM

Description: GETSEIS is a command procedure that determines where the .GRM file of interest is on the mass storage system, copies the .GRM file to your directory, and them automatically does byte-swapping so that the bytes are in the correct order for the VAX/VMS system.

Input Files: none

Output Files: Xcuspid.GRM

Common Errors: none

Example run:

```
$GETSEIS 2049932
Retrieving seismogram from the Mass-storage system.

2049932 (92/05):    508928 bytes   995 blocks
$
```

Purpose: To select records of interest for plotting from the larger set of all triggered stations and create a new, smaller binary digital data file (.GRM), and a new associated "pointer file" (.D1). Also, to create an individual ASCII file of digital seismogram data for each station of interest.

Source Code: LEAP$DISK:[LEAP.SEIS]GRMCHOP.FOR

Description: **GRMCHOP** allows a choice of two options:

•allows users to generate a new .D1 and .GRM file (sequential, binary) with all station records filtered and decimated to sampling interval of choice. This is useful when the event is very large and the sampling interval is unnecessarily fine, creating an awkwardly large .GRM file.

•allows users to select station records of interest and create an individual ASCII file of the digital data for each station. Records may be filtered and decimated to sampling interval of choice. Useful for converting data for use with other types of digital records.

The new .D1 and .GRM files are called Xcuspid.D and Xcuspid.DEC, respectively. If you want to run auxillary CUSP programs with them, they must be renamed with the .D1 and .GRM suffixes.

CHOP.INC is a file which has been included and compiled with the source file. It includes a limit on the number of stations and the number of points per record. If you need to change the limit on the number of stations or points per record, then you will have to copy this file and the source file into your directory, edit CHOP.INC, and then recompile it using FORGRMCHOP.COM in LEAP$DISK:[LEAP.SEIS] by typing **@LEAP$DISK:[LEAP.SEIS]FORGRMCHOP**. Otherwise do not worry about this input file. The default is set to 160 stations and 20,000 points.

See also description under **RECSEL** for details on filtering and decimation.

Input Files:
Xcusp.GRM
Xcuspid.D1

Output Files:

Xcuspid.DEC	the new decimated .GRM file
Xcuspid.D	the new .D1 file
station name.DIND	individual ASCII station file

Common Errors: The old .P file is not compatible with the decimated .GRM file, so phase picks will not be in the correct place in the record if you try to use it.

See common errors under **RECSEL**.

Example run:

```
$GRMCHOP
Enter data type: CIT, or CSP(cusp format)
CSP
ENTER EVENT NAME
X746395
X746395
15     100.0000            88     3      23            17     38
45.21000            6465691

READING DMUX DATA
ENTER CORN. FREQU. OF HIGHPASS BUTTERWORTH. ENTER
ZERO IF YOU WANT FILTERING SKIPPED
.01

ENTER CORN. FREQU. OF LOWPASS BUTTERWORTH. ENTER
1000. IF YOU WANT FILTERING SKIPPED
1.0

ENTER THE DECIMATION FACTOR (2 will take every other
point, 3 will take every third point, etc.)
```

```
ENTER 1 TO SKIP DECIMATION
5

SELECTED STATIONS OR ALL (SEL or ALL)?
ALL
FORTRAN STOP
$


$GRMCHOP
Enter data type: CIT, or CSP(cusp format)
CSP
ENTER EVENT NAME
X746395
X746395
15     100.0000              88     3      23              17     38
45.21000              6465691

READING DMUX DATA
ENTER CORN. FREQU. OF HIGHPASS BUTTERWORTH. ENTER
ZERO IF YOU WANT FILTERING SKIPPED
0.

ENTER CORN. FREQU. OF LOWPASS BUTTERWORTH. ENTER
1000. IF YOU WANT FILTERING SKIPPED
1000.

ENTER THE DECIMATION FACTOR (2 will take every other
point, 3 will take every third point, etc.)
ENTER 1 TO SKIP DECIMATION
5

SELECTED STATIONS OR ALL (SEL or ALL)?
SEL

Enter station name (CAPITALS)
END = end of list   *** = start list over
ISA
Enter station name (CAPITALS)
END = end of list   *** = start list over
WOF
Enter station name (CAPITALS)
END = end of list   *** = start list over
WJP
Enter station name (CAPITALS)
END = end of list   *** = start list over
END
FORTRAN STOP
$
```

Purpose: To locate earthquake hypocenters from arrival time information.

Source Code: LEAP$DISK:[LEAP.PHASE.HYPOINVERSE]HYPOINVERSE.COM

Description: **HYPOINVERSE** is a general purpose, file oriented earthquake location program written for mini/micro-computer use. Complete descriptions of the program, its algorithms, usage, files, etc. are in U.S.G.S. Open-file Reports 78--694, 85--515 and 89-xxx, all by Fred Klein. In summary, the input data are arrival times of P and S waves (and optionally coda durations) at some set of stations, locations of those stations with optional station delays and 1--24 crustal model(s) while the output results are hypocenters, duration magnitudes (if duration data included), and azimuth and takeoff angles for all phases.

One of the newest features of **HYPOINVERSE** includes multiple overlapping velocity models for different areas with smooth transitions, all defined by the user. Also, **HYPOINVERSE** now offers the option to read .MEM files directly or the shadowcard format currently used in Menlo Park.

The version of **HYPOINVERSE** on the VAX4300 in Pasadena is driven by user commands. The various commands define input and output files, set adjustable parameters, and locate a file of earthquake data using the parameters and files currently set. It is both interactive and "batch" in that commands can be entered from either the keyboard or a file.

All commands are 3 letters long and are usually followed by one or more parameters or file names. Character strings such as file names must be enclosed in apostrophes, and may be up to 40 characters long. **HYPOINVERSE** commands do not generate prompts and must be followed by the required parameters in the required order (see the USGS Open-file Report 85-51 for more information or use the sample commands in the HYPINST. file---see below). The HYPINST. file contains the 3-letter commands which run the program and instructs which crustal model file, station file etc. to use in the location. When you start **HYPOINVERSE**, default values are in effect for all parameters except file names. A DCL command file has been set up to run **HYPOINVERSE** called HYPOINVERSE.COM which will read in filename.P and write out filename.C, .HI, and .O. If you are running the program interactively, the executable version is called HYP.EXE. After typing in the input and output file names, type **LOC** to locate the event and **STO** to exit the program. See the second example run below.

If a file called HYPINST. resides in your current directory, it is read as a startup file by **HYPOINVERSE**. It can be used to set your own default values, read station or crust model files that you always use, etc. A sample HYPINST. file and HYPOINVERSE.COM filename can be found in LEAP$DISK: [LEAP.INPUT]. HYPOINVERSE.COM is a command procedure to run the executable (**HYP**) without editing HYPINST. for different cusp id numbers each time a new earthquake is located. The input and output filenames in HYPINST. are HQUAKE.P, HQUAKE.O, etc. The command file copies Xcuspid.P to HQUAKE.P, runs **HYPOINVERSE**, and then renames HQUAKE.O, etc. to Xcuspid.O, etc. See first example run below.

Current station files called PASALL.STA, PASNOW.STA, and OTHERS.STA and a crustal model file called HADLEY.CRU will also be kept in this same directory. PASALL.STA contains all the USGS-CIT stations that have ever existed, PASNOW.STA contains all those stations that are currently in operation, and OTHERS.STA contains all the Menlo Park stations and others that the Southern California Seismic Network has ever recorded. The current USGS-CIT station file will be updated as needed. These input files can have any name and can be entirely different than the two examples. Other example input and output files are in LEAP$DISK: [LEAP.INPUT] with the prefix HYPOIN. The full path name to these files should be specified when running the program except **HYPINST.** which should be put into your default directory.

Input Files:

HYPINST.	optional instruction file (**HYP**)
LEAP$DISK:[LEAP.INPUT]PASNOW.STA	(for example,see above) station file (**STA**)
LEAP$DISK:[LEAP.INPUT]HADLEY.CRU	crustal model (**CRH**)
filename.P	from **MAKEPHAS (PHS)**

Output Files:

filename.HI	summary file (**SUM**)
filename.O	printed extended output (**PRT**)
filename.C	Archive (phase, travel path info.) (**ARC**)

If a name for one of these files is not defined with the appropriate command either interactively or in HYPINST., that file will not be created. It is thus possible to run **HYPOINVERSE** and get no output at all. Any names can be used, but many find it convenient to have the same name with different endings for the input phase and all output files.

Common Errors: Forgot quotes around filenames in input.

Example run:

```
$HYPOINVERSE FILENAME    this assumes a HYPINST. file is in the directory

HYPOINVERSE STARTING

EVENT LOCATED:  REMARK -LAT-  --LON-       DEPTH       XMAG  FMAG
NUM   RMS   ERH   ERZ
86/ 7/ 8 22:36           34 2  116  40     12.15       0.0   0.0
 16    0.08   0.24   0.33
$


$HYP                     directly running the program interactively

SUM  'filename.HI'
PHS  'filename.P'
ARC  'filename.C'
STA  'filename.DCK'
CRH 1  'velocity model.DCK'
LOC

HYPOINVERSE STARTING

EVENT LOCATED:  REMARK -LAT-  --LON-       DEPTH       XMAG  FMAG
NUM   RMS   ERH   ERZ
86/ 7/ 8 22:36           34 2  116  40     12.15       0.0   0.0
 16    0.08   0.24   0.33
STO
$
```

Purpose: To add the magnitude of an event to the summary line in the **HYPOINVERSE** output files (.HI, .C).

Source Code: LEAP$DISK:[LEAP.PHASE]MAGADD(C).FOR

Description: **MAGADD** is a program that copies the Caltech magnitude from the .P file of an event and puts the magnitude in the .HI file for that event. **HYPOINVERSE** locates events but cannot calculate Caltech magnitudes. Caltech magnitudes are local magnitudes for larger events or coda amplitude for smaller events. To have magnitude in the output files for plotting with **QPLOT**, magnitudes must be added. This procedure can be used if you want to make a seismicity plot (with **QPLOT**) and represent different size earthquakes with different size symbols. Normally the .HI file contains a "0" in the place of the magnitude. The magnitude appears in columns 69 & 70 of the summary line.

MAGADDC is a program that copies the magnitude from the .P file of an event and puts the magnitude in the .C file for that event. This procedure should be used if you want to use **FPFIT** and have the magnitude of the events appear on the focal mechanism plot. As above, the magnitude columns of the .P header normally contain a "0". The output file will have a .CM suffix which should be changed to .C to use in **FPFIT**.

Input Files:
Xcuspid.P (or filename.P)
Xcuspid.HI (for **MAGADD** only)
Xcuspid.C (for **MAGADDC** only)

Output Files:
Xcuspid.LO (for **MAGADD** only)
Xcuspid.CM (for **MAGADDC** only)

Common Errors: none

Example run: same for **MAGADDC**

```
$MAGADD
FILE NAME?
[CR=PALMS]?
HQUAKE

REACHED END OF .HI FILE
$
```

MAKEPHAS

program by Susanna Gross

Purpose: To extract phase information from a .MEM file for relocating with **HYPOINVERSE** or using in other programs. Also, to obtain an ASCII ``pointer file" in order to use one of the several plotting programs such as **WAVE** or **RECSEL**.

Source Code: LEAP$DISK:[LEAP.GET]MAKEPHAS.FOR

Description: **MAKEPHAS** pulls information from a .MEM file or a list of .MEM files and creates:

- a .P file, a phase file with the P picks for each station in **HYPOINVERSE** format
- a .D1 file, a ``pointer file" needed for using plotting the seismograms, optional

This program does not require any special CUSP structures or files other than the input files.

The CUSP id #'s for which the user wants a .P or .D1 file are read from a file which can be created by:

DIRECTORY/SIZE X*.MEM /OUT=DIR.DAT

This will produce a file called DIR.DAT with a list of all the CUSP events for which you have .MEM files in your directory. DIR.DAT is the default in the program, although the file can be named anything. If you want only selected events, you can create a file with a list of the CUSP id #'s like this:

X643295
X643297

If you want .MEM files from a directory instead of your current working directory, for instance the directory for May 1988, you need to type the following in order to direct the input from a directory other than the current one:

DEFINE CUSP$IN MEMS1$:[88MAY]

The last question the program will ask determines the format of the summary lines in the phase file. If you answer "Y", the phase file will be in NEWHYP format.

Input Files: Xcuspid.MEM
DIR.DAT

Output Files: Xcuspid.P
Xcusp.D1

Common Errors: The CUSP ID file (DIR.DAT) has not been created X left off of beginning of CUSP id #'s
X not in upper case
CUSP$IN has not been defined

Example run:

```
$DEFINE CUSP$IN []

$MAKEPHAS
Output phase file name:
[CR=FILE.P]?
X2049932.P
Cusp ID list file name:
[CR=DIR.DAT]?

Do you want .D1 files generated?
[CR=Y]?

Do you want NEWHYP summary lines?
[CR=Y]?

===>      1 :  2049932
Writing seismogram information.
X 2049932.D1
$
```

Purpose: Makes an ASCII listing of .MEM file(s).

Source Code: CUSP$COM

Description: If only one .MEM file is to be listed, simply typing **MEMDCK cuspid** will work. If more than one events are to be listed, the processing is "state" driven with only those ids "posted" for state MEMDCK are processed (see **POST** command in CHELP). Job is submitted to batch queue BIGONE$BATCH and the ASCII listing is output to file MEMDCK.LST. A log file called MEMDCK.LOG is also created. Up to 100 events can be included in one output file. This is a program which requires a CUSP environment. Type **CHELP MEMDCK** for more information.

The listing groups together all summary level tuple information for each pin. To make an ASCII listing of the .MEM file in tuple order use the **TUPLE** command (see CHELP).

Input Files: Xcuspid.MEM

Output Files:

Xcuspid.DCK	if listing one file at a time
MEMDCK.LST	if listing many files posted to MEMDCK state
MEMDCK.LOG	"

Common Errors: none

Example Run:

```
$MEMDCK 2049932
$1$DUA3: [LISA.CUSP.WORK]
Contents of .MEM file written to X2049932.DCK
MEMDCK: X2049932.MEM
MEMDCK: CUSP-ID     2049932 COMPLETED.
$
```

QED — program by Carl Johnson, modified by Peter Johnson, Allan Walter, and Sam Stewart

Purpose: To time events, enter hand-picked data from paper records, and check location interactively.

Source Code: DIR$CUSP:[MODULES.QED.QEDTIME]QEDTIME.FOR

Description: **QED** is the quake editor. It is used to originally time and locate events recorded on the Southern California (and Central California) Network and to enter hand-picked data from paper records both interactively. You must use a Tektronics terminal or equivalent to see the seismograms and make phase picks from them. Any terminal can be used for editing. **QED** requires a special CUSP directory structure although in the future this will not be a requirement (at which time a new updated version of this manual will be printed). Documentation on **QED** is currently being written but is not yet completed. See Kate Hutton for more detailed information about using this program.

Input Files:
Xcuspid.GRM
Xcuspid.MEM
CUSP.KIN
CAT.KIN

Output Files: Xcuspid.MEM with new information

Common Errors: none

Example run: Type CHELP for more information.

Purpose: To make maps and plots of seismicity, stations, spatial plots, etc.

Source Code: SYS$TOOLS:[QPLOT]QPLOT.FOR

Description: **QPLOT** is a general plotting program with a large variety of options. It is driven by 4-letter commands which may either be typed in at a terminal or read and executed from a command file by typing **JUMP** and entering the command file name. A sample command file called QPLOT.JMP can be found in LEAP$DISK:[LEAP.INPUT]. Digitized lines for various California features arefound in LEAP$DISK:[LEAP.MAP]. To use them in **QPLOT** you must first dump this information into ASCII files using **SIFT**. See **SIFT** for further information. Very detailed documentation about **QPLOT** may be found in LEAP$DISK:[LEAP.DOC] or by typing **HELP** at the prompt while in **QPLOT**.

Input Files: filename.JMP if using a file with commands

other input files vary with type of plot, but may include:
list of stations
digitized lines (state boundaries, faults, etc.)
list of earthquakes

Output Files: BATCH.PLT (or choice, if makinghard paper copy)

Common Errors: none

Example run: $QPLOT

```
Plot options available:
1 = Terminal only
2 = Batch only
3 = Preview and prompt (1 & 2)
4 = No plots

Option? [I20;CR=3]?
2

Batch devices available:
1 = Disk file

Device? [I20;CR=1]?

Enter name for plot file [CR=Batch.plt     ]

Welcome to the new QPLOT.
COMMAND?
MTIT
MAIN TITLE CHAR. SIZE, INCHES (0 FOR NONE) [CR=0.00000E+00]?
.3
MAIN TITLE?
[CR=]?
L.A. BASIN

COMMAND?
LINE
NUMBER OF LINE FILES (0-8) [CR=0]?
2
FILE NUMBER      1
LINEAR DATA FILENAME?
[CR=]?
CALBOUND.DCK
PEN NUMBER [CR=1]?

DASH PATTERN NUMBER (0=SOLID OR 1-10) [CR=0]?

FILE NUMBER      2
LINEAR DATA FILENAME?
[CR=]?
```

```
FAULTS.DCK
PEN NUMBER [CR=1]?

DASH PATTERN NUMBER (0=SOLID OR 1-10) [CR=0]?

COMMAND?
STAS
STATION FORMAT: 0=NO STAS 1=H71 2=HYPOE,HYPOI [CR=2]?

STATION FILENAME?
[CR=NONE.]?
CALNET.DCK
LABEL THE STATION WITH A 4-LETTER NAME [T OR F, CR=T]?
F
STATION SYMBOL TYPE [CR=10]?

STATION SYMBOL SIZE [CR=10]?
3

COMMAND?
FILE
DATA INPUT FILENAME?
[CR=NONE.]?
QUAKE.DCK

COMMAND?
SCAL
MAP, DISTANCE & DEPTH SCALE  [CR=0.45000E+06]?
5000000

COMMAND?
AMAP
USING SCALE OF   5000000., SET UP MAP FROM NEW LIMITS:
LEFT  DEG [CR=156.00]?
120.
LEFT  MIN [CR=23.385]?
0.
RIGHT DEG [CR=78.000]?
114.
RIGHT MIN [CR=36.615]?
0.
TOP   DEG [CR=50.000]?
35.
TOP   MIN [CR=10.022]?
0.
BOT   DEG [CR=16.000]?
32.
BOT   MIN [CR=49.978]?
0.
NEW LON AXIS=  4.380403    IN., NEW LAT AXIS=  2.626500

COMMAND?
SAVE
SAVE PARAMETERS ON FILE:
[CR=]?
TEST.JMP

COMMAND?
PLOT

COMMAND?
QUIT
$
```

Purpose: To plot seismograms from .GRM files.

Source Code: LEAP$DISK:[LEAP.SEIS]RECSEL.FOR

Description: RECSEL is a plotting program specifically for CUSP seismogram data. It will plot records in computer channel # (pin #) order or in increasing epicentral distance.

It includes the following options:

- high-pass filter
- low-pass filter
- decimation factor
- time scale
- amplitude scale
- plotting device

If the instrument response is to be removed (optional), GAIN.DAT must be changed for each event. This information can be obtained from the USGS network database. Each record will have the amplitude in microns (bias removed, labeled absamp), in digital counts (bias not removed, labeled amp), and bias (labeled bias). If digital count amplitude exceeds the limit (a glitch) or gain information is not available for a station, the absolute amplitude in microns will be shown as the same as amplitude in counts. The absolute amplitude is only a rough estimate and is not to be used for anything but getting a rough estimate.

COMMON.INC is a file which has been included and compiled with the source file. It includes a limit on the number of stations and the number of points per record. If you need to change the limit on the # of stations or points per record, then you will have to copy this file and the source file from LEAP$DISK:[LEAP.SEIS] into your directory, edit COMMON.INC, and then recompile it using FORRECSEL.COM in LEAP$DISK:[LEAP.SEIS] by typing **@LEAP$DISK: [LEAP.SEIS] FORRECSEL**. Otherwise do not worry about this input file. The default is set to 160 stations and 20,000 points.

Latitude and longitude convention is North and East positive. Distance is in kilometers.

When plotting in order of increasing epicentral distance, if the station is not in PASALL.STA, the plot will not include that station. The list contains all stations that have been active at some time in the Southern California Seismic Network.

A little explanation is needed concerning the choices of normalization (see the example run below). S will take each individual record and make the largest amplitude one unit and scale all the other points in that record by that unit. RG will scale every record with the one single scale, using 2048, the largest amplitude count that can be recorded on the digitizer, as one unit. The scaling for the plots is done before the gain information is removed from the records. R is the same as RG except that the scaling for the plots is done after the gain information has been removed from the records.

Input Files:

Xcuspid.GRM	
Xcuspid.D1	
LEAP$DISK:[LEAP.INPUT]PASALL.STA	needed only for increasing epicentral distance plots; will be opened automatically in LEAP directory
GAIN.DAT	(optional) must be edited for attenuation and discriminator velocity values for date of event (use USGS database if absolute amplitudes are important)

Output Files: BATCH.PLT (or choice, if making hard paper copy)

Common Errors: If the number of stations exceeds the parameter the MAXS dimension in COMMON.INC, or the number of points exceeds the MAXD dimension in COMMON.INC, you will get an error. To correct this, you must either edit COMMON.INC and increase the dimension of one or both of these parameters.

Example run:

```
$RECSEL
ENTER ALL RESPONSES IN UPPER CASE

enter event name
X746395
X746395
15      100.0000              88      3       23              17      38
45.21000              6465691
read dmux data

Plot options available:
1 = Terminal only
2 = Batch only
3 = Preview and prompt (1 & 2)
4 = No plots

Option? [I20;CR=3]?
2

Batch devices available:
1 = Disk file

Device? [I20;CR=1]?

Enter name for plot file [CR=Batch.plt     ]

ENTER THE TITLE OF THE PLOT (a80)
TEST.PLT

ENTER TIME SCALE (SECONDS/INCH) AND PLOT HEIGHT IN
INCHES MEASURED FROM ZERO LINE  NOTE: if choosing ordinary
plots or plots in increasing epicentral dist., default
will be .3in for height.
15. .3

ENTER CORN. FREQU. OF HIGHPASS BUTTERWORTH. ENTER
ZERO IF YOU WANT FILTERING SKIPPED
0.

ENTER CORN. FREQU. OF LOWPASS BUTTERWORTH. ENTER
1000. IF YOU WANT FILTERING SKIPPED
1000.

ENTER DECIMATION FACTOR. A DECIMATION FACTOR OF
TWO CUTS NUMBER OF POINTS IN HALF. ENTER ZERO TO SKIP
DECIMATION.
4.

ENTER TYPE OF NORMALIZATION (in upper case):
S    self-normalization
RG   relative normalization with gain
R    relative normalization without gain
SG

SELECTED STATIONS OR ALL (SEL or ALL)?
ALL

ORDINARY PLOTS OR INCREASING EPICENTRAL DISTANCE? (1 OR 2)
2

ENTER EPICENTER LAT. AND LON. IN DECIMAL DEGREES
(N and E are positive)
45. -118.

ENTER MINIMUM AZIMUTH, MAXIMUM AZIMUTH
0. 360..
ENTER MINUMUM DISTANCE, MAXIMUM DISTANCE
50. 1000.
FORTRAN STOP
$
```

```
$RECSEL
ENTER ALL RESPONSES IN UPPER CASE

Enter data type: CIT, or CSP(cusp format)
CSP

enter event name
X746395
X746395
15      100.0000              88      3       23              17      38
45.21000              6465691
read dmux data

Plot options available:
1 = Terminal only
2 = Batch only
3 = Preview and prompt (1 & 2)
4 = No plots

Option? [I20;CR=3]?
2

Batch devices available:
1 = Disk file

Device? [I20;CR=1]?

Enter name for plot file [CR=Batch.plt      ]

ENTER THE TITLE OF THE PLOT (a80)
TEST.PLT

ENTER TIME SCALE (SECONDS/INCH) AND PLOT HEIGHT IN
INCHES MEASURED FROM ZERO LINE  NOTE: if choosing ordinary
plots or plots in increasing epicentral dist., default
will be .3in for height.
15. .3

ENTER CORN. FREQU. OF HIGHPASS BUTTERWORTH. ENTER
ZERO IF YOU WANT FILTERING SKIPPED
0.

ENTER CORN. FREQU. OF LOWPASS BUTTERWORTH. ENTER
1000. IF YOU WANT FILTERING SKIPPED
1000.

ENTER DECIMATION FACTOR. A DECIMATION FACTOR OF
TWO CUTS NUMBER OF POINTS IN HALF. ENTER ZERO TO SKIP
DECIMATION.
4.

ENTER TYPE OF NORMALIZATION (in upper case):
S    self-normalization
RG   relative normalization with gain
R    relative normalization without gain
S

SELECTED STATIONS OR ALL (SEL or ALL)?
SEL
Enter station name (CAPITALS)
END = end of list   *** = start list over
ISA
Enter station name (CAPITALS)
END = end of list   *** = start list over
WOF
Enter station name (CAPITALS)
END = end of list   *** = start list over
END
FORTRAN STOP
$
```

SEISMIC

program by Carl Johnson, modified by Doug Given

Purpose: To select catalog data and make maps and plots of the seismic data.

Source Code: SYS$TOOLS:[SEISMIC]SEISMIC.FOR

Description: **SEISMIC** performs three major functions:

1) selects earthquakes from the catalog based on the following parameters:
- region
- time
- magnitude
- quality
- blast or quake
- depth

2) makes maps and plots of this data in formats you determine.

3) makes color plots of various quantities in each element of a map grid

SEISMIC can be run interactively or from a command file. Example command files, SEISMIC_1.COM, SEISMIC_2.COM, and SEISMIC_3.COM can be found in LEAP$DISK:[LEAP.INPUT]. They show how to do a sort only, how to do a map, and how to do a cross-section, respectively. By default, no output files are created. To create one or more output files, the commands are:

PLOT filename
PRINT filename
HYPO filename
BINARY filename

These filenames can all be different, but it is best to keep them all the same because each one will have a different suffix. See below for a description of the output files. See SEISMIC.DOC in LEAP$DISK:[LEAP.DOC] for a more detailed description of this program.

Before running the program either interactively or from the command file, you must type the following logical assignments:

```
ASSIGN SYS$OUTPUT FOR005
ASSIGN SYS$INPUT FOR010
```

Input Files: none

Output Files:

filename.GML	graphic plot file (**PLOT**)
filename.LIS	list of selected events (**PRINT**)
filename.HYP	HYPO71 format list of events (**HYPO**)
filename.BIN	binary list of events in CUSP format (**BINARY**)

Common Errors: none

Example run: See documentation in LEAP$DISK:[LEAP.DOC]

Purpose: To select line files from digitized map features and convert into ASCII files which can be read and plotted with **QPLOT.**

Source Code: LEAP$DISK:[LEAP.MAP]SIFT.FOR

Description: **SIFT** will access a databank of boundary lines, faults, etc. in binary files and create ASCII output files which can then be used in **QPLOT** or other plotting programs. The program allows a choice of the following features:

- •APCRP.BIN - Alquist-Prioloa sites of active creep
- •APFLTS.BIN - Alquist-Priola faults in San Fransisco Bay area
- •BANNING.BIN - Banning fault & region (Jon Matti, 1985)
- •CAFAULTS.BIN - California faults
- •CALAKES.BIN - California lakes
- •CAOUTLINE - California outline
- •CARESRVOR.BIN - California reservoirs
- •COALINGA - Coalinga area
- •HAWAII - Hawaii
- •MHFLTS.BIN - Herd's fault map of Morgan Hill
- •MLFLTS.BIN - Mammoth Lakes faults
- •MLGEOG.BIN - Mammoth Lakes & Mono Lake geography
- •MLRDS.BIN - Mammoth Lakes roads
- •PKF.BIN - Parkfield (John Sims)
- •SCITEX.BIN - California quaternary faults (scan of Jennings, 1975)
- •SFBAYRDS.BIN - San Fransisco Bay roads
- •SOCALFOLD.BIN - Cenozoic anticlinal fold axes in southern California region
- •SPECIAL.BIN - Special features: calderas, domes, detailed fault maps
- •SROUTLINE.BIN - Snake River Plain outline
- •STATES.BIN - U.S. state outlines
- •WORLD.BIN - World map
- •YELLOWSTN.BIN - Yellowstone faults, boundaries, lakes, calderas

The .BIN files are located in LEAP$DISK:[LEAP.MAP] but may be left there when running the program.

Input Files: filenam.BIN see above

Output Files: user's choice

Common Errors: None

Example run:

```
$SIFT
ENTER LATITUDE RANGE (+ = NORTH) (DEG MIN,
DEG MIN):
32. 0. 42. 0.
ENTER LONGITUDE RANGE (- = WEST) (DEG MIN,
DEG MIN):
-114. 0. -124. 0.
ENTER SCALING OPTION:S=MAP SCALE,OR
D=APPROX MAP DIMENSIONS:
D
ENTER APPROXIMATE WIDTH, HEIGHT (INCHES):
8.5,11
MAP WILL HAVE A SCALE OF 1:    4521028
OK (Y OR N) ?
Y
ENTER OUTPUT FILENAME:
SIFT.OUT

DATA SETS AVAILABLE ARE....
CO = CALIFORNIA STATE OUTLINE
CF = CALIFORNIA MAJOR QUAT. FAULTS FROM
JENNINGS (1975)- SEE ALSO "SI"
CL = CALIFORNIA MAJOR LAKES AND
RESERVOIRS
CR = CALIFORNIA MINOR LAKES AND
RESERVOIRS
YL = YELLOWSTONE FAULTS, BOUNDARIES,
LAKES,
CALDERAS
SO = SNAKE RIVER PLAIN OUTLINE
HW = HAWAII
US = U.S. STATE BOUNDARIES
WD = WORLD MAP
PT = WORLD TECTONIC PLATE BOUNDARIES
SP = SPECIAL FEATURES (TYPE "SP" FOR MENU)
? = THIS MENU
X = EXIT

ENTER CODE:
WD
ENTER CODE:
X
FORTRAN STOP
$
```

STRECK

program by Lisa Wald

Purpose: To deconvolve the TERRAscope broad-band instrument response to produce a ground displacement record and then convolve the resulting ground displacement record with the instrument of your choice, if so desired.

Source Code: LEAP$DISK:[LEAP.TERRA]STRECK.FOR

Description: **STRECK** deconvolves the Streckeisen instrument response and then convolves the ground displacement record with the instrument of your choice. There is also an option to omit the convolution so that you have the ground displacement record. Use this program if you want to convolve the record with any instrument other than the Wood-Anderson. The synthetic Wood-Anderson record should be produced with **STRECKWA**. The input file may have 1-3 records corresponding to different components. The accepted input file is the ASCII output file from **DECODE2** or **DECODE4**.

Input Files:

user's choice	output file from **DECODE2** or **DECODE4**
LEAP$DISK:[LEAP.TERRA]TERSTA.DAT	will be opened automatically in LEAP directory

Output Files: user's choice

Common Errors: none

Example run:

```
$STRECK
WHAT INSTRUMENT TYPE IS TO BE DECONVOLVED/CONVOLVED?

1 - Broadband LG
2 - Broadband VSP
3 - Broadband VBB
4 - Broadband LP
5 - Broadband VLP
6 - WWSSN 30-90 Press-Ewing (gain 2300)
7 - WWSSN 15-100        (gain 1500)
8 - WWSSN 100-300       (gain 1500)
9 - WWSSN SP            (gain 1000)
10 - WWSSN SP           (gain 100000)
11 - WWSSN 1-90 Benioff    (gain 2300)
12 - Torsion 6. sec     (gain 2800)
13 - Torsion .8 sec     (gain 2800)

3
     3
TERRAscope or IRIS data? (T or I)
T

Enter LOW and HIGH cutoff frequency
Enter 0,0 for default
Default is now     0.1000    8.0000
0,0
     t      VBB
input file name
PASVBB.ASCII

HOW MANY COMPONENTS IN THIS FILE?
3
output file name
OUT.DAT

DO YOU WANT TO CONVOLVE THE RECORD
WITH AN INSTRUMENT RESPONSE NOW? (Y or N)
N
FORTRAN STOP
$
```

Purpose: To create a plot of 1-3 records from the output files of **STRECKWA** or **STRECK** or from unprocessed Streckeisen data output from **DECODE2** or **DECODE4** with the option to smooth and rotate the records to radial and tangential components.

Source: LEAP$DISK:[LEAP.TERRA]STRECKPLOT.FOR

Description: **STRECKPLOT** creates a plot of the seismograms from the output files of **STRECKWA, STRECK, DECODE2,** or **DECODE4**. There is an option to smooth the records and to rotate the records to the radial and tangential components. The amplitude scale and time scale are set interactively. The record will be 8 inches long, and the time scale can be set accordingly. The largest amplitude of each record and the length of the records are displayed in order to correctly set the scales.

Input Files: user's choice output filename from **STRECK(WA), DECODE2,** or **DECODE4**

Output Files: BATCH.PLT (or choice, if making hard paper copy)

Common Errors: none

Example run:

```
$STRECKPLOT
TYPE NAME OF INPUT FILE
PASVBB.ASCII

HOW MANY COMPONENTS IN THE FILE?
3
TYPE THE NAME OF THE EVENT (AND MAGNITUDE)FOR THE TITLE
EXAMPLE BROAD-BAND SEISMOGRAM

HAS STRECK OR STRECKWA BEEN RUN ON THIS DATA? (Y or N)
N
TYPE OF DATA: VSP, VBB, LP, VLP, or LG (upper case)
VBB

MAX/MIN AMPLITUDES OF RECORD ARE=   521   -605
MAX/MIN AMPLITUDES OF RECORD ARE=   656   -620
MAX/MIN AMPLITUDES OF RECORD ARE=   704   -693

THE LENGTH OF THE RECORD (in sec.) IS =    250
WHAT IS THE TIME SCALE (sec/in)?
5.
WHAT IS THE AMPLITUDE SCALE (cm/in)?
700.
SMOOTH THE WAVEFORM (Y or N)?
N
ROTATE RECORDS TO RADIAL AND TANGENTIAL? (Y or N)
N


Plot options available:
1 = Terminal only
2 = Batch only
3 = Preview and prompt (1 & 2)
4 = No plots

Option? [I20;CR=3]? 2

Batch devices available:
1 = Disk file

Device? [I20;CR=1]?
Enter name for plot file [CR=Batch.plt]
FORTRAN STOP
$
```

STRECKWA

program by Lisa Wald

Purpose: To deconvolve the TERRAscope broad-band instrument response for a seismogram and then convolve the resulting ground displacement data with a Wood-Anderson instrument response to produce a synthetic Wood-Anderson record.

Source Code: LEAP$DISK:[LEAP.TERRA]STRECKWA.FOR

Description: **STRECKWA** is a program that deconvolves the instrument response from a TERRAscope broad-band seismogram and then convolves a Wood-Anderson instrument response to produce a synthetic Wood-Anderson record. The input file may have 1-3 records corresponding to different components.

Input Files:

user's choice	output file from **DECODE2** or **DECODE4**
LEAP$DISK:[LEAP.TERRA]TERSTA.DAT	will be opened automatically in LEAP directory

Output Files: user's choice

Common Errors: none

Example run:

```
$STRECKWA
This program will convert the VBB, VSP or LG channel
from any broad-band TERRAscope station and produce
a Wood-Anderson record for obtaining a Wood-Anderson
magnitude.

WHICH TYPE OF DATA: VBB, VSP or LG (upper case)
VBB
VBB

enter seismogram filename (a25):
PASVBB.ASCII

HOW MANY COMPONENTS IN THIS FILE?
3

enter output file name
OUT.DAT
FORTRAN STOP
$
```

Purpose: To interactively pick phases on network station records in order to determine the hypocentral location of earthquakes recorded on the Southern California Seismic Network.

Source Code: MOD$TIMIT

Description: TIMIT is a program that allows interactive phase picking on the seismograms recorded by the Southern California Seismic Network. It is the program that is used to routinely locate all events recorded by the Network. This program requires a CUSP environment. See Kate Hutton for more detailed documentation.

Input Files: Xcuspid.MEM
Xcuspid.GRM

Output Files: revised Xcuspid.MEM

Common Errors: none

Example run: not able to show

Purpose:

TO_AH - To convert event data from the CUSP format to a standard AH format readable on SUN workstations.

TO_SAC - To convert event data from the CUSP format to the SAC format.

TO_SEGY - To convert event data from the CUSP format into the SEGY format as defined in USGS publication OFR 90-99. Disk file is readable only on VAXes.

TO_XDR - Converts event data from the CUSP format to the XDR AH format as defined by Lamont Doherty Lab. The resulting file is readable on SUN-type workstations and can be transferred as a binary file using the network utility FTP.

Source: CUSP$COM

Description: These are programs that require a CUSP directory structure. The jobs are "state" driven, processing only those CUSP event ids posted for the state "AH" (or "SAC" or "SEGY" or "XDR") in the scheduling file (CUSP.KIN) of the default directory (see **POST** command). The jobs run in batch mode and are submitted to a queue with the logical name BIGONE$BATCH; a job log is written to the file TO_XDR.LOG in the default working directory. If an event is processed without an error, its state entry in the CUSP.KIN file is assigned a status value of 1 (see **STATUS** command), otherwise it is assigned the negation of the error number encountered in the program.

The CUSP command **SEGY_LIST** will dump a SEGY disk file's header data to an ASCII listing.

The AH file can be transferred from the VAX to a SUN as a binary file using the network utility FTP.

If you wish the "standard" AH format, use instead the **TO_AH** command.

Input Files:
Xcuspid.MEM
Xcuspid.GRM
Xcuspid.kom (optional)

Output Files: Xcuspid.AH (or SAC or.SEGY or .XDR)

Common Errors: CUSP.KIN not in directory

Example run: see CHELP **TO_AH (TO_SAC, TO_SEGY, TO_XDR)**

Purpose: To pick phases on network station records, plot seismograms, and plot record sections.

Source Code: LEAP$DISK:[LEAP.SEIS.ENVWAVE]PPING2

Description: **WAVE** is a waveform plotting, picking, and manipulation program for use on a graphics terminal. With this program, users can look at seismograms on the screen in a variety of different ways and can create or amend a HYPOINVERSE .P file. Input formats can be CSP (.GRM), ANZA network, CDR (for CEDAR tapes from Caltech 1977--1980), and SAC.

Available command options are:

- **allst** - plot all stations, 6 per page in pin # order
- **selst** - select one station at a time to look at.
- **ordst** - plot all stations, 6 per page in order of increasing epicentral distance. (To use this, there must be a .P file with a location line at the end of the file. It will not work on teleseisms.
- **sortst** - plot picked records in order of increasing arrival time, 6 per page. Only stations with a P-arrival time in the .P file will be plotted.
- **manst** - plot stations as entered manually
- **resev** - reduced vertical record section
- **reseh** - reduced horizontal record section
- **nexte** - do next earthquake
- **spawn** - spawn another process
- **help** - list of commands and what each does
- **stop** - exit from program.

All commands must be given in lower case letters (except station names.)

Once one of the first five plotting options is chosen, seismograms will begin to appear, and the only way to communicate with the program is to enter one character when the cursors appear. When a page of 6 records is displayed (using allst, ordst, or sortst), one or more records can be chosen for full page display and/or arrival time picking. To do so, place the cross-hair on a trace; the vertical cross-hair selects the beginning of the window to be ``blown up". Then type 'x'. None or all traces can be selected in any order. Then type 'q' to see each one individually.

When a single seismogram is displayed (with `selst', or with an `x' as described above, arrival times can be picked interactively and stored in a HYPOINVERSE .P file. Picks from an existing .P file will be plotted. If a .C file from **HYPOINVERSE** is in the directory, residuals from the .C file can also be plotted.

To move onward from the traces you have, type:

q --- to get the next seismograms (either a single seismogram picked with `x' or if none of those, the next page of 6)
$ --- to get back to command mode
! --- to quietly depart the program through the back door.

Once you have a single seismogram on the page (either chosen with `x' from a page of 6 or with `selst'), you can change the plotting parameters, replot the trace, pick arrival times, durations, or go on to the next trace.

To change plotting parameters (this will not replot, just change the parameters for the next plot):

+ or **=** --- expand horizontal scale by a factor of 2 so that the location of the vertical cursor moves to the center of the screen.

- or **_** --- reduce horizontal scale by a factor of 2 so that the previous location of the vertical cursor moves to the center of the screen.

space bar --- (i.e. hit the space bar) move/scroll the seismogram to the left or right so that the previous location of the vertical cursor moves to the center of the screen.

***** or **8** --- expand vertical scale by a factor of 2
/ or **?** --- reduce vertical scale by a factor of 2
d --- decimate (i.e. plot less data points) by a factor of 2
u --- undecimate (i.e. plot more data points) by a factor of 2

To replot the trace:

i --- initialize again (i.e. you lost the seismogram) with reduced time scale and increased decimation (you might want to get back to a dt of 0.01 after doing this)
r --- replot (incorporating any parameter changes)
f --- filtering (you'll be asked for fmin and fmax) if (min f = max f) you get the original trace back

To save information in the EVENTN.P file:

p --- pick p - arrival time (i.e. peu0)

e --- emergent
i --- impulsive
u --- up
d --- down
0-4 --- weight

s --- pick s - arrival time (i.e. se3)

e --- pick coda duration
z --- pick period
a --- pick min max amplitude in counts

To leave the page:

q --- go on to the next station or next page of seismograms
k --- label a bad channel for irreversible removal
$ --- go back to the command level
! --- exit through the back door

Input Files:

Xcusp.D2 or Xcusp.GRM
Xcusp.D1
Xcusp.P
Xcusp.C optional

Output Files:

Xcusp.P
BATCH.PLT (or choice, if making hard paper copy)

Common Errors: Command was not entered in lower case.

When picking an arrival, always enter the 'p' or 's' first, otherwise the other characters (i,d,etc.) will be taken to mean the above commands. WAVE expects three more characters after a 'p' or 's', so if you don't want to enter a first motion, enter a blank.

Example run: unable to show in this format

VII. ERROR TRACKING SYSTEM

When a problem is encountered during a CUSP procedure (this applies to those procedures which require a special CUSP directory structure), you will see errors such as the examples below either in the screen or in a .LOG file associated with the procedure.

```
** DROP      -- FATAL ERROR:  53
** RESULT    -- FATAL ERROR:  870
** MEMRES    -- FATAL ERROR:  30
** MEMRES    -- FATAL ERROR:  45
** DELGRM    -- FATAL ERROR:  140
```

This tells you, first of all, that there is a problem, but it also tells you the location of the problem. There is a subroutine called **FATAL** which every well-written CUSP program and subroutine calls under conditions which could be interpreted as an error. Its purpose is to print error lines into SYS$OUTPUT and return a parameter IRES which indicates where in the program the error occurred. If you look at the code for FORGET.FOR, for example, you will find subroutine calls accompanied by other statements like:

```
CALL GET(KLONE, 0, IRES)
IER = 140
IF(IRES .LT. 1) GOTO 910
```

GET, which is another CUSP subroutine, does whatever it does (in this case look for a tuple in the KLONE.KIN that matches the partially completed one in the array KIN(80)) and returns a value of IRES depending on its success. A positive IRES generally means success, zero means there was no such tuple, and a negative value means an error condition. The IER = 140 marks the location in the program (or subroutine). If IRES is less than one, ie. **GET** had less than complete success, we go to statement 910, which passed the message that an error occurred up to the next level of subroutine.

```
C++ WOODSHED
910 CALL FATAL('FORGET', IER)
IRES = -IER
RETURN
```

Each level of subroutine has its own "WOODSHED", so that in many cases the error can be traced downward to its source through a string of FATAL messages like the first example above. If you are running a batch job, the messages will appear in your .LOG file. If you are running in interactive mode, they will appear on the screen. They can be very helpful in debugging a program or troubleshooting a situation.

In addition to writing the messages to SYS$OUTPUT, **FATAL** also sets a symbol called EXSTAT (exit status) equal to IRES. So the DCL has an equivalent system of keeping track of where errors occurred.

```
BASE = 1000
RUN CLONE:FORGET
SHO SYM EXSTAT
RES = BASE - 'EXSTAT'
IF 'EXSTAT' .NE. 1 THEN GOTO RESULT
```

Here if the **FORGET** fortran code returns a negative EXSTAT (or IRES) that fact (and value) is recorded in RES, as well as the location within the .BAT file (BASE). A well-written .BAT file will have sections, each with a different BASE, just as a well-written CUSP fortran routine will use IER in any place that a failure is possible.

Later in the .BAT file ("RESULT:"), we have

```
CALL MEMRES SEC_MEM LOCAL 'RES'
```

which sets the event being processed with a nonzero result. The events that experienced failures in **FORGET** will then be posted FORGET.2140 (instead of FORGET.0 before **FORGET** was run - the 0 is silent). The 1 indicates 1000, the location in the .BAT file, and the 140 indicates the IRES from the CUSP program called there. The .LOG file will contain the rest of the comments from **FATAL**.