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EARTH OBSERVATIONS DIVISION VERSION OF THE LABORATORY FOR APPLICATIONS OF REMOTE SENSING SYSTEM (EOD-LARSYS) USER GUIDE FOR THE IBM 370/148

VOLUME I — SYSTEM OVERVIEW

Job Order 71-593

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VOLUME I — SYSTEM OVERVIEW

Job Order 71-593

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1. INTRODUCTION

For many years, the Earth Observations Division (EOD) of the Lyndon B. Johnson Space Center (JSC), National Aeronautics and Space Administration (NASA), has sponsored research on image analysis techniques. Finally, in 1970, it adapted the Purdue University Laboratory for Applications of Remote Sensing System (LARSYS) for use on the Univac 1108 at JSC. The present system, now called EOD-LARSYS, is a direct descendant of that original system.

Since 1970, EOD-LARSYS has evolved independently of Purdue's LARSYS. The systems have evolved to the point that they differ significantly. EOD-LARSYS reflects the early interest of EOD in airborne scanners; significant programs from the Skylab missions; and, currently, the development of programs for worldwide monitoring of crops.

This document, Volume I of a set of four, presents brief instructions for the use of EOD-LARSYS. Simple examples are presented to demonstrate the use of each processor. Tables of necessary information are included, such as control cards, processor interaction, and the like. In short, this document presents all the information needed to make immediate, simple use of all the processors in this system. It should be sufficient for many users.

EOD-LARSYS can be used in very complex ways. Volume II of the EOD-LARSYS documentation contains greater depth of detail on all subjects mentioned in this document. Like this document, it contains examples of system use, but the examples tend to be more complex.

Detailed documentation of the individual programs comprising the EOD-LARSYS is given in Volume III. With the exception of utility routines, the programs are grouped by processor. Fortran listings are provided in Volume IV. For ease of reference, the documentation relating to each processor has the same section number in each of the four volumes of documentation.

EOD-LARSYS is currently implemented on the Purdue LARS IBM 370/148 computer at LARS, West Lafayette, Indiana. This system uses Virtual Machine (VM) 370 and the Conversational Monitor System (CMS). It is accessed from remote terminals using average-grade telephone lines.

2. DESCRIPTION

EOD-LARSYS is a comprehensive tool in applications involving recognition of patterns in remotely sensed data. The program system (1) facilitates analyst organization and evaluation of analysis, (2) incorporates techniques for the examination and manipulation of the statistical properties of the data, (3) provides for the use of either point or field training samples, (4) includes both supervised and unsupervised classification procedures, (5) offers several feature selection methods and thresholding to reduce computation time, and (6) outputs a range of products for various forms of display.

EOD-LARSYS is a non-interactive system for the analysis of multispectral imagery data. It can be used with imagery data from many sources, provided only that they are in either the JSC-Universal or the LARSYS-III tape format. In practice, most data come from the Landsat series of satellites, but images from aircraft-mounted scanners, the Skylab missions, and meteorological satellites have also been used in the past.

This section will serve only as an introduction to the use of EOD-LARSYS. An amplified discussion can be found in Volume II of this set of documentation.

The system is divided into processors. The user must supply the data to be analyzed, normally on tape, and a file of card images which specifies the processors that are to be used in analysis.

In practice, a user will normally want to classify the contents of an image. Initial steps might be to call the Histogram processor, HIST, to assemble the image data in bins, and then to produce a symbol-density map of some of the channels using the GRAYMAP processor. HIST prepares histograms for viewing; it is normally required to precede GRAYMAP so that symbols can be properly assigned to ranges of radiance values.

To see results and perform calculations on them, the user might use the DISPLAY processor. This allows the user to prepare tapes with classification images or maps on paper with symbols representing classes and to perform certain calculations on the results of the classification.

EOD-LARSYS also allows the analyst to use Procedure 1, a semi-automatic algorithm for classifying an image, based on labeled dots. The DOTDATA and LABEL processors would be used in addition to most of the above processors, and possibly the NDHIST and SCTRPL processors might be used in the same procedure

to obtain spectral plots based on the N-dimensional histogram. An integrated Procedure 1 example is given in Section 20 of this volume.

For some studies, an analyst may need to select the channels or sets of channels (such as Landsat acquisitions) that best separate the classes of interest. For this he or she would use the Feature Selection processor, SELECT.

Many useful transformations can be applied to imagery data. The Data Transformation (DATA-TR) processor allows the analyst to apply any matrix transformation or merely to rescale the data.

Finally, the analyst may perform a linear transformation on means and covariances and output the transformed statistics, in which case the Statistics Transformation (TRSTAT) processor, would be used.

The user communicates with the EOD-LARSYS system with card image files. In a typical case, an image tape and a file of card images specifying the processing options would be furnished. For example, to apply HIST and GRAYMAP in the same batch, the analyst would furnish an image tape and a file of card images. The file would have a few system card images, then the HIST card images, and then the GRAYMAP card images. Details of these files are to be found in the remaining sections of this volume and in Volume II. In applications involving the use of a remote terminal, the files of card images specifying the processing options are created in advance and are read at run time.

Figure 2-1 presents the major processing paths in the EOD-LARSYS.

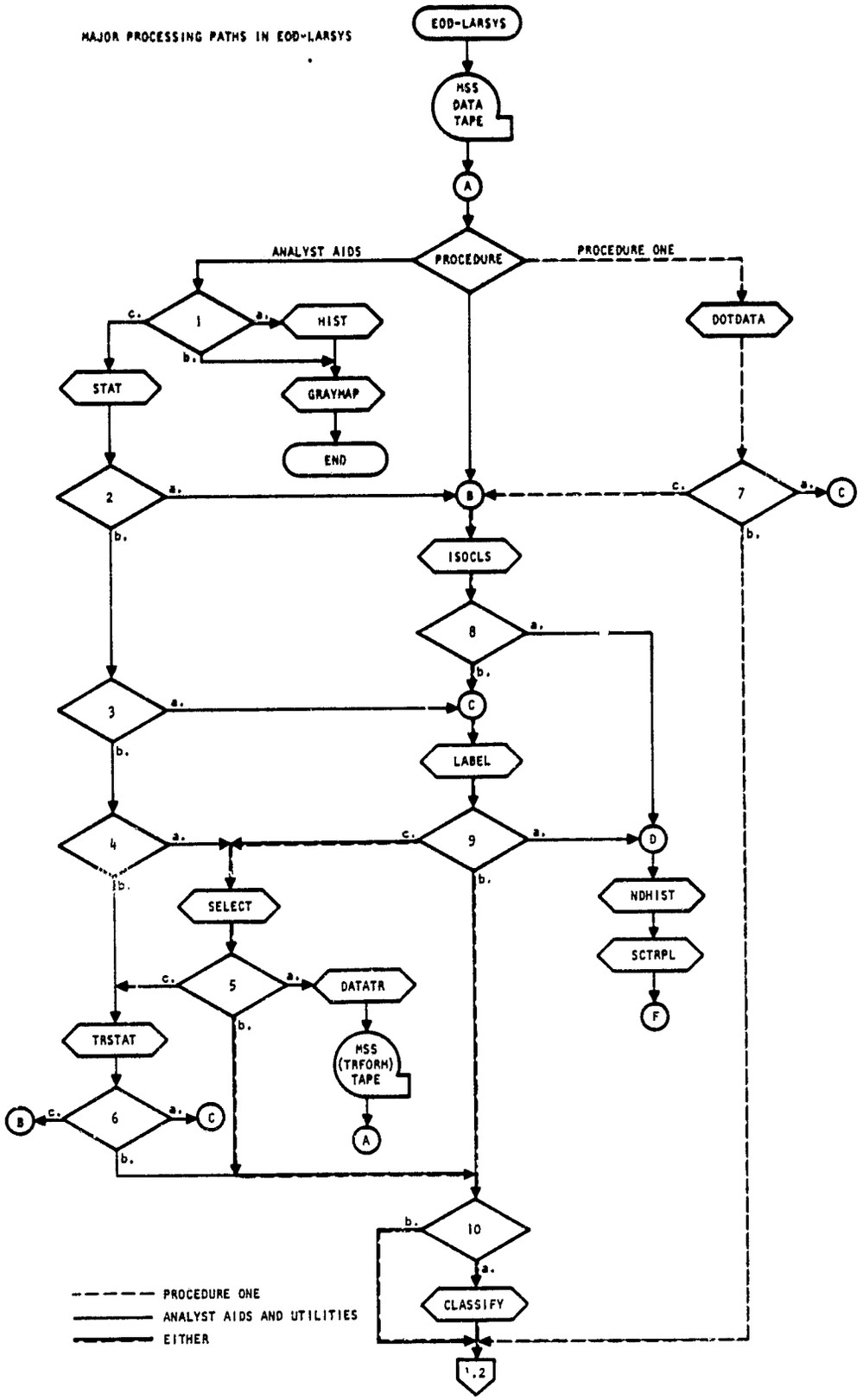
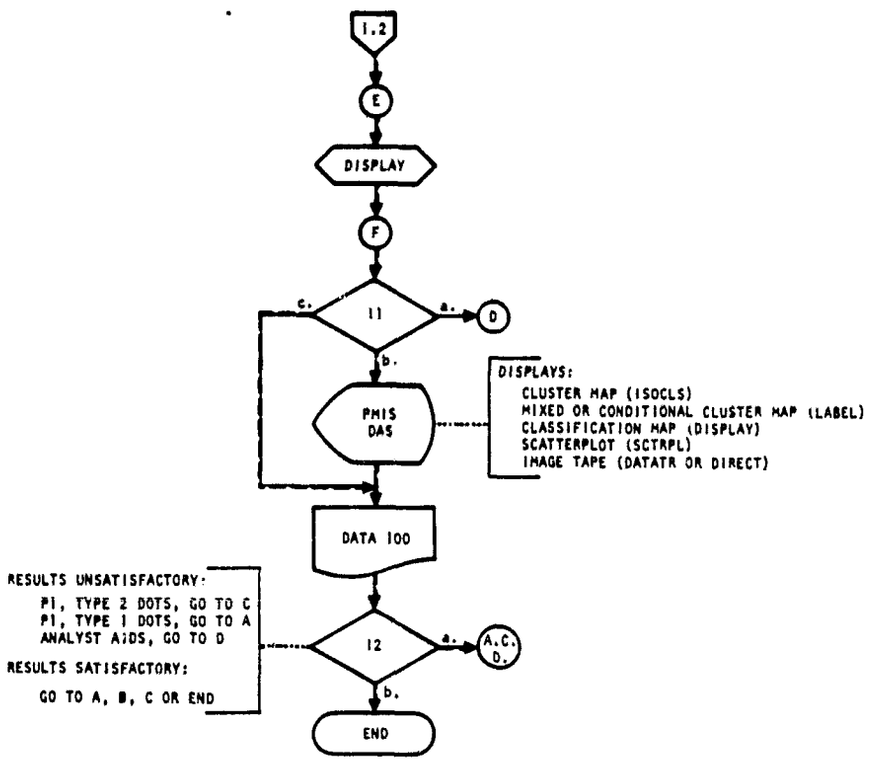


Figure 2-1.– Major processing paths in EOD-LARSYS.



Key to decision points 1 through 12.

1 a. Compute histograms and print pictorial gray scale map of data from any channel, using HIST and GRAYMAP.
b. Print pictorial gray scale map only, using GRAYMAP.
c. Compute training field statistics, write SAVTAP file, using STAT.

2 a. Group training fields into classes, using ISOCLS.
b. Omit clustering.

3 a. (Re)label training field statistics.
b. Omit labeling.

4 a. Determine subset or linear combination of channels that maximizes subclass separability, using SELECT.
b. Transform training field statistics using TRSTAT.

5 a. Create new image data tape, applying linear transformation matrix computed by SELECT, using DATATR.
b. Perform supervised classification of image using CLASSIFY.

6 a. Relabel previously labelled statistics file SAVTAP, using LABEL.
b. Proceed to classification, using CLASSIFY.
c. Use statistics file SAVTAP to provide starting cluster mean vectors for ISOCLS.

7 a. Relabel dots in dot data file using LABEL.
b. Display dots using DISPLAY.
c. Cluster image using ISOCLS.

8 a. Compute n-dimensional histogram of selected data areas, using NDHIST, and scatter plot, using SCTRPL.
b. Proceed to labeling, using LABEL.

9 a. Compute n-dimensional histogram of selected data areas, using NDHIST, and scatterplot, using SCTRPL.
b. Proceed to classification, using CLASSIFY.
c. Evaluate discriminatory capability of channels, using SELECT.

10 a. Proceed to classification, using CLASSIFY.
b. Proceed to classification summary, using DISPLAY.

11 a. Compute n-dimensional histogram of selected data areas, using NDHIST, and scatterplot, using SCTRPL.
b. Display image on display station and print results.

12 a. Results unsatisfactory (see annotation on flowchart).
b. Results satisfactory (see annotation on flowchart).

Figure 2-1.— Concluded.

3. INPUT

3.1 IMAGE TAPES

An analyst is normally concerned with the classification of picture elements (pixels) of an image made by a multispectral scanner (MSS). For this reason, most processors require the input of an image tape in JSC-Universal format or the LARSYS-III format. However, the SELECT, TRSTAT, SCTRPL, and LABEL processors function without such tapes. Image tapes are read from unit 11, unless a DATAFILE card changes the logical unit number.

3.2 CARD IMAGES

The analyst controls EOD-LARSYS with card image files. In the following discussion, "card image" should be understood for "card." Processor cards are used to call the processors; control cards choose the options available from the processor; field cards specify parts of an image; and special system files furnish special information to the analyst on request.

Processor cards contain the "$" sign in column 1 and the name of the processor immediately following it. The following are the currently available processors and the section in which each is documented.

$HIST	Section 6
$GRAYMAP	Section 7
$STAT	Section 8
$ISOCLS	Section 9
$SELECT	Section 10
$CLASSIFY	Section 11
$DISPLAY	Section 12
$DATA-TR	Section 13
$TRSTAT	Section 14
$NDHIST	Section 15
$SCTRPL	Section 16
$DOTDATA	Section 17
$LABEL	Section 18
$EXIT	Execution terminates when this card is encountered.

Control card images specify all the options available to the analyst. Normally, the absence of a control card triggers a default option. To the extent possible, processors are designed to function with defaults. All control cards have keywords beginning in column 1 and parameter values starting after column 10. In almost all cases, if more than one card is necessary, additional cards with the same keyword can be used. The *END card ends the control cards for a processor.

Ancillary cards can be used with all processors to control titles on the printout sheets. As shown in Table 3-1, defaults present standard titles and the current date. An optional COMMENT card can be used to furnish further identification on output sheets.

Class, subclass, and field cards define blocks of data to be edited from imagery tapes for processing. The exact way of using these cards differs from processor to processor, as shown in Table 3-2. Fields are defined by a sample increment, a line increment, and from 1 to 10 vertices. The user may associate a name with each field. The alphanumeric field description is located in columns 1 through 4. In columns 11 through 72, sample and line increments are separated by a comma and enclosed in parentheses. A comma separates the increments and each of the following vertices. The vertices must be arranged in clockwise order. The sample numbers are given first, then the line number, for each vertex.

More than one card may be used to describe a field. An asterisk occurring after a vertex indicates a continuation card is to be read beginning in column 11. A vertex must be completed on a card and cannot be split between two cards. The numbers which describe the increments and vertices must be integers. Some examples are given in sample programs in this volume. A more detailed discussion can be found in the EOD-LARSYS User's Reference Manual (Volume II).

A $END card signifies the end of field cards and the end of a processor in most cases.

Special system files are normally produced for later use by another processor. Some may be prepared as a user option; the B-MATRIX file is one example (see the sample program for DATA-TR). Some of the system files may be output on punched cards if desired.

The special system files are listed in Section 4 (Table 4-1). The detailed formats for these files are given in Volume II of this set of documentation.

3.3 PRACTICAL STEPS FOR USING EOD-LARSYS AS IMPLEMENTED AT PURDUE LARS

The processors described here can be executed in two forms, both originating at JSC. Batch or interactive runs can be run from the special terminal of the computer facilities in Building 17, or anywhere that telephone contact can be established with the computer at Purdue. At present, this includes two terminals in suite 2076 of Building L-IX in Nassau Bay. However, any remote terminal located anywhere can be used for the purpose, provided only that telephone contact of moderate quality can be established with the computer at Purdue.

For batch or interactive operations, files of cards may be prepared as shown in this document. From the Data-100 terminal, the operator issues commands to read those cards in the card reader.

Use of the editor to enter control card images from the terminal is rather more complex. The user must understand several concepts and know how to meet various contingencies.

3.3.1 SIGN ON

To operate either in batch or interactive mode, the user must activate a terminal and establish telephone contact between computer and terminal.

For the dial-up terminals using FTS, make sure terminal and coupler are turned on. Then dial the Houston FTS operator at 87-331-7000. Ask for 317-463-7551 (at Purdue University). When asked for the calling number, furnish 525- followed by the last four digits of your telephone number. When a high-pitched computer noise appears, insert the telephone receiver in the acoustic coupler.

For the direct-line terminals in Building 17, the telephone connection is already made, simply log on to the system. Depress "N" and then the carriage return (CR) to summon the system. The system will ask first for your password and then for your name. Type each and CR after the respective queries. (Figure 3-1 is a printout of a system log-on and log-off.) The system will then type a log-on message (LOGMSG), giving certain information regarding system operation. You should respond by typing 1PL LARSYSP1 (CR). The system will respond with EOD LARSYS READY, signifying that you have successfully logged onto the system and are ready to begin. Other system queries

and responses are given in Figure 3-1. Control is now with the IBM CMS system. Type EODLARSY to start the run (initiate the prompter).

3.3.2 LOG OFF

To stop using the system, the user must log off. To do this, depress BREAK then LOG at any time during processing. Normally, this is done in batch processing after the READY message has been displayed by the terminal. In interactive operations, it may be done at any time.

3.3.3 FILE STRUCTURE

For physical cards serving as control card images, it is not necessary to know more than the above; however, for interactive operations, the user must know how to create, modify, and destroy card image files.

Such a file is a collection of data in card image form stored in the memory of the computer. Files have names which may consist of as many as eight characters, the first being any legal symbols such as letters, numbers, and anything else appearing on the keyboard of the terminal, including a blank or space. Some typical names are:

```
GIDDINGS
FILE
```

The complete file descriptor consists of a file name and file type CC. Examples:

```
GIDDINGS    CC
FILE        CC
```

You may elect to create a control card file on disk before you can use EOD-LARSYS in interactive mode. To do this, you use the editor, as described in the next section.

3.3.4 USING THE EDITOR TO CREATE, MODIFY, AND ERASE FILES

After logging onto the system, you must type EDIT in response to the prompt to call the editor processor.

To create a file, you type I (CR) after the EDIT; the prompt appears on the terminal. Then begin entering control card images one line at a time, beginning in column 1. For example:

```
FORM          1 .                          (CR)
$ISOCLS       INPUT/UNIT=11,FILE=1         (CR)
DATA                                       (CR)
  :
  :
$EXI                                       (CR)
FILE           (to store the file)         (CR)
```

If a mistake is made by typing a wrong character, it may be erased by typing @. For example, to finish typing CAROLYN after you started with CARIL, you will have the following line of text in your screen:

CARIL@@OLYN

To erase whole line, type [(CR). To insert a line of text, position the system at the line just above and type I followed by a blank, then the line, then CR. For example:

I CHAN 3,4 (CR)

To delete a line, type DEL 1 (CR) after the line in question is displayed.

Care must be taken in using the editor, especially in inserting lines. The user may move to the top of the file by typing TOP (CR) and then print the existing contents line by line by typing N (CR) repeatedly. The entire file can be printed out prior to editing by typing TYPE filename CC (CR). More detailed instructions on use of an editor can be found in the CMS manuals located in the vicinity of the terminals.

3.3.5 TO RUN A PROGRAM

Prior to all operations, use this manual to define the complete set of EOD-LARSYS control cards that are to be used. In addition, add the following card image as the first one in the file:

FORM 1 – for input tapes in JSC-Universal image format; or

FORM 2 – for input image tapes in LARSYS-III format.

As is the case for all control cards, the "1" and "2" must appear in column 11 (or a column greater than 11). Then sign onto the system and create the file of card images, using any name you choose.

Then, to execute the run, type EODLARSY. You will be prompted for necessary information such as MSS tape number, and so on.

Users are encouraged to elect the BATCH option when initiating a run. The two CMS 370 batch machines are BATEOD and BATJSC. BATJSC runs only at night and has the advantage of a less expensive billing rate.

Figure 3-1 is a list of prompting questions to which users respond in using the EOD-LARSYS. (This prompting program, as well as the IPL system, was provided by members of the staff at Purdue LARS).

3.3.6 TROUBLE SHOOTING

Problems may be encountered. A typical problem is a return to CP mode (line noise). For the CP error, you must type B (CR) to return to CMS. For the READ ERROR error, you must type (CR).

In certain cases, it may be necessary to call a systems analyst. Make a copy of the screen's contents using the hard-copy printer next to the terminal, then sign off, and then contact a systems analyst. At this writing, the person to contact is Dr. P. J. Aucoin, Jr., at 333-6311, mail code C42, at room 2076 of Building L-IX.

TABLE 3-1.— ANCILLARY CARDS FOR ALL PROCESSORS

Keyword	Parameter and default values	Function
HED1	Any 60 characters beginning in column 11 Default: LYNDON B. JOHNSON SPACE CENTER	Replaces first header line with the indicated characters in the parameter field.
HED2	Any 60 characters beginning in column 11 Default: HOUSTON, TEXAS	Replaces second header line with indicated characters in the parameter field.
DATE	Any 12 characters beginning in column 11 Default: Current date	Prints the indicated 12 characters in the right corner of the heading in place of the current date.
COMMENT	Any 60 characters beginning in column 11 Default: No comments printed	Prints a comment line using the 60 characters found in the parameter field.

TABLE 3-2.— FIELDS IN THE PROCESSORS OF EOD-LARSYS

Processor	Required fields	Kinds of fields	Permitted structures			
HIST	Required	Areas to be histogrammed	*END FIELD (FIELD) $END			
GRAYMAP	Required	Areas to be displayed as gray maps	*END FIELD (FIELD) $END			
STAT	Required	Training fields	*END CLASSNAME... SUBCLASS... FIELD (FIELD) (CLASSNAME) (SUBCLASS) (FIELD) (FIELD) $END			
[a]ISOCLS	Required	Training fields	*END CLASSNAME... FIELD (FIELD) (CLASSNAME) (FIELD) $END	[b]*END DO or DU FIELD (FIELD) $END		
SELECT	None					
CLASSIFY	Required	Areas to be classified	*END FIELD (FIELD) $END			
DISPLAY	Optional automatic display of classified fields	[c]Test field or designated fields	[d]*END CLASSNAME... FIELD (FIELD) (CLASSNAME) (FIELD) $END	[e]*END SUBCLASS FIELD (FIELD) (SUBCLASS) (FIELD) $END	*END DESIGNATE UNIDE FIELD (FIELD) DESIGNATE OTHER FIELD (FIELD) $END	
DATA-TR	Required	Area to be transformed	*END FIELD (FIELD) $END			
TRSTAT	None					
NDHIST	Required	Area to be histogrammed	OPTION SUBCLS *END CLASSNAME... SUBCLASS FIELD (FIELD) (SUBCLASS) (FIELD) ... $END	OPTION CLASS *END CLASSNAME... FIELD (FIELD) (CLASSNAME) (FIELD) ... $END	*END FIELD (FIELD) $END	
SCTRPL	None					
DOTDATA	Required	Dots are treated as point fields	*END TYPE 1 CLASSNAME... FIELD (FIELD) CLASSNAME... -(CONTINUED)-	FIELD (FIELD) TYPE 2 CLASSNAME... FIELD (FIELD) -(CONTINUED)-	CLASS-IM FIELD (FIELD) $END	or *END (LACIE FORMATTED DOT CARDS)
LABEL	Optional	Area of the unconditional cluster map if a procedure is selected	*END FIELD (FIELD) $END			

[a]ISOCLS generates clusters, which are subclasses.

[b]Designated other or designated unidentifiable.

[c]Can include one, the other, or neither, but not both.

[d]This type of field deck can be used profitably if statistics are generated by STAT or ISOCLS.

[e]This deck should be used only if statistics were generated by STAT.

QUESTION 1. ARE THE EOD-LARSYS INPUT CARDS IN THE CARD READER, ON DISK, OR DO YOU WISH TO CREATE OR MODIFY THEM (READER, DISK, OR EDIT)

POSSIBLE RESPONSES

A) READER (DEFAULT)

IMPLIES EOD-LARSYS INPUT CARDS ARE IN YOUR CARD READER

B) DISK ␣FILENAME (WILL ASK FOR FILENAME, IF NOT GIVEN)

WHAT IS THE FILENAME OF THE EOD-LARSYS INPUT CARDS
FILENAME

IMPLIES EOD-LARSYS INPUT CARDS ARE IN DISK FILE 'FILENAME CC'

E.G. DISK SEG127

C) EDIT ␣FILENAME (WILL ASK FOR FILENAME, IF NOT GIVEN)

WHAT IS THE FILENAME OF THE EOD-LARSYS INPUT CARDS THAT YOU WISH TO CREATE OR MODIFY
FILENAME
EDIT

EDIT COMMANDS

EDIT
FILE

IMPLIES EOD-LARSYS INPUT CARDS WILL BE EDITED ON DISK, OR WILL BE CREATED ON DISK VIA EDIT.

E.G. EDIT PRO-1

POSSIBLE ERRORS

E00001 FILE 'FILENAME' CC A NOT FOUND

THIS ERROR OCCURS WHEN QUESTION 1 IS ANSWERED BY 'DISK FILENAME' AND THE SPECIFIED FILE DOES NOT EXIST

(IF THIS ERROR OCCURS QUESTION 1 IS REISSUED)

Figure 3-1.— EOD-LARSYS system queries and responses.

QUESTION 2. DO YOU WISH TO RUN INTERACTIVELY AT THE TERMINAL OR HAVE YOUR EOD-LARSYS JOB SENT TO A BATCH MACHINE (INTER OR BATCH)

POSSIBLE RESPONSES

A) INTER (DEFAULT)

IMPLIES YOU WISH TO RUN INTERACTIVELY.

B) BATCH

IMPLIES EOD-LARSYS INPUT CARDS WILL BE SENT TO A BATCH MACHINE FOR PROCESSING.

IF BATCH IS SELECTED, THE FOLLOWING QUESTIONS ARE ASKED.

DO YOU WISH TO SEND YOUR EOD-LARSYS JOB TO A DAYTIME BATCH MACHINE OR TO AN OVERNIGHT BATCH MACHINE (DAY OR NITE)

POSSIBLE RESPONSES

A) DAY (DEFAULT)

JOB WILL BE SENT TO A DAYTIME BATCH MACHINE AND QUEUED. IT WILL BE EXECUTED AS SOON AS IT BECOMES THE FIRST JOB IN THE QUEUE.

B) NITE

JOB WILL BE SENT TO AN OVERNIGHT BATCH MACHINE AND QUEUED. THE JOBS IN THE QUEUE FOR THIS BATCH MACHINE WILL BE RUN EVERY NIGHT.

IF THE DAYTIME BATCH MACHINE IS SELECTED, THE FOLLOWING QUESTION WILL BE ASKED.

DO YOU WISH TO RECEIVE STATUS MESSAGES FROM THE BATCH MACHINE (YES OR NO)

POSSIBLE RESPONSES

A) NO (DEFAULT)

B) YES

IMPLIES YOU WISH THE BATCH MACHINE TO SEND STATUS MESSAGES WHEN IT STARTS PROCESSING YOUR JOB, IS WAITING FOR SYSTEM RESOURCES, AND WHEN IT FINISHES.

Figure 3-1.— Continued.

QUESTION 3

IF THE ANSWER TO QUESTION 2 IS [illegible], A DEDICATED USER TEMPORARY DISK MUST BE OBTAINED. IF NONE ARE AVAILABLE, THE FOLLOWING QUESTION IS ASKED.

E0003A SUFFICIENT SYSTEM RESOURCES ARE NOT CURRENTLY AVAILABLE TO EXECUTE YOUR JOB.

HOW MANY MINUTES CAN YOU WAIT

POSSIBLE RESPONSE

A) nn (DEFAULT IS 20 MINUTES)

E.G. 45

AFTER EACH MINUTE PASSES, AN ATTEMPT IS TO OBTAIN A DISK. IF NO MINUTES PASS AND STILL NONE IS AVAILABLE, THE FOLLOWING MESSAGE IS PRINTED.

E0003B nn MINUTES HAVE PASSED AND SYSTEM RESOURCES ARE STILL NOT AVAILABLE

HOW MANY MINUTES CAN YOU WAIT

QUESTION 4. AT WHICH SITE DO YOU WISH TO RECEIVE THE PRINTER OUTPUT (AND OPTIONALLY PRINT STATUS)

POSSIBLE RESPONSES

A) SITE HOLD/NOHOLD (DEFAULT SITE IS WHERE COMMAND) (DEFAULT PRINT STATUS IS HOLD)

E.G. JSCTEXAS NOHOLD

POSSIBLE ERRORS

E0004A 'SITE' IS NOT A VALID PRINT SITE
(IF THIS ERROR OCCURS QUESTION 3 IS REISSUED)

E0004B 'STATUS' IS NOT A VALID HOLD STATUS
PLEASE ENTER HOLD OR NOHOLD

Figure 3-1.— Continued.

QUESTION 5. WILL YOUR END-LARSYS JOB BE USING A MSS DATA TAPE (YES OR NO)

POSSIBLE RESPONSES

A) YES (DEFAULT)

THE ABOVE QUESTION WILL NOT BE ASKED IF THE USER IS GOING TO RUN BATCH SINCE A TAPE IS REQUIRED FOR BATCH. HOWEVER, THE FOLLOWING LINE WILL BE TYPED FOR EITHER INTERACTIVE OR BATCH MODE.

TYPE IN MSS DATA TAPE NUMBER

POSSIBLE RESPONSE

NNNN

E.G. 1267

B) NO

IMPLIES A MSS DATA TAPE IS NOT NEEDED FOR THIS JOB.

QUESTION 6. DO YOU WISH TO SAVE ANY INTERMEDIATE RESULTS PRODUCED BY END-LARSYS, OR USE ANY PREVIOUSLY SAVE ONES (YES OR NO)

POSSIBLE RESPONSES

A) NO (DEFAULT)

IMPLIES INTERMEDIATE RESULTS WILL BE WRITTEN TO A TEMPORARY DISK AND WILL NOT BE AVAILABLE AFTER THE JOB FINISHES EXECUTION.

B) YES

THE FOLLOWING QUESTION WILL THEN BE ASKED ABOUT EACH OF THE INTERMEDIATE RESULTS.

CLASSIFICATION MAP (NO, SAVE, OR USE)

POSSIBLE RESPONSES

A) NO (DEFAULT)

IMPLIES YOU DO NOT WISH TO SAVE THE CLASSIFICATION MAP OR USE A PREVIOUSLY GENERATED MAP.

B) SAVE ØFILENAME

IMPLIES YOU WANT THE CLASSIFICATION MAP STORED ON YOUR PERMANENT DISK.

C) USE ØFILENAME

IMPLIES YOU WANT A CLASSIFICATION MAP THAT IS STORED ON YOUR PERMANENT DISK TO BE USED.

N-DIMENSIONAL HISTOGRAM (NO, SAVE, OR USE)

TRAINING STATISTICS (NO, SAVE, OR USE)

HISTOGRAM (NO, SAVE, OR USE)

DOT DATA (NO, SAVE, OR USE)

STATISTICS (NO, SAVE, OR USE)

TRANSFORMATION MATRIX (NO, SAVE, OR USE)

Figure 3-1.— Continued.

```
THE FOLLOWING INTERMEDIATE RESULTS MAY BE SAVED ON OR USED FROM
EITHER YOUR PERMANENT DISK OR A TAPE.

          SCATTER PLOT       (NO, SAVE, OR USE)

               POSSIBLE RESPONSES

                    A)  NO                                   (DEFAULT)

                    B)  SAVE  ¤FILENAME

                        IMPLIES THE SCATTER PLOT WILL BE SAVED ON
                        YOUR PERMANENT DISK.

                    C)  SAVE  ¤NNNN

                        IMPLIES THE SCATTER PLOT WILL BE SAVED ON
                        TAPE NNNN FILE MM, WHERE THE DEFAULT
                        FILE NUMBER IS 1.

                    D)  USE  ¤FILENAME

                        IMPLIES THE PREVIOUSLY SAVED SCATTER PLOT
                        IS ON YOUR PERMANENT DISK.

                    E)  USE  ¤NNNN

                        IMPLIES THE PREVIOUSLY SAVED SCATTER PLOT
                        IS ON TAPE NNNN FILE MM, WHERE THE DEFAULT
                        FILE NUMBER IS 1.

          TRANSFORMED MSS DATA       (NO, SAVE, OR USE)

          CLUSTER MAP       (NO, SAVE, OR USE)


IF THE USER IS GOING TO RUN HIS JOB BATCH, THE FOLLOWING MESSAGE
IS PRINTED AND ONLY THE FOLLOWING QUESTIONS
WILL BE ASKED SINCE INTERMEDIATE RESULTS MAY ONLY BE SAVED
OR USED FROM TAPE.

THE FOLLOWING INTERMEDIATE RESULTS MAY BE USED FROM AND/OR
SAVED ON TAPE.

          SCATTER PLOT       (NO, SAVE, OR USE)

          TRANSFORMED MSS DATA       (NO, SAVE, OR USE)

          CLUSTER MAP       (NO, SAVE, OR USE)

THE ONLY VALID RESPONSES FOR BATCH PROCESSING ARE   A), C), AND E)
LISTED UNDER 'SCATTER PLOT  ' ABOVE.

POSSIBLE ERRORS

    E0006A TYPE IS NOT PERMITTED FOR THIS DATA SET.


POSSIBLE ERRORS FOR USE ¤FILENAME

    E0006B  'FILENAME' DOES NOT EXIST ON YOUR A-DISK.

POSSIBLE ERRORS FOR SAVE ¤FILENAME

    E0006C  SAVE IS NOT A VALID OPTION SINCE YOU DO NOT HAVE
            AN A-DISK THAT CAN BE WRITTEN ON.

    E0006D  THERE IS NOT ENOUGH SPACE ON YOUR A-DISK TO SAVE
            'FILENAME'.  TYPE A SERIES OF CMS COMMANDS TO MAKE
            ROOM.  TYPE READY WHEN DONE OR TYPE SKIP IF YOU DO NOT
            WANT TO MAKE ROOM.

            SINCE FILES ARE NOT SAVED UNTIL AFTER THE END-LARSYS
            JOB IS COMPLETED, ERROR E0006D WILL NOT APPEAR UNTIL THEN.
```

Figure 3-1.– Continued

QUESTION 7. DO YOU WANT TO RUN ANOTHER JOB (YES OR NO)

POSSIBLE RESPONSES

A) YES (DEFAULT)

THEN QUESTION 1 IS ASKED AGAIN AND SO ON.

B) NO

AN EXIT TO CMS IS TAKEN

QUESTION 8. IF A BATCH JOB IS TO BE RUN AND THE USER SPECIFIED 'READER' FOR QUESTION 1, THE FOLLOWING ERROR MAY OCCUR.

E0008A THERE WERE NO CARDS IN YOUR CARD READER.
READ THEM IN AND THEN TYPE 'READY'

(DEFAULT RESPONSE HERE IS READY)

AFTER THE JOB HAS BEEN SENT TO THE BATCH MACHINE, THE FOLLOWING MESSAGE IS TYPED.

YOUR JOB HAS BEEN SENT TO THE _____ BATCH MACHINE

THEN, QUESTION 7 IS ASKED OF THE USER, AND SO ON.

Figure 3-1.— Concluded.

4. FILES

The Fortran files used to pass information between processors, along with the corresponding EOD-LARSYS files, are listed in Table 4-1; Table 4-2 provides an overview of EOD-LARSYS files. Details on each file are given in the User's Reference Manual (Volume II of this set of documentation).

File descriptions are accomplished by providing FILEDEF's prior to executing EOD-LARSYS. A standard set of these is given in the prompter provided for most applications. Thus, the user may not have to be concerned with these. However, in the event of input/output errors, some FILEDEF's may have to be changed to accommodate the run.

TABLE 4-1.- FILE ASSIGNMENTS

Fortran file (unit) number	EOD-LARSYS file
2	MAPTAP (classification map)
4	NHSTUN (N-dimensional histograms)
9	SAVTAP (output from TRSTAT)
11	DATAPE (MSS data tape)
12	SCTRUN (scatter plots)
13	HISFIL (histogram file)
14	TRFORM (transformed MSS data)
16	MAPUNT (mixed, conditional cluster map or ISOCLS cluster map)
19	DOTUNT (dot data)
20	SAVTAP (statistics file)
21	21 (control card images)
22	RANDIO (direct access file for pixel storage)
10	BMFILE (transformation matrix if on separate file)
6	6 (printer results)

Note: Unit 16 is fixed at this time.

TABLE 4-2.— OVERVIEW OF EOD-LARSYS FILES

[Processors not using MSS data tape are SELECT, LABEL, TRSTAT, AND SCTRPL]

Processor	Possible inputs	OUTPUT
DOTDATA	Field cards (dots)	DOTUNT
ISOCLS	BMFILE SAVTAP DOTUNT Field cards	SAVTAP MAPFIL
LABEL	SAVTAP DOTUNT MAPFIL — all-of-a-kind field cards option	MAPFIL (mixed, conditional cluster) MAPTAP SAVTAP DOTUNT
CLASSIFY	BMFILE SAVTAP Field cards	MAPTAP
DISPLAY	DOTUNT MAPTAP Field card images — DO/DU* or test fields	MAPFIL
SELECT	BMFILE SAVTAP	BMFILE Best channels through common block INFORM
STAT	Field cards	SAVTAP
DATATR	BMFILE Field cards	TRFORM
TRSTAT	SAVTAP AMFIL	SAVTAP
NDHIST	MAPFIL Field cards	NDHUNT (histogrammed by class, subclass, or field)

*Designated other (DO) or designated unidentifiable (DU).

TABLE 4-2.– Concluded

Processor	Possible inputs	OUTPUT
SCTRPL	SAVTAP NDHUNT BMFILE	PLOTAP
HIST	Field cards	HISFIL
GRAYMAP	HISFIL Field cards	

5. OUTPUT

Several processors can produce tapes for later use. Some are used in later returns to EOD-LARSYS, and others are designed for use on other computer systems.

A map tape (MAPUNT, unit 16) contains the subclass or cluster number for each pixel or some other information derived from classification or clustering. Map tapes are designed for display. They may contain several files, each of which contains a cluster or class map. Tapes can be generated in JSC Universal image format or LARSYS-III format.

The class map produced by the DISPLAY or LABEL processor always contains subclass numbers, but the cluster map produced by the ISOCLS processor can be either a single-channel or a multi-channel map. The default information is the mean vector, but it may also contain the number of the cluster. In this mode, the clusters can be displayed in much the same manner as ordinary images.

Scatter plots (SCTRUN, unit 12) can be produced on JSC Universal image format tapes, for display on other systems. There may be several scatter plots, each on a separate file.

Image tapes can be transformed in several ways by the DATA-TR processor. The transformed data tapes (TRFORM, unit 14) or essentially new image tapes can be used. They can be produced in JSC Universal image format or in LARSYS-III format.

The N-Dimensional Histogram (NDHIST) processor always produces a file for use by the Scatter Plot (SCTRPL) processor (NHSTUN, unit 4). Although the file can be saved for later use, the user normally has no other need for it.

6. HISTOGRAM PROCESSOR — HIST

6.1 DESCRIPTION

In beginning analysis of an image, an analyst often makes histograms. These show the range and the distribution of the data and their means and then sometimes allow the analyst to identify defective data. An entire image or only certain defined portions, such as test fields, may be examined.

6.2 INPUT/OUTPUT

The processor requires an image tape and a small file of control card images. Figures 6-1 and 6-2 show sample job setups. Control cards are defined in Table 6-1. Processor diagnostics are given in Table 6-2. A full discussion of control cards and of processor diagnostics is given in section 6 of Volume 2.

In addition to line printer displays of histograms, this processor writes histogram results to the HIS"IL file. If this file is to be used later in the same batch run (for the execution of GRAYMAP), logical unit 13 should be assigned.

TABLE 6-1.— CONTROL CARDS FOR HIST

Required cards

Keyword	Parameter and default values	Function
$HIST	None	Calls HIST Processor.
CHANNELS	$C_1,C_2,C_3\ldots,C_k$ $k \leq 30$ Default: None	Channels to be histogrammed, $C_1,C_2,C_3\ldots,C_k$, should be integer numbers separated by commas.
*END	Blank	Signals the end of the control cards.
FIELDS III		Gives field coordinates.
$END	Blank	Signals the end of all card input for the processing function.

Optional cards

Keyword	Parameter and default values	Function
SIZE	XHIGH=K 0<K<225 Default: XHIGH=255	K is an integer which sets the maximum radiance value which will be histogrammed. XHIGH becomes X_{max} on the X-axis of the histogram plot.[a]
SIZE	XLOW=J 0<J<XHIGH Default: XLOW=0	J is an integer which sets the minimum radiance value which will be histogrammed. XLOW becomes X_{min} on the X-axis of the histogram plot.[a]

[a]The difference between XHIGH and XLOW must be at least 100.

TABLE 6-1.– Concluded

Keyword	Parameter and default values	Function
SIZE	YSIZ=L $0<L<f(x)_{max}$ Default: YSIZ=15	L is an integer which sets the height of the Y-axis (number of print lines). Using the input YSIZ, the Y-axis scale for the histogram plot will be determined by the processor to be: $f(x)_{max}+(YSIZ-1)/YSIZ$.
DISPLAY	$C_1,C_2,C_3...,C_k$ $K\leq 30$ Default: No plots	Channels for which histograms will be plotted. $C_1,C_2,C_3,...,C_k$ must be a subset of the CHANNELS card.
DATAFILE	UNIT=N,FILE=M Default: N=11,M=1	N is the Fortran logical unit number to which the MSS data tape (DATAPE) has been assigned; M is the file number for the tape to be processed. For back-to-back executions of more than one processor, if using the same file number, only one DATAFILE control card need be submitted.

Ancillary cards

HED1, HED2, DATE, COMMENT (see Table 3-1)

TABLE 6-2.– DIAGNOSTICS FROM HIST

Message	Explanation
ONLY THE FIRST 50 FIELD DESCRIPTIONS WERE PRINTED, BUT ALL THE FIELDS WERE INCLUDED IN THE TOTAL HISTOGRAMMED STATS.	The user has input more than 50 fields, and only the first 50 field descriptions will be Printed in the "Data Blocks Histogrammed" portion of the total report; however, all the input fields were included in the calculations of the "Total Histogrammed Statistics."
CHANNEL ____IS NOT A SUBSET OF THE CHANNELS GIVEN ON CHANNELS CARD.	A channel on the DISPLAY card is not a member of the set of channels on the CHANNELS card.
TOO MANY CHANNELS ARE BEING HISTOGRAMMED AND PLOTTED, NO. OF CHANNELS PLOTTED WAS RESET TO _____.	User requested too many histograms to be plotted. The number of histograms plotted varies according to the number of channels histogrammed.
TOO MUCH DATA REQUESTED -- SAMPLE END WAS RESET TO _____.	The data for all channels for one scan line are unpacked into an array dimensioned 12 000. If the number of channels times [(sample end - sample begin)/ sample increment] exceeds 12 000, this diagnostic is printed. Sample end is reset to fit the dimensions and execution continues.

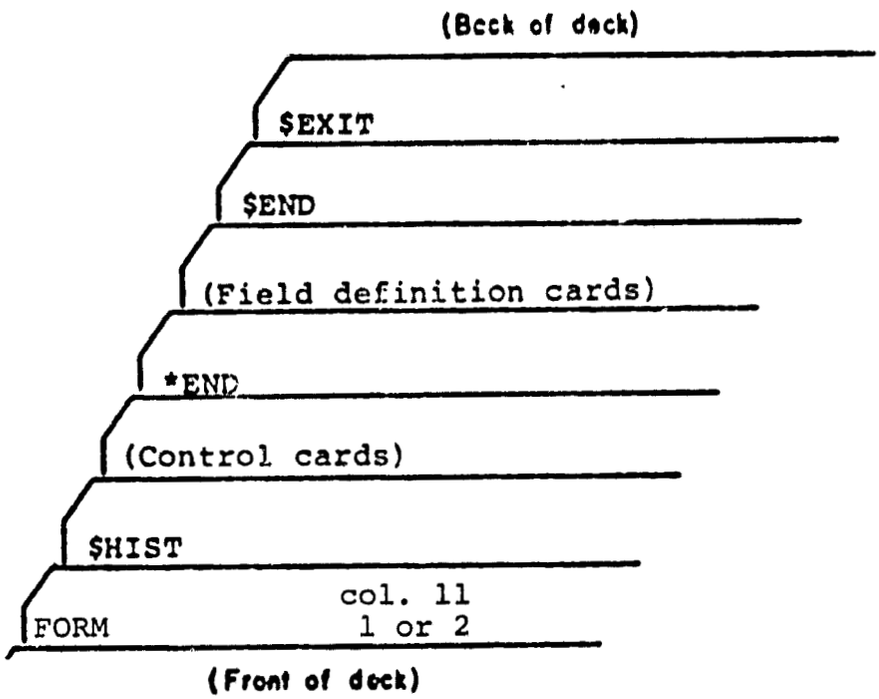


Figure 6-1.— Deck setup for the HIST processor for independent execution. In edit-type execution, a card image file is used.

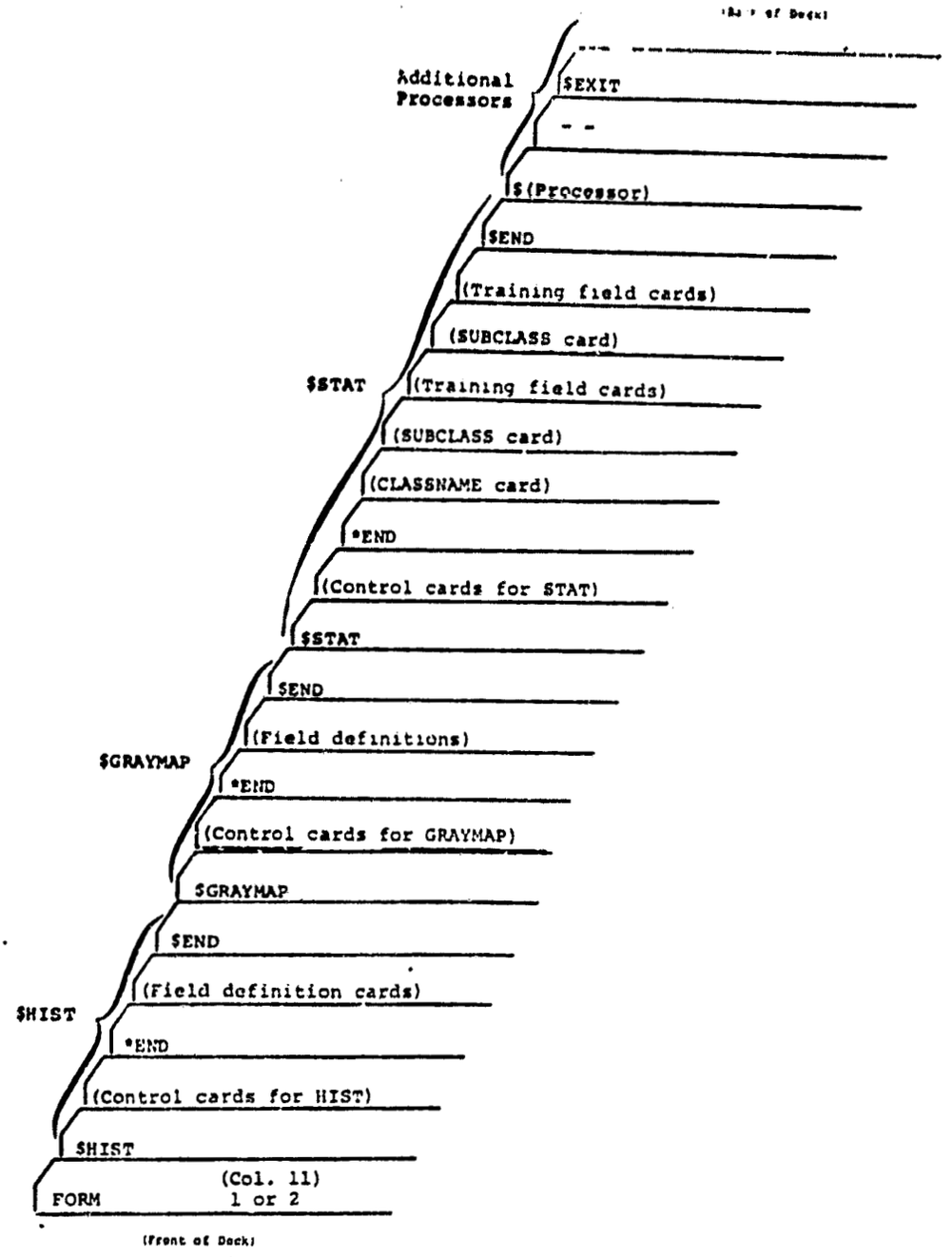


Figure 6-2.— Deck setup for execution of HIST with GRAYMAP and STAT.

7. GRAYMAP PROCESSOR - GRAYMAP

This processor produces symbol-density maps of individual channels of MSS images. Using the printer, it produces maps in which each pixel is represented by one of 16 possible symbols.

The 16 bins (the ranges represented by the symbols) may be assigned arbitrarily, or they may be computed from histograms. If the HIST processor was called before this processor in the same run, the histograms will be computed automatically with arbitrary assumptions. Otherwise, the program will derive the histogram from selected data within the image.

7.1 INPUT/OUTPUT

An MSS data tape must be furnished. In addition, the GRAYMAP processor requires the bin levels to be input on a control card image (see Figures 7-1 and 7-2 for sample job setups) or computed from the histograms output by the HIST processor on the HISFIL file. If the HIST processor has not been executed prior to running GRAYMAP, and bin levels have not been input, a default histogram of every 10th line for 500 lines and every 10th sample for 200 samples is computed, and HISFIL is created on logical unit 13. Note that this is not adequate for images having fewer than 500 lines and 200 samples, such as LACIE segments. In these cases, HIST must be run or arbitrary bin levels furnished. Control cards are listed in Table 7-1. Processor diagnostics are given in Table 7-2.

Output from this processor is limited to character representation of the image. A full discussion of control cards and of processor diagnostics is given in section 7 of Volume II.

TABLE 7-1.– CONTROL CARDS FOR GRAYMAP

Required cards

Keyword	Parameter and default values	Function
$GRAYMAP		Calls processor.
CHANNELS	$C_1,C_2,C_3,\ldots C_k$; $k \leq 30$ Default: Graymap for all channels on HISFIL only if created by a previous execution of HIST.	Provides pictorial printout for requested channels.
*END		
Fields...		
$END		

Optional cards

BINLEVEL	$N_1,N_2,N_3,\ldots,N_k$; $k \leq 16$ Default: Histograms used to set bin levels.	Upper bin edges for gray-scale levels with a range of 0 to 255 and a maximum of 16 levels; the last bin level should always be 225.
SYMBOLS	$S_1,S_2,S_3,\ldots,S_k$; $k \leq 16$ Default: Two sets overprinted, resulting in one of , ,0,O,*,=,.,-,/,b	Character set separated by commas, with a maximum of 16 symbols per SYMBOL card. If two sets are input, the second overprints the first. The number of symbols input on one card determines the number of bin levels when using the histograms to set the levels. Blank is a legitimate character.

TABLE 7-1.– Concluded

Keyword	Parameter and default values	Function
DATAFILE	UNIT=N,FILE=M Default: N=11,M=1	N is the FORTRAN logical unit number to which the image data tape has been assigned; M is the file number on the tape to process.

Ancillary Cards

HED1, HED2, DATE, COMMENT (see Table 3-1)

TABLE 7-2.— DIAGNOSTICS FROM GRAYMAP

Message	
BAD SUPERVISOR CONTROL CARD. ONLY 16 BINLEVELS PERMITTED.	Check spelling of keyword. Reduce the number of bin levels to 16.
THIS CHANNEL IS NOT HISTOGRAMMED.	Check CHANNELS control card and make sure all channels requested have been histogrammed.
THIS CHANNEL IS OUT OF NUMERICAL RANGE AND WAS IGNORED.	All channels requested must be in the range 1 to 30.
YOU HAVE ASKED FOR TOO MANY SAMPLES. THE LAST SAMPLE IS_____.	The last sample is reset to the last sample on the data tape.

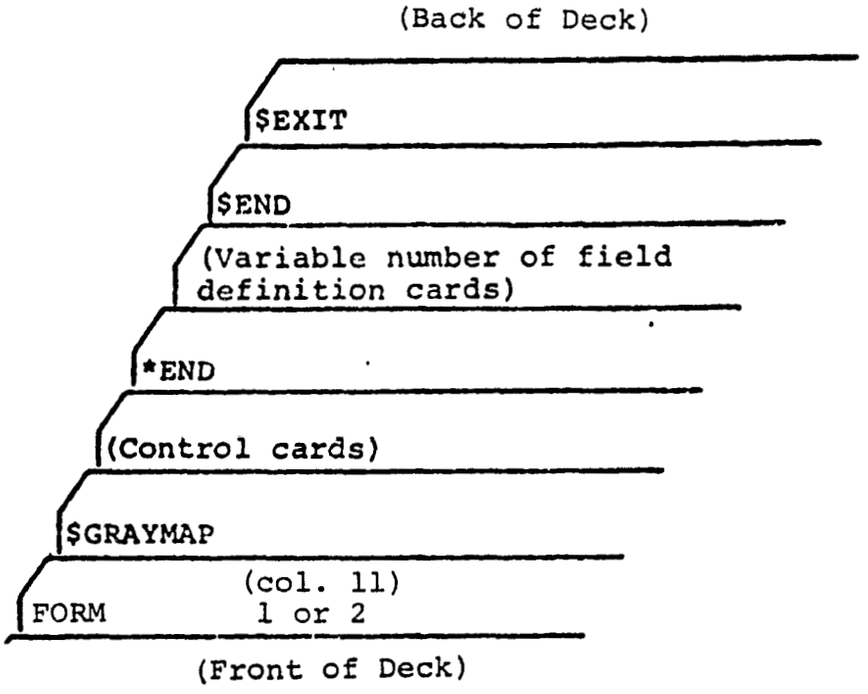


Figure 7-1. - Deck setup for the GRAYMAP processor for independent execution. In remote operation, a card image file is used.

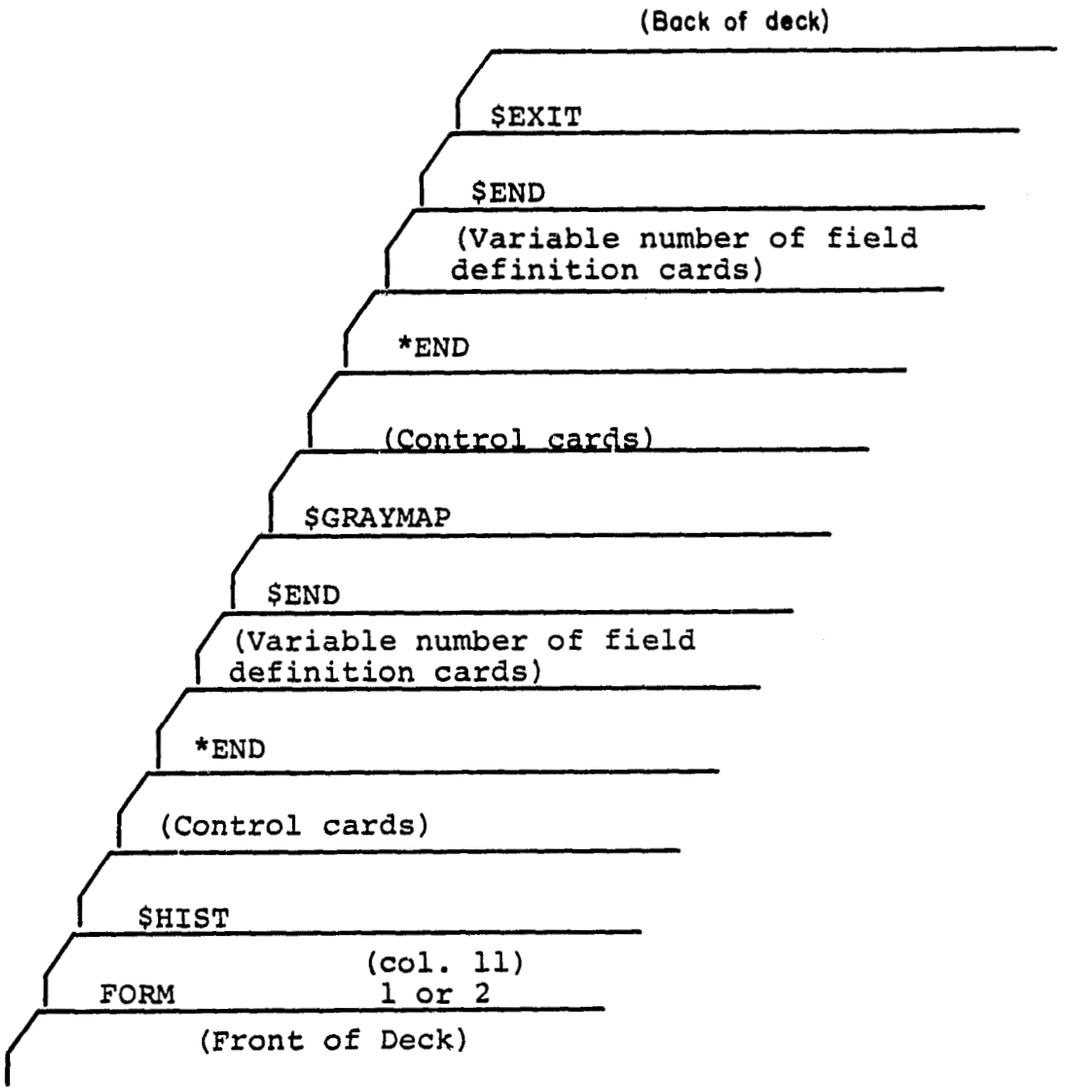


Figure 7-2. - Deck setup for GRAYMAP for execution back to back with HIST.

8. STATISTICS PROCESSOR - STAT

8.1 DESCRIPTION

The statistics processor, STAT, computes the multichannel means, standard deviations, covariance matrix, and correlation coefficient for each training field and all training subclasses. In addition, histograms and spectral plots may be computed for each field and or subclass.

8.2 INPUT/OUTPUT

The STAT processor requires user input of a card image file and an MSS data tape (DATAPE). Card image file input is shown in Table 8-1 and Figures 8-1 and 8-2, and training field definitions are described in Section 3.2.

In addition to the optional printouts, the STAT processor creates an output file on the SAVTAP unit, which contains the computed statistics (mean vector and covariance matrix) for each training subclass. The training subclass statistics can be output on punched cards (the module STAT deck). However, output would normally be as a disk file. Both the output statistics file SAVTAP and the output module STAT file are in a format acceptable to the statistics input requirements of other processors in the EOD-LARSYS system.

The module STAT file contains the training field vertices, the subclass names for each training subclass, the subclass numbers assigned to each subclass and class, and the computed statistics for each training subclass. The module STAT file is output by the processor only on demand.

A training class is defined to the processor by a card image containing the keyword CLASSNAME in columns 1 through 9. The user-determined alphanumeric name to be assigned to the class begins in column 11 and may contain a maximum of six characters (through column 16). At least one CLASSNAME card must be input.

A CLASSNAME card must be followed by at least one subclass grouping. A subclass grouping is on a SUBCLASS card followed immediately by one or more field definition cards. All fields defined by field definition cards following the SUBCLASS card will contribute a cumulative sample set from which the training subclass statistics will be computed for the named subclass. The set of cards - one SUBCLASS card followed by one or more field definition cards - generates the statistics for one training subclass. The number of training fields to be defined for one given subclass is not restricted. The example in figure 8-1 shows the grouping of subclasses into classes.

A full discussion of control cards, and of processor diagnostics, is given in section 8 of Volume 2.

TABLE 8-1.— CONTROL CARDS FOR STAT

Required cards

Keyword	Parameter and default values	Function
$STAT		Call processor.
CHANNELS	$N_1,N_2,N_3,\ldots,N_k$ 1 K 30 Default: K=30; unless the MSS data tape (DATAPE) has exactly 30 channels, the default should not be taken.	N's are the integer channel numbers used by the processor in computing training subclass and training field statistics; must be from the set of channels available on the MSS DATATAPE file.
*END	Blank	Signals the end of the control cards.
FIELDS ...		
$END	Blank	Signals the end of all card input for this processor.

Optional cards

Keyword	Parameter and default values	Function
DATAFILE	UNIT=N,FILE=M Default: N=11,M=1	N is the Fortran logical unit number to which the MSS data tape (DATAPE) has been assigned; M is the file number on the tape to be processed. For back-to back executions of several processors if the same file number is used, only one DATAFILE control card need image need be input.
HISTO	$N_1,N_2,N_3,\ldots N_k$ $1 \leq k \leq 30$ Default: k=30	N's are integers which provide a list of channel numbers for use in the histogram options. The channel numbers must be from the set designated on the CHANNELS control card. Note: This control card does not initiate the histogram option.
OPTION	HIST Default: No histograms	A histogram showing frequency distribution of pixels (resolution elements or radiance values) is printed out for every training field and every training subclass defined in the input training field definition deck. For each subclass (or field), a histogram is provided for every channel designated on the HISTO control card.
OPTION	HIST=C Default: No histograms	A histogram printout is provided for every training subclass defined in the input training field definition card. For each subclass, a histogram is provided for channel designated on the HISTO control card.
OPTION	HIST=F Default: No histograms	A histogram printout is provided for every training field defined in the input training field definition deck.
OPTION	COVAR Default: Statistics are not printed.	The multichannel means, standard deviations, and covariance matrix (lower triangular portion) are printed out for each training subclass and training field definition deck.
OPTION	COVAR=C Default: Statistics	The multichannel means, standard deviations, and covariance matrix (lower triangular portion) are printed out for each training subclass defined in the input training field definition deck.
OPTION	COVAR=F Default: Statistics are not printed.	The multichannel means, standard deviations, and covariance matrix (lower triangular portion) are printed out for each training field defined in the input training field definition deck.
OPTION	MAXSUB=N Default: MAXSUB=15	Informs the processor as to the maximum number of subclasses which will be input. The parameter value is used for dimensioning purposes and reflects the maximum number of available computer storage locations being utilized for other options allowed by the STAT processor. This parameter must be set by the user if the number of subclasses he is about to define will exceed the default. It is advisable to use this option when a large number of training fields are to be processed or when histograms have been requested.

TABLE 8-1.– Concluded

Keyword	Parameter and default values	
OPTION	NOCOVAR	No training subclass or training field statistics are printed out.
OPTION	PUNCH Default: The module STAT file is not punched, in which case statistics are output on the SAVTAP file only.	The subclass mean vector and covariance matrix for every subclass defined by user input will be punched on cards in a format acceptable as input to other processors in the system. This punched card deck is the module STAT deck defined in Section 3.1.4.1.
OPTION	SPECTRAL Default: Spectral plots for subclasses	A spectral plot is printed out for every training subclass and training field defined in the input training field definition deck. The plot consists of the subclass (or field) mean radiance value, mean standard deviation (*), and mean +3* plotted versus the channel (spectral band) for every channel designated on the CHANNELS control card.
OPTION	SPECTRAL=C Default: Spectral plots for subclasses	A spectral plot will be printed out for every subclass defined in the input training field definition deck.
SIZE	SPECBAS=I $0 \leq I \leq 105$ Default: SPECBAS=75	I is an integer which sets the minimum radiance value on the Y-axis of the spectral plot (i.e., Y_{min}). The processor has a fixed Y-axis increment (3) and a fixed number of Y-axis values (50). Using SPECBAS, the processor determines the Y-axis range to be: Y_{min}=SPECBAS, Y_{max}=SPECBAS+150.
SIZE	XHIGH=K $0 < K < 255$ Default: XHIGH=220	K is an integer which sets the maximum radiance value which will be histogrammed. XHIGH becomes X_{max} of the X-axis of the histogram plot.
SIZE	XLOW=L $0 \leq L \leq$ XHIGH	L is an integer which sets the minimum radiance value which will be histogrammed. XLOW becomes X_{min} of the X-axis of the histogram plot.
SIZE	YSIZ=J $0 < J \leq f(x)_{max}$ Default: YSIZ=14	J is an integer which sets the number of increments on the Y-axis of the histogram plot; therefore, it is the height (number of print lines) of the Y-axis. Using the input YSIZ, the processor will determine the Y-axis scale for the histogram plot to be $f(x)_{max}$ +(YSIZ-1)/YSIZ.
SIZE	XSIZ=K Default: XHIGH=XLOW	Sets the range which will be histogrammed; maximum range is 101.
SPECTRAL	M_1, M_2, M_3, M_4 $1 \leq M_i \leq 30$ Default: 4 subclasses per spectral plot; subclasses 1, 2, 3, and 4 on the first plot; 5, 6, 7, and 8 on the second plot; etc.	M's are integers which provide a list of from one to four subclass numbers for the subclasses which are to be plotted on one single composite spectral plot. The subclass numbers must be obtained from the set of subclasses defined in the deck, and subsequent subclass numbers are obtained by sequentially numbering the subclasses as they occur in the training field definition deck.
STATFILE	UNIT=N,FILE=M Default: N=20,M=1	N is the logical Fortran unit number to which the SAVTAP file has been assigned; M is the file number on the tape to be processed.

Ancillary cards

HED1, HED2, DATE, COMMENT (see Table 3-1)

TABLE 8-2.– DIAGNOSTICS FROM STAT

Message	Explanation
//,// FROM SUBR. SETUP1 --- BAD CONTROL CARD ENCOUNTERED --- INPUT CARD IS _____, 'CCCC ...CCC'	The input card image which was read has none of the legitimate keywords to identify it as a recognizable control card. The card which caused the image is printed out a part of the message. Although the processor will continue to read more control cards, this is an indication of an error in the deck setup. The file should be checked for proper sequence of cards.
CHECK CHANNELS OR CLASS NOS. REQUESTED -- CANNOT BE LESS THAN 30 ***** TERMINATING PROGRAM EXECUTION FROM SUBR. SETUP1 *****	If the channel numbers specified on a HISTO or CHANNELS control card image are not integers within the range 1 through 30, this message results. The processor terminates execution after printing this message. Check the format of the applicable processor control cards (see section 3.1.2 and table 8-1).
///// FROM SUB. SETUP1 --- DECREASE OPTIONS ***** TERMINATING PROGRAM EXECUTION FROM SUBR. SETUP1 *****	The STAT processor has run out of internal storage to handle the combination of the quantities of input training fields, subclasses, and channels. Internal storage is fixed at 10 600 locations. Each subclass requires roughly 1/2 (number of channels)^2 locations for the subclass statistics. If histograms or spectral plots of subclasses and/or fields are requested, additional internal storage is required. The options specified in the run deck (i.e., histograms and spectral plots) and possibly the quantities of subclasses, channels, and training fields must be decreased or eliminated in order to get a successful run within the core storage limitation.
*** STAT/SETUP1 -- ERROR IN OPTION(S) REQUESTED - SCAN OF OPTION(S) DISCONTINUED AT CARD COLUMN XX ***	An OPTION control card image is not acceptable to the processor. The scan of the options will be discontinued by the processor, and any options specified beyond the erroneous one will not be activated for the run. The processor continues with reading of the next control card. (See section 3.1.2 and table 8-1 for correct OPTION control card usage.)
*** MAXSUB=XX --- MAX. NO OF SUBCLASSES CANNOT BE GREATER THAN YY MAXSUB SET=YY PROCEEDING TO NEXT OPTION(S) ***	The maximum subclass number input on the OPTION MAXSUB control card exceeds the maximum number of subclasses that can be handled by the EOD-LARSYS. The processor will set the maximum number of subclasses, which will apply to subclasses read in from the input subclass/field definition deck.
***** STAT/LEARNN - - MAX. OF XX SUBCLASSES EXCEEDED -- FIRST XX SUBCLASSES USED -- REMAINDER IGNORED	The processor has read the maximum allowable number of subclass names and training fields to be associated with each subclass, and the next subclass name encountered in the training field/subclass definition deck caused this diagnostic message. The first MAXSUB subclasses and associated training fields input are computed and the remainder are ignored by the processor.
***** STAT/LEARNN -- MAX. OF XX FIELDS EXCEEDED --- XX FIELDS RETAINED FOR YY SUBCLASSES ***** REMAINDER OF INPUT TRAINING FIELDS NOT USED	The STAT processor has read the maximum number of subclass names and associated training fields from the input training field/subclass definition deck. The available internal storage has been filled, and no further training fields can be accepted. Training statistics will be computed for the subclasses and fields which have been read to this point, and the remainder are ignored by the processor.

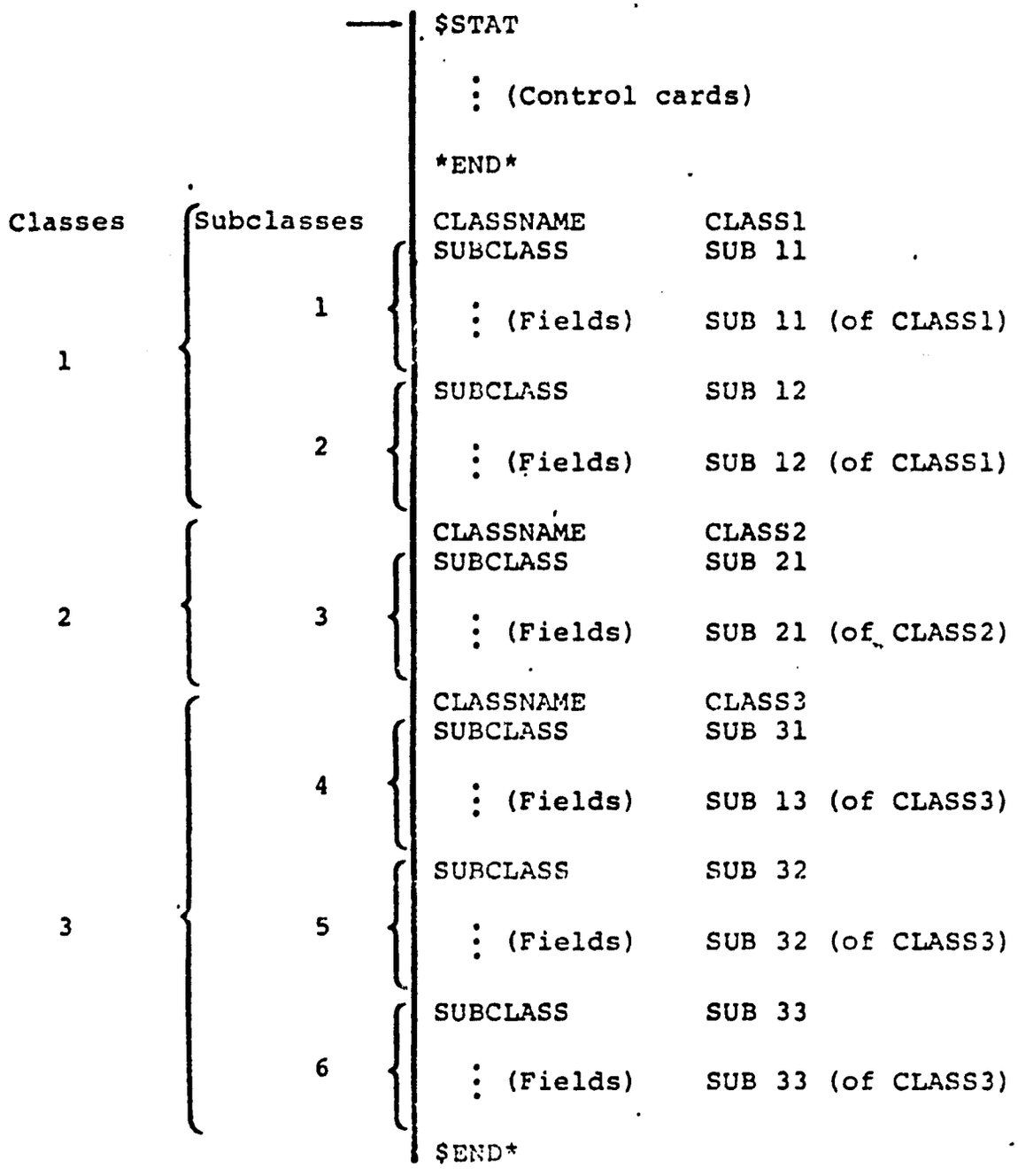


Figure 8-1.— Classes, subclasses, and fields.
Actual names must not exceed four characters.

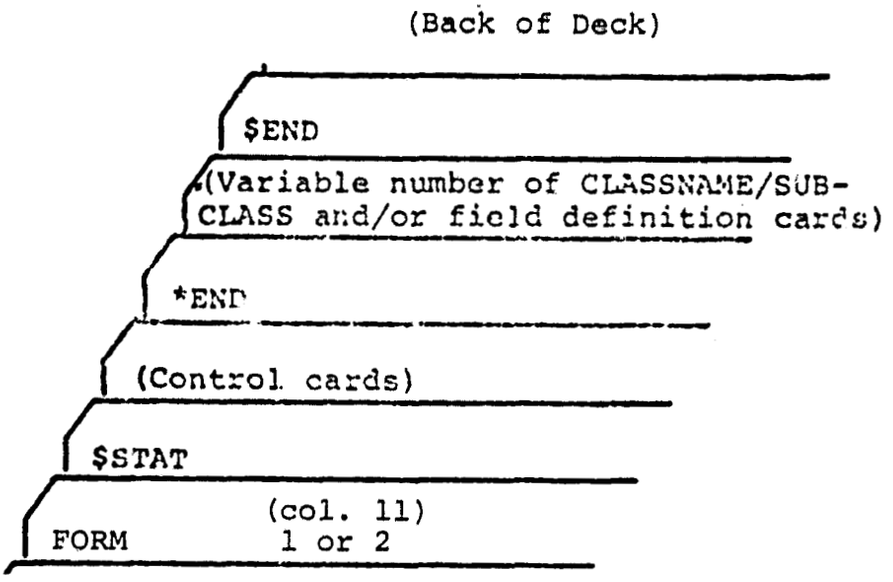


Figure 8-2.– Deck setup for the STAT processor. In edit-type operation, a card image file is used.

9. ITERATIVE SELF-ORGANIZING CLUSTERING SYSTEM

PROCESSOR - ISOCLS

9.1 INTRODUCTION

This clustering processor is one of the most versatile features of EOD-LARSYS. It allows an analyst to search for the natural spectral features of a scene without the use of training fields or ground truth. It permits him to examine the homogeneity of training fields. And in the general case, it allows him to extend the capability of his eye-brain system, which functions in three channels or dimensions (our three primary colors), to thirty channels.

The use of ISOCLS can be relatively simple and straightforward, but its proper use will require very careful attention to a large number of details.

An analyst may cluster "classes" of data from an MSS data tape, and each class may consist of one or more fields. He can define and cluster as many classes as he wishes with a single call to the ISOCLS processor. The actual card images defining classes and fields are shown:

	*END
WHT1 clustered as one data set.	CLASSNAME WHT1
	FLD1
	FLD2
	FLD3
	CLASSNAME WHT2
	FLD4
Enter SETUP routine again for new parameter values.	FLD5
	$END

(New parameter values)

```
                    *END*
                    CLASSNAME           NWH1
                    FLD6
                    FLD7
                    FLD8
                    CLASSNAME           NWH2
                    FLD9
                    CLASSNAME           NWH3
                    FLD10
Now write statistics $END*
file.
```

For conciseness, control card images will be referred to as cards in the discussion that follows. A CLASSNAME card, followed by at least one field definition card, must immediately follow the *END control cards. The formats for these cards are defined in Section 3.1, Volume II. Diagnostics from ISOCLS are given in Table 9-2. A full discussion of control cards, and of processor diagnostics, is given in Section 9 of Volume 2.

The data from all fields for one class are clustered as one data set. The statistics for all clusters in that class are saved on a scratch file, and the next class is clustered. When all classes have been clustered, the statistics are written on the SAVTAP file. (See Figure 9-1 for job setup.) Parameters may be changed after every class as shown below.

9.2 NUMBER OF CLUSTERS

An analyst has control over the maximum number of clusters allowed per class via the CLUSTERS control card. However, the procedure may find fewer clusters than the maximum allowed. If he plans to use the statistics generated from the clusters in later CLASSIFY or SELECT runs, he must control the maximum number of clusters; the SAVTAP file may contain statistics for up to 75 clusters (or subclasses), but only 60 can be used for processing at any time in CLASSIFY or SELECT.

9.3 SPLITTING, COMBINING, AND CHAINING

The clustering procedure used in ISOCLS is an iterative procedure. It assigns each data sample to a specific cluster by determining the nearest cluster center and assigning the sample to it. At the end of each iteration (i.e., when all samples have been assigned to a cluster), new cluster centers are defined by computing the mean vector for the data samples actually assigned to the cluster.

The iterative procedure terminates when the user-specified sequence of splits and combinations is exhausted (see the

DEQUEN control card). The criteria for splitting or combining a cluster are specified by the STDMAX and DLMIN control cards.

After the final iteration, the covariance matrix for each cluster is computed and, at the user's option, is printed. All cluster statistics for the class are saved on a scratch file until all classes have been clustered, at which time the SAVTAP file is written.

The chaining of clusters for the final map printout is performed if the user has requested the option (see CHAIN control card, Table 9-1). Statistics for the chained clusters are not computed.

9.4 SOME OPTIONS

The processor allows an analyst to control the amount of line-printer output he receives via the KRN and MAP control cards. A final map of the clustered data is always output along with a statistical summary of the clusters, which includes mean and standard deviation vectors, total points assigned to each cluster, and intercluster distances.

Optionally he may (1) input initial cluster centers to hasten the clustering process or (2) allow the program to initialize the process by assigning all the data to one cluster, obtaining the mean and standard deviation, and then splitting. Initial means may be input (1) by cards (see control card MEANS and Cluster Means Deck, section 3.1.4.3, Volume 2) or (2) by the SAVTAP file (see control card STATFILE) or, in Procedure 1, from dots. Input of the initial means causes a scratch file to be written so that the means can be used repeatedly. Successive classes may or may not use the same means to initialize cluster centers for a new class.

The control card MEANS allows the user to request cluster centers from the last class to be read from the scratch file and used as initial centers for a new class. Input of a new set of initial means will cause the scratch file to be overwritten with new cluster centers.

9.5 PROCEDURE 1 AND ISOCLS

Starting dots (pixels) from the dot data file DOTUNT may be used to begin clustering. This is usually done in a Procedure 1 application.

By entering sun angle, using correction table, the pixel radiance values may be modified to 60° above horizon. (The correction table has been built into the programs.) The radiance value correction applies only for clustering purposes. The user may input the sun angles by cards or request that these angles be extracted from the header record of a JSC Universal formatted MSS data tape (ERIPS unload tape).

Nearest-neighbor clustering can be achieved by an ISTOP 0 control card. Clusters are assigned to input means without iteration. This is standard in Procedure 1 applications.

DO and DU Fields are those fields the analyst may identify "designated other" and "designated unidentifiable" pixel sets (fields) by field card input. The pixels in these fields are not included as inputs to the clustering algorithm. They are assigned special cluster numbers and mean vectors for display purposes.

The DO/DU field cards for all classes must be input before the fields to be clustered. These fields must immediately follow the *END card. The CLASSNAME card follows the last DO/DU field card.

Example:

If DO/DU fields are being defined

```
*END
DESIGNATED          OTHER
OTHER               (1,1), (1,1), (40,1), (40,20), (1,2
DESIGNATED          UNIDENTIFIABLE
UNIDEN              (1,1), (5,7), (8,10), (5,10)
CLASSNAME           WHT
WHT1                (1,1), (1,1), (196,1), (196,117), (1,117)
$END
```

9.6 SAMPLE RUN

Section 20 illustrates an application of EOD-LARSYS which includes the use of the ISOCLS processor.

TABLE 9-1.– CONTROL CARDS FOR ISOCLS

Keyword	Parameter and default values	Function
		Required cards
$ISOCLS		Calls processor
CHANNELS	DATA=$C_1,C_2,C_3,\ldots,C_K$, STAT=$A_1,A_2,\ldots,A_k$ k≤ number of channels on SAVTAP ≤ 30 Default: None	C's are integer channel numbers that (1) will be used in clustering and (2) refer to the MSS data tape (DATAPE). A's are integer channel numbers that (1) will be the starting vectors (initial means), (2) refer to the SAVTAP file, and (3) must be a subset of the channels on the SAVTAP file. The same channels must be used throughout one execution of ISOCLS. If a cluster MEANS deck is input, the channels on this card image must be a subset of the channels in the MEANS deck.
*END	Blank	Indicates the end of control cards.
CLASSNAME	(Field cards)	
$END	Blank	Indicates the end of all classes to be clustered.
		Optional cards
CHAIN	X Default: Chaining not performed	Chains all clusters within x units of each other to form one cluster. Chaining affects only the final map printout and MAPUNT tape.
CLASSES	N Default: 1	Number of classes to be clustered.
CLUSTERS	N Default: 60	Maximum number of clusters per class; must be ≤ 60.
DATAFILE	UNIT=N,FILE=M Default: N=11,M=1	N is the Fortran logical unit number to which the MSS data tape (DATAPE) has been assigned; M is the file number on the tape to be processed. For back-to-back executions, if the same data file is to be processed throughout the execution, only one DATAFILE card need be submitted.
DLMIN	X Default: 3.2	On a combine iteration, combines any two clusters whose means are closer than X units.
FORMAT	LARSYS	Generates the output cluster MAPUNT tape in LARSYS format.
FORMAT	UNIVERSAL Default: Output MAPUNT	Generates the output cluster MAPUNT tape in Universal format.
ISTOP	N Default: ,0	A maximum of N iterations is performed in the initial split sequence.
KRN	N Default: 20	Prints out a summary of the clusters at every Nth iteration.
MAP	N Default: 20	Prints out a map of the clustered data along with the summary for every Nth iteration. A final cluster map is printed regardless of this parameter.
MEANS	CARDS Default: Clustering procedure is automatically initialized if this deck or MEANS file is not input.	Initializes input of the cluster MEANS file. This file is use used to initialize cluster centers for the clustering procedure.

TABLE 9-1.— Continued

Keyword	Parameter and default values	Function
MEANS	FILE Default: Cluster centers are automatically initialized from this card or the MEANS card	Indicates means for initial clusters have been input previously from cards and stored on file. The same initial means are to be used again for initializing the process for a new data set.
MODULE	Blanks	Initializes the readings of the module STAT file that immediately follows this card.
NMIN	N	Deletes any cluster with fewer than N members on the first through next-to-last iteration.
OPTION	CLUSTER Default: If the FORMAT control card is input, the output cluster MAPUNT file will contain the mean vector of the cluster to which the corresponding pixel was assigned.	The output cluster MAPUNT file will contain the cluster number to which the corresponding pixel was assigned. When selecting this option, the FORMAT control card must be input also.
OPTION	ERCOMP	Prints an error criterion for each iteration.
OPTION	ORDER Default: The color keys will be ordered according to cluster numbers.	The color keys on the MAPUNT tape will be ordered according according to greenness. See section 5.1, Volume II.
OPTION	PUNCH=N Default: If PUNCH is omitted, no cards are punched; if N is omitted, it defaults to 1.	Punches the means and covariance matrix for each cluster in the module STAT file format, N=1 punches module STAT deck; N=2 punches ERIPS interface deck; N=3 punches both decks.
OPTION	STATS	Prints the covariance matrix for each cluster.
PERCENT	N Default: 80	N, an integer number, is the test variable for the percentage of stabilized clusters with standard deviations unless it is less than the threshold parameter STDMAX in the initial split iteration sequence.
PMIN	N	Deletes any cluster with fewer than N members on last iteration.
SEP	X Default: Maximum of the channel standard deviations in the cluster	When splitting a cluster, separates the new clusters by a distance of X units.
SEQUEN	AA···A Default: SC	A represents the sequence of S and C characters used for iteration control after the initial split sequence. A maximum of 19 characters may be input.
STATFILE	INPUT/UNIT=N,FILE=M, OUTPUT/UNIT=L,FILE=S Default: No defaults for INPUT; L=20,S=1 for OUTPUT	N is the Fortran logical unit number to which the SAVTAP file containing the initial means has been assigned; M is the file number of the tape to be processed; L is the Fortran logical unit number to which the SAVTAP file containing the generated statistics will be output; S is the file number on the tape for saving the clustered statistics.

TABLE 9-1.– Concluded

Keyword	Parameter and default values	Function
STDMAX	X Default: 4.5	On a split iteration, splits any cluster whose maximum standard deviation is greater than X units.
SUBCLASS	$C_1,C_2,C_3,\ldots,C_k$ $k \leq 60$ Default: All subclasses/clusters on SAVTAP file will be used in initializing the clustering.	C's are integer subclass or cluster numbers that (1) will be used in the initial means, (2) refer to the SAVTAP file, and (3) must be a subset of the subclasses or clusters on the SAVTAP file.
SYMBOLS	$S_1,S_2,S_3,\ldots$ Default: 1,2,...9. A,B...Z,¢,#,£/,-,*,+, $,@,=,0,?,,,), (,:,!, ,;, ,', comma, period, blank	Symbols used to identify clusters in the printout.

Special cards, for Procedure 1

DOTFILE	INPUT/UNIT=n,FILE=m (Default: Self-initializing starting)	Defines the FORTRAN unit number n and file number m of the dot data file DOTUNT containing the starting vectors.
DOTS	$n_1,n_2,\ldots,n_{60}$ (Default: Dots will not be used for starting vectors.)	n_i are integer numbers separated by a comma specifying the dots to be used as starting vectors.
SUNANG	TAPE (Default: No sun andle correction applied)	Sun angles will be extracted from the ERIPS unload MSS data tape.
SUNANG	$n_1,n_2,\ldots n_j$ n_j are integer numbers, $j \leq 7$. (Default: No sun angle correction applied)	(n_j) are the sun angles to be used in computing the sun angle corrections for use in the clustering algorithm. A sun angle must be input for each set of 4 channels input on the CHANNEL control card.

Ancillary cards

HED1, HED2, DATE, COMMENT (see Table 3-1)

TABLE 9-2.- DIAGNOSTICS FROM ISOCLS

Message	Explanation
CHANNELS CANNOT BE CHANGED UNTIL THIS EXECUTION OF ISOCLS IS COMPLETED.	The channels to be used should be set in the first set of control cards input after the ISOCLS card. That set of channels will be used for all classes. If the user attempts to input a CHANNELS card into the SETUP routine on a later entry, the card will be ignored.
NO. OF CLASSES CANNOT BE CHANGED UNTIL THIS EXECUTION OF ISOCLS IS COMPLETED.	The number of classes to be clustered must be input only in the first set of control cards input after the ISOCLS card. If the user attempts to change this parameter, the input will be ignored.
END-OF-TAPE REACHED BEFORE END-OF-FIELD.	A field has been defined beyond the limits of the MSS DATAPE.
INPUT ERROR - A CLASSNAME CARD MUST BE INPUT BEFORE A GROUP OF FIELDS.	
NO. OF PIXELS TO BE UNPACKED PER SCAN EXCEEDS THE DIMENSION LIMIT OF ___.	Decrease the number of channels or pixels per scan in the field.
TOO MUCH DATA REQUESTED -- PIXELS * (CHANNELS + 1) CANNOT EXCEED ____.	Drum file will not hold all of the data for one class. Reduce channels or size of fields.
STORAGE REQUIRED FOR FIELD DEFINITION INFORMATION EXCEEDS THE DIMENSION LIMIT OF ____.	Reduce the number of fields. All vertices, names, and rectangular coordinates are saved for each field. The user has exceeded storage.
DIMENSION LIMITS EXCEEDED IN ISOCLS BY ____. REDUCE CHANNELS OR MAX. CLUSTERS.	The user has exceeded storage. The number of channels or maximum clusters per class should be reduced.
DIMENSION LIMIT OF ____ FOR COVARIANCES EXCEEDED.	Same.
WRITE ON UNIT ____ TERMINATED ABNORMALLY. DAS TAPE NOT CREATED. ISTAT = ____.	Printed by subroutine DSTAPE. User should re-submit the job with a different output tape. This diagnostic message indicates that either a bad tape was being used or a tape drive error occurred.
END-OF-TAPE ON UNIT ____. LAST LINE WRITTEN.	Printed by DSTAPE. The end of reel has been encountered while attempting to write the MAPUNT tape.
INVALID INPUT CARD ____ IGNORED.	Printed by subroutine SETUP7. Check table 9-1 for correct spelling of keywords for card input and make sure the keyword is left justified in the field.

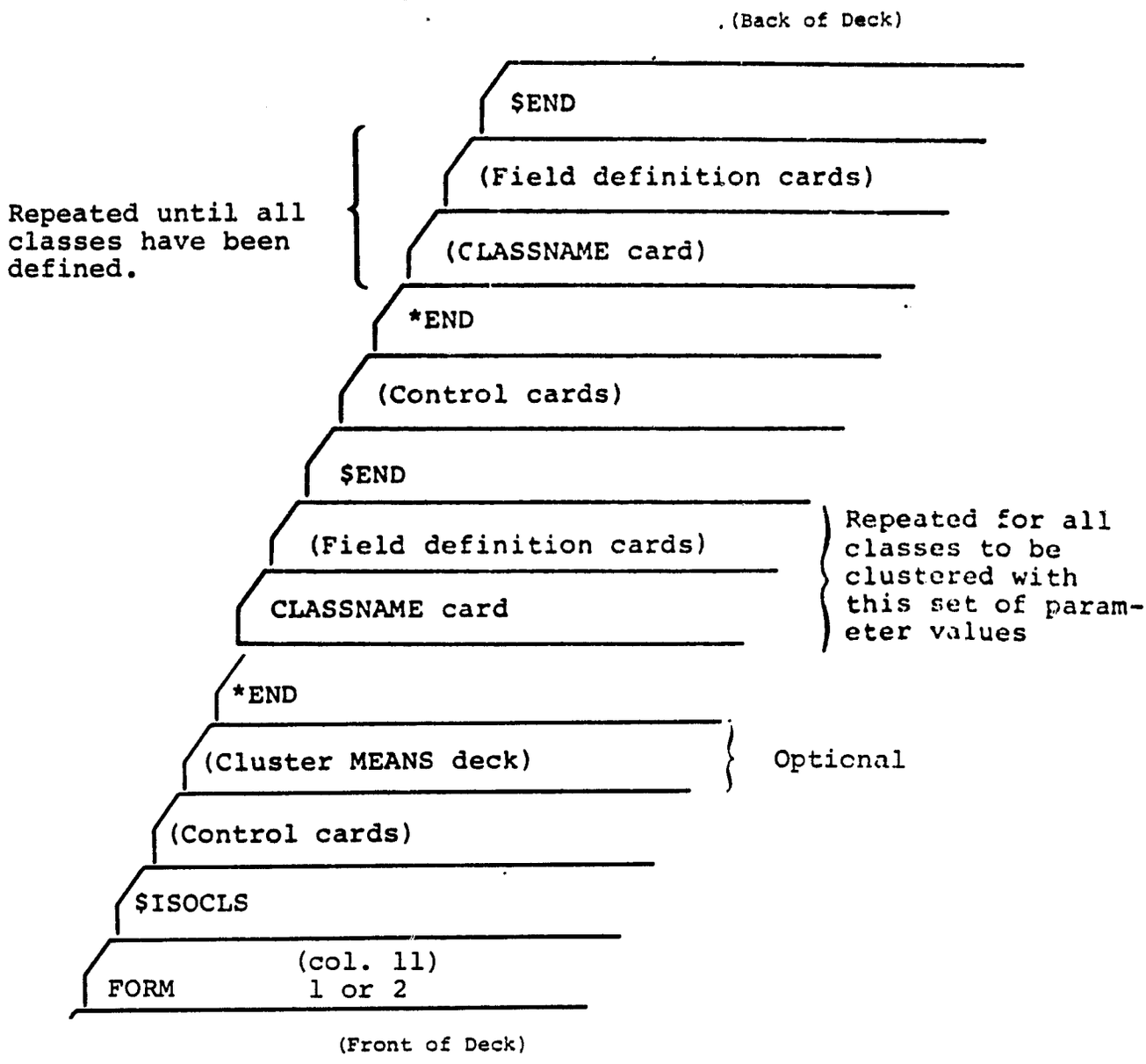


Figure 9-1.— Deck setup for the ISOCLS processor for independent execution. In remote operation, a card image file is used.

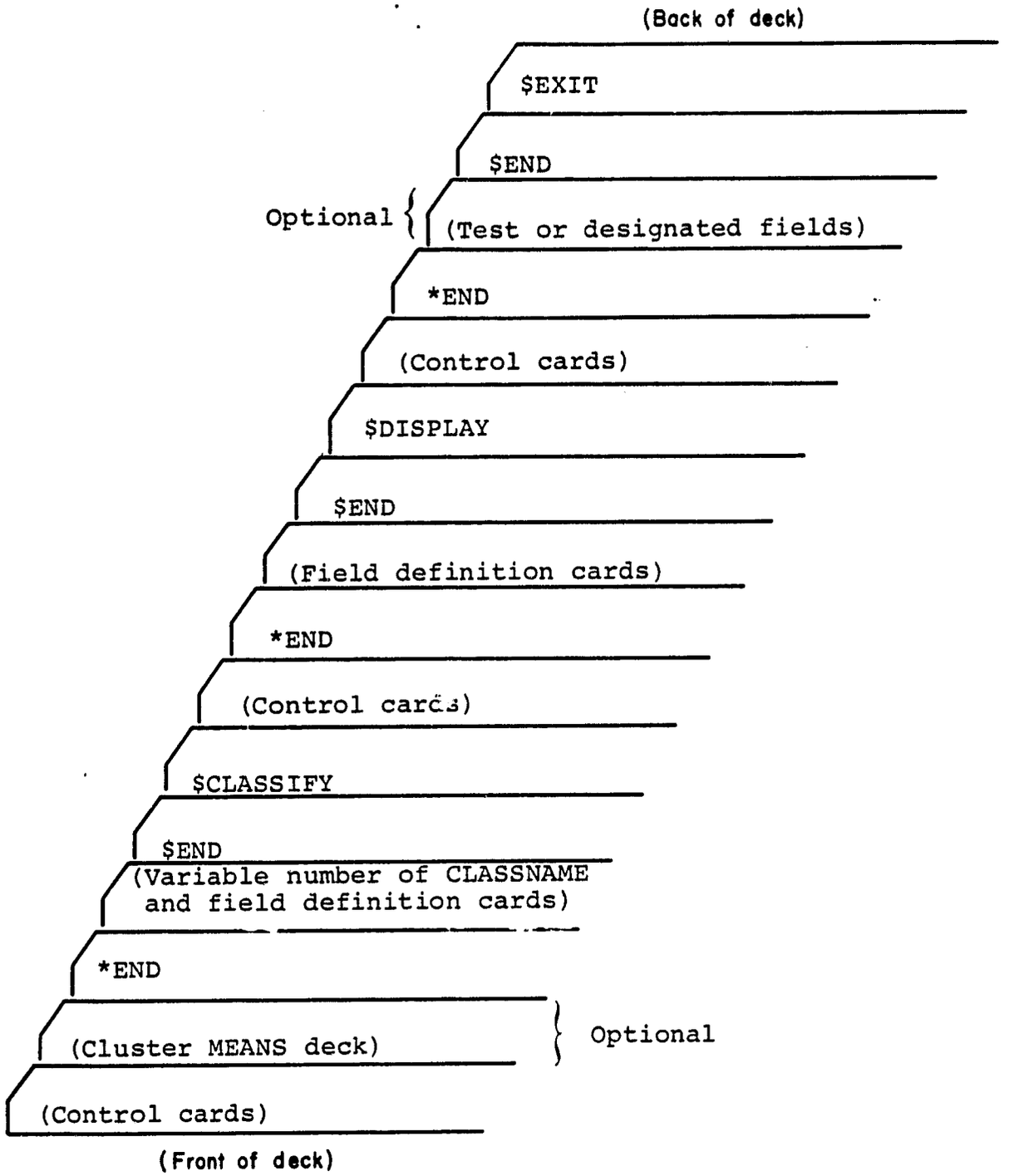


Figure 9-2.— Deck setup for ISOCLS for execution back to back with CLASSIFY and DISPLAY. In remote operation, a card image file is used.

10. FEATURE SELECTION PROCESSOR - SELECT

10.1 DISCUSSION

SELECT allows an analyst to judge the relative importance of the individual channels and to identify the set of channels that provides the best discrimination between subclasses. It allows him to choose one of the following three criteria for the separability of the subclasses for a set of channels, or for linear combinations of the channels.

- Weighted average interclass divergence
- Weighted average transformed divergence
- Weighted average Bhattacharyya distance

Either the Exhaustive Search or the Without Replacement Procedure can be used with any of the criteria to select a "best" set of channels. The Exhaustive Search Procedure determines the best set of k out of n channels by computing the separability measure for every possible combination of k channels.

The Without Replacement Procedure determines the best k out of n channels by selecting the single channel which extremizes the separability measure, and then pairing it with the best channel selected from the remaining (n - 1) channels. The best triplet is determined by combining the best channel selected from the remaining (n - 2) channels with the best pair. The process continues until the best set of k channels has been selected.

A third procedure, the Davidon-Fletcher-Powell Procedure, is an iterative descent method for finding a local minimum of a function of several variables. This procedure computes a k-by-n linear transformation matrix which extremizes a given separability measure. This matrix, B-matrix, is saved on the BMFILE and optionally is punched on cards (B-matrix deck) for later input to the CLASSIFY, SELECT, TRSTAT, SCTRPL, or DATA-TR processors. For more information on this procedure, see Section 10, Volume II.

In addition to selecting a best set of channels the processor can evaluate any of the separability measures for a specified set or linear combination of the channels. The linear combination must be input via the B-matrix deck, or via the BMFILE if SELECT has been executed previously in the same run.

The processor can also evaluate any of the separability measures for specified sets of channels. This request is made using the EVALUATE and PROCEDURE control cards.

The best subset of passes (acquisitions) from a set of acquisitions can also be determined using the sixth procedure option.

10.2 SPECTRAL INFORMATION

The SELECT processor requires the statistics output from either STAT or ISOCLS. Both STAT and ISOCLS write the SAVTAP file and optionally punch the module STAT file which may be used as input to SELECT.

The BMFILE is output by SELECT when the Davidon-Fletcher-Powell procedure is used.

10.3 SAMPLE RUN

A job setup for independent execution of SELECT is shown in Figure 10-1. Table 10-1 lists control cards relevant to SELECT. Diagnostics from SELECT are given in Table 10-2. A full discussion of control cards, and of processor diagnostics, is given in section 10 of Volume II.

TABLE 10-1,— CONTROL CARDS FOR SELECT

Required cards

Keyword	Parameter and default values	Function
$SELECT		Calls Processor.
BEST	$N_1,N_2,\ldots$	Find the best set of $N_1,\ldots$ channels if procedure 1 or 2 is indicated. If procedure 3 is indicated, the best N_1,N_2 linear combination of the channels are found. $N_1,N_2,\ldots$ are integers separated by commas. A request can be made for a maximum of 10 best in one call to select.
END	Blank	Signals the end of the control cards.
$END*	Blank	Signals the end of all card input for the processing function.

Optional cards

B-MATRIX	CARDS Default: None.	Indicates that the B-matrix card deck immediately follows; results in the evaluation of the separability measure using the linear combinations defined by the B-matrix if procedure 4 is indicated. If procedure 3 is indicated, the B-matrix will be used as a first guess for the Davidon-Fletcher-Powell Procedure.
B-MATRIX	FILE Default: None.	Indicates that a previous execution of SELECT has written the BMFILE. Depending on the PROCEDURE card, the B-matrix on file will be used as an initial guess for the Davidon-Fletcher-Powell procedure or in evaluating the separability measure.
CHANNELS	$C_1,C_2,\ldots,C_k$ k≤number of on SAVTAP≤30 Default: All channels on the SAVTAP file.	Selects the best set of channels from those indicated on this card. Must be a subset of the channels for which statistics are input via the SAVTAP file or module STAT file. $C_1,C_2,\ldots$ are integers separated by commas.
CRITERION	N Default: N=1	The indicated criterion is used to measure the separability between subclasses. N=1 for weighted average divergence; N=2 for weighted transformed divergence; and N=3 for weighted average Bhattacharyya distance.
EVALUATE	$C_1,C_2,\ldots$ Default: None.	Evaluates the separability measure indicated on the CRITERION card for channels $C_1,C_2,\ldots$. The set of channels to be evaluated must be (1) a subset of the channels on CHANNEL card and (2) must be on one card. Several sets of channels may be input by using more than on EVALUATE card.
GROUP	NAME,I,J,... Default: No grouping; individual subclasses are used.	Groups the training subclasses I, J, ..., pools their statistics, and assigns NAME as the group name. Name may be any six characters. Integers I, J, ... must correspond to the subclasses as they occur in the module STAT file or the SAVTAP file.
ICOUNT	N Default: N=300.	Number of iterations for the Davidon-Fletcher-Powell Procedure.
INCLUDE	$C_1,C_2,\ldots$ Default: None.	Includes channels $C_1,C_2,\ldots$ in the best set; meaningful only for the Without Replacement Procedure. $C_1,C_2,\ldots$ must be a subset of channels on CHANNELS card.
MODULE	Blank	Indicates that the module STAT file immediately follows. The SAVTAP file will be written as this card deck is read.

TABLE 10-1.– Concluded

Optional cards

Keyword	Parameter and default values	Function
OPTION	STATS Default: No statistics printed.	Prints a summary of the statistics for the subclasses and channels actually used in SELECT.
PROCEDURE	N Default: N=2	N=1: The Exhaustive Search Procedure is used; N=2: The Without Replacement Procedure is used; N=3: The Davidon-Fletcher-Powell Procedure is used; N=4: The user-input B-matrix is used to eliminate the separability measure; N=5: The Evaluate Channels Procedure is used; N=6: Best subset of passes.
NCPASS	N Default: N=4	Number of channels per acquisition (pass). Needed for Procedure 6.
APRIOR		Use a priori weight factors as multiplier for intercluster weights.
STATFILE	UNIT=N,FILE=M	N is the FORTRAN logical unit number to which the SAVTAP file has been assigned; M is (1) the file number from which the training statistics are to be retrieved and (2) if the module STAT file is input, the file number on which the statistics are to be stored. If M≠20, this control card must precede the module STAT file in the control card deck setup.
SUBCLASSES	$C_1,C_2,\ldots,C_k$ k≤number of subclasses on SAVTAP≤60 Default: All subclasses on the SAVTAP file.	Provides for use of only subclasses $C_1,C_2,\ldots$ statistics for computation of separability measure, allows the user to select a subset of the statistics on the SAVTAP file for use in computing the subclass separabilities. $C_1,C_2,\ldots$ are integers, the subclass number as it occurs in the SAVTAP file.
WEIGHTS	C1=XX,(C1,C2)=YY, OTHERS=ZZ Default: All weights set to 1.0 for criteria 2 and 3. For criterion 1, weights for subclass pair (i,j) are $W_{ij}=e-D_{ij}/16$, where D_{ij} is the divergence for subclass pair (i,j).	Sets weights for all subclass pairs of subclasses C1 to XX, then sets subclass pair (C1,C2) to YY; sets all other subclass pairs to ZZ. Subclass names C1, C2, etc., must match a subclass name from the module STAT file, the SAVTAP file, or a GROUP name.

Ancillary cards

HED1, HED2, DATE, COMMENT (see Table 3-1)

TABLE 10-2.— DIAGNOSTICS FROM SELECT

CORE OVERFLOW IN SUBRAY - NN - STORAGE LOCATIONS NEEDED FOR THIS PROBLEM.	User might reduce the number of subclasses or channels or try another procedure. The SUBRAY array is used for temporary storage in SELECT only. (See restrictions, section 10.7)
CORE OVERFLOW IN ARRAY - NN*2 - STORAGE LOCATIONS NEEDED FOR THIS PROBLEM.	See suggestions for first diagnostic message. The ARRAY array is used throughout the system for variably dimensioned storage.
TOO MANY EVALUATE REQUESTS -- REMAINDER IGNORED.	The buffer to hold EVALUATE requests is dimensioned 100. The number of channels and channels to be evaluated for each EVALUATE request are stored in this array.
GROUP CARD IN ERROR - IGNORED.	Check format of GROUP option.
PROGRAM CANNOT PROCESS LESS THAN 2 CHANNELS.	At least two channels must be input.
PROGRAM CANNOT PROCESS LESS THAN 2 CLASSES.	At least two classes must be input.
INVALID CONTROL CARD - IGNORED.	Check spelling of keyword.
REDUCED COVARIANCE MATRIX FOR CLASS IN IS NOT POSITIVE DEFINITE.	The indicated covariance matrix cannot be inverted.
THE INCLUDE REQUEST FOR CHANNEL N IS NOT A LEGITIMATE REQUEST - IGNORED.	The indicated channel to be included is not among the input channels.

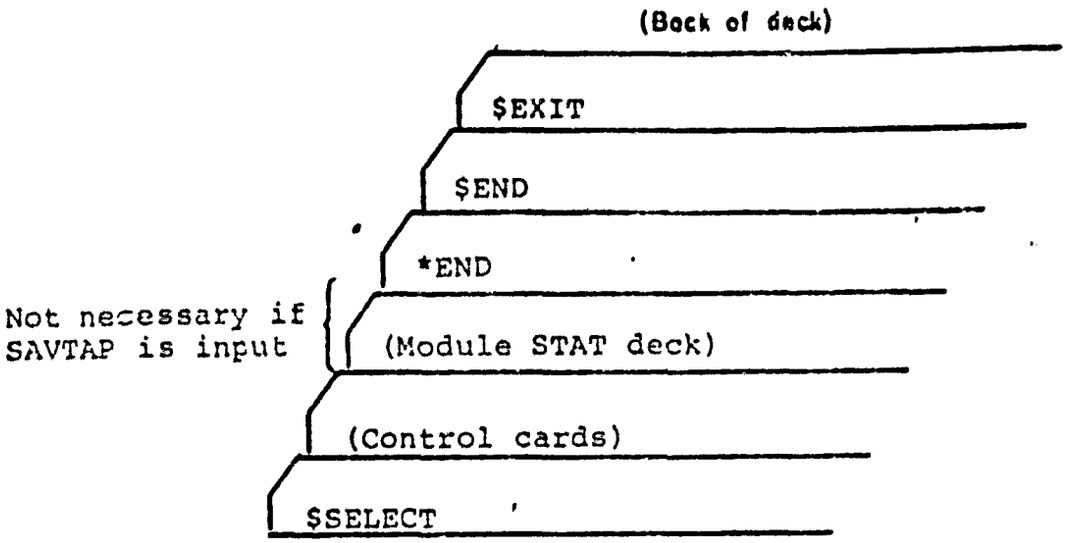


Figure 10-1.— Deck setup for the SELECT processor for independent execution. In remote processing, a card image file is used.

11. CLASSIFICATION PROCESSOR - CLASSIFY

11.1 DISCUSSION

This processor classifies MSS image data on the basis of statistics (mean vectors and covariance matrices) which have been computed from the training fields.

Given the statistics for each subclass of interest, all pixels are assigned to a subclass by one of two procedures.

In the first procedure, the user does not define categories in his input, and the standard m-class maximum likelihood classification rule is followed. In the second procedure, the user defines categories in his input, and the sum-of-normal-densities classification rule is followed.

11.2 INPUT/OUPUT

An MSS data tape (DATAPE) must be input to the CLASSIFY processor. The tape assignment defaults to logical unit 11. Classification results are output on the MAPTAP file, which is assigned to logical unit 2. In the event of card input of the module STAT file, the statistics will be output on the SAVTAP file.

Training statistics may be input my means of the module STAT file. The B-transformation matrix may be input by means of the B-matrix card file.

Areas to be classified must be specified on field definition cards. At least one field definition card must be in the run deck immediately following the *END control card, but the processor will also accept more than one. The processor will classify each field in the order it is identified, will print on the line printer the first 110 samples of the classification map, and will print any optional output prescribed by the control cards for each field classified.

11.3 PROCEDURE 1

In the use of procedure 1, CLASSIFY can obtain subclass a priori values using subclass population data from the input file, SAVTAP. It also allows the system to assign category names using the class names from the input statistics file, SAVTAP.

Both options are in addition to the usual capability of analyst input a priori probability values at the subclass, class, or category level via the APRIORI control card, and of category name input via the CATEGORY control card.

11.4 SAMPLE RUN

A job setup for execution of the CLASSIFY processor back to back with the STAT and DISPLAY processors is shown in Figure 11-1. Table 11-1 lists control cards applicable to CLASSIFY. Diagnostics from CLASSIFY are given in Table 11-2. A full discussion of control cards, and of processor diagnostics, is given in section 11 of Volume II.

Section 20 illustrates an application of EOD-LARSYS which includes the use of the CLASSIFY processor.

TABLE 11-1.– CONTROL CARDS FOR CLASSIFY

Required cards

Keyword	Parameter and default values	Function
$CLASSIFY		Calls processor.
MAPTAP	OUTPUT/UNIT=n,FILE=m (usually n=2,m=1)	Unit and file number of classification map.
*END	Blank	Signals the end of the control cards.
FIELDS ...		
$END*	Blank	Signals the end of card input for the processing function.

Optional cards

Keyword	Parameter and default values	Function
APRIORI	$A_1, A_2, \ldots, A_M$ or $N*A_1, K*A_{N+1}, \ldots, A_M$ $M \leq 60$ Default: If executing the standard classifier, each subclass is given an equal a priori value. If executing the category classifier, each category is given an equal a priori value which is divided equally among the subclasses in that category.	A priori values may be input by sub-subclass, class, or category. N and K are arbitrary repetition factors, and A_i's are decimal numbers such that $\sum_{i=1}^{M} A_i = 1.0$ M = number of training subclasses, training classes, or categories. If input by class or category, the setup routine will distribute the a priori values among the subclasses in the following manner: By class = $\frac{\text{Class a priori values}}{\text{Number of subclasses in that class}}$ By category = $\frac{\text{Category a priori values}}{\text{Number of subclasses in that category}}$ The order in which the A_i's are input must be the order in which the category, class, or subclass was defined.
B-MATRIX	CARDS or FILE Default: No transformation of training subclass covariance matrices.	Informs the processor that the B-transformation matrix is to be input and applied to the training subclass statistics prior to classification. If FILE is placed in the parameter field, the mode of B-matrix input will be from BMFILE; if CARDS is specified, the B-matrix card file must immediately follow this control card. The channels were used to derive the B-transformation matrix will be the channels used by the processor in classification.
CATEGORY	CATNAM/$NAME_1$,$NAME_2$... Default: If no categories are defined, the standard classifier is applied.	Informs the processor that the category classifier option will be applied and defines one category name (CATNAM) and the class names ($NAME_i$'s) for this category. All subclasses for a class are assigned to this category. CATNAM and $NAME_i$ may be up to four characters, and $NAME_1$ must match a class name on the SAVTAP file. A slash (/) separates the category name from the class name. NOTE: (1) Every class must be assigned to a category unless the class was eliminated by omitting all of its subclasses on the SUBCLASS control card; (2) at least two categories must be defined; (3) continuation of the list of class names in the category on another card is indicated by an asterick afterthe last class name of that card. The next card should continue the list of class names in columns 11-72.

TABLE 11-1.- Continued

Optional cards

Keyword	Parameter and default values	Function
CHANNELS	STAT=$N_1,N_2,\ldots N$ DATA=$M_1,M_2,\ldots M_k$ $K \leq 30$ Default: (1) if executed back to back with SELECT, the channels selected by the SELECT processor are used; (2) if a B-matrix is input, the channels used in computing the matrix are used; (3) otherwise, all channels in the statistics are used.	$N_1,N_2,\ldots N_K$ are the channel numbers (integers) from the SAVTAP file to be used in classification; $M_1,M_2,\ldots,M_k$ are the channel numbers (integers) from the MSS data tape selected from SAVTAP and DATAPE must be equal.
DATAFILE	UNIT=N,FILE=M Default: N=11,M=1	N is the FORTRAN logical unit number to which the MSS data tape (DATAPE) has been assigned; M is the file number of the tape to be processed. For back-to-back executions of several processors, if using the same file number, only one DATAFILE control card need be input.
GROUP	SUBNAM,$K_1,K_2,\ldots,K_i$ $1 \leq k_i \leq 60$; i=number of training subclasses. Default: Subject to the SUBCLASS control card, each individual training subclass is used as a possibility for unknown data sample classification.	K_i's are integer subclass numbers taken from the set of available training subclasses. The processor creates a new training subclass by combining the statistics of the training subclasses listed. The training subclasses used are not thereafter available as individual subclass possibilities for an unknown data sample. The set of training subclasses to be used is renumbered by the processor to account for the new grouped subclass and the training sub-subclasses deleted by grouping. The revised subclasses is used for all processor output. SUBNAM may be from one to four characters and will become the name for a new training subclass.
MODULE	Blank Default: Training subclass statistics are read from the input file SAVTAP.	Indicates to the processor that the training subclass statistics will be input on cards. The module STAT deck must immediately follow this control card.
OPTION	STATS Default: No training subclass statistics printout.	Training statistics will be printed out for each subclass, reflecting the B-transformation, if any, and the Cholesky factorization of the covariance matrices.
STATFILE	UNIT=N,FILE=M Default: N=20,M=1	N is the FORTRAN logical unit number to which the SAVTAP file has been assigned; M is: (1) the number of the file to be processed or (2) if the module STAT file is input, the number of the file for storing the statistics. If M≠1, this control card must precede the module STAT file in the control card file setup.
SUBCLASS	$K_1,K_2,\ldots K_i$ $1 \leq K_i \leq 60$; i = number of subclasses in training statistics. Default: All the training subclasses are used.	K's are integers comprising the set of subclass numbers used by the processor to classify the unknown data points; must be a subset of training subclasses designated as they occur on the SAVTAP file.

Cards for Procedure 1

APRIORI	FILE Default: Subclass a priori values will not be computed from the statistics file, SAVTAP.	The subclass a priori probability values are computed using subclass or cluster point populations from the statistics file, SAVTAP.

TABLE 11-1.– Concluded

Keyword	Parameter and default values	Function
APRIORI	$A_1, A_2, \ldots A_m$ or $N*A_1 K*A_2, A_3, \ldots$ where N and K are arbitrary integer repetition factors, A_i's are decimal numbers such that $\sum_{i=1}^{M} A_i = 1.0$ where M=number of subclasses, classes, or categories. Default: Varies by classifier. See Volume II, User's Reference Manual.	The parameter field is expected to contain decimal numbers separated by a comma "," which are the a priori probability values for either all subclasses, classes, or categories defined to the CLASSIFY processor. If the a priori values are input by class or category, the values will be distributed among the subclasses in the following manner: By class - $Subclass_i$ a priori=class a priori/number of subclasses in the class. By category - $Subclass_i$ a priori=category a priori/number of subclasses in the category. The order in which the a priori probability values, A_i, are input must be in the order in which the category, class, or subclass is defined to the CLASSIFY processor.
CATEGORY	FILE Default: No categories are defined and the standard classifier will be applied.	Initializes the assigning of the category names using the class names from the input statistics file, SAVTAP, and invokes the category classifier.

Ancillary cards

HED1, HED2, DATE, COMMENT (see Table 3-1)

TABLE 11-2.- DIAGNOSTICS FROM CLASSIFY

CLSFY1 routine

Message	Explanation
***** CLSFY/CLSFY1/CLSF1A --- THE COVARIANCE MATRIX FOR SUBCLASS NO. XX IS EITHER SINGULAR OR NOT POSITIVE DEFINITE - THE DETERMINANT = XXXX.XXXX ***** TERMINATING PROGRAM EXECUTION *****	The determinant of each subclass covariance matrix is checked by CLASSIFY to see that it is a positive non-zero value. A zero value indicates a singular matrix, and a negative value i indicates a non-positive definite matrix. If either condition occurs for any subclass covariance matrix to be used in classification, the processor will stop. NOTE: A probable source of an invalid covariance matrix is a module STAT file which has been incorrectly formatted and thus is not producing good training class statistics. Another possible source is that the SAVTAP file does not contain valid statistical data.

CLSFY2 routine

WIDTH OR RECTANGULAR FIELD SURROUNDING CLASSIFICATION FIELD CANNOT EXCEED 1000 POINTS.	The largest sample of the classification field minus the smallest sample of the classification field cannot exceed 1000 samples. Reduce amount of samples per scan line.
TOO MUCH DATA REQUESTED.	When too much data has been requested, (1) for the standard classifier, reduce parameters so that: Number of subclasses - 1 and Number of subclasses - 2 + number of subclasses + points per scan line + number of channels ≤ 12 500; or (2) for category classifier, reduce data so that points per scan line x number of channels ≤ 12 500.

REDIF2 routine

***** CLSFY/REDIF2 --- BAD CARD INPUT DETECTED ON ATTEMPT TO READ B-MATRIX INFORMATION AS DIRECTED BY THE CONTROL CARD ... 'CCCC ...CCCC' ***** TERMINATING PROGRAM EXECUTION FROM REDIF2 *****	The input B-MATRIX control card is printed out as part of the error message. One of the data cards following it is incorrectly formatted. Check deck setup and B-matrix card file.
** CLSFY/REDIF2 -- B-MATRIX INPUT FROM BMFILE - BAD INPUT VALUES DETECTED: NO. COMBINATIONS (BMCOMB) = _____, NO. CHANNELS (BMFEAT) = _____, CHANNEL VECTOR (FETVC2) = _____.	Invalid data from the BMFILE has been deleted.
AT LEAST TWO (2) CATEGORIES MUST BE ASSIGNED. EXITING FROM REDIF2.	In exercising the category option, two or more categories must be used.

SETUP2 routine

***** CLSFY/SETUP2 ... ERROR CONDITION ON ATTEMPT TO POSITION MAPTAP TO FILE NO. XX ***** ERROR STATUS CODE = YY --- ABORTING THE RUN *****	The CLASSIFY processor attempted to position the output classification results file (MAPTAP) to the file number specified on the $CLASSIFY processor card. Possibly (1) more files were indicated than currently existed on the MAPTAP file, (2) bad tape if the file is assigned to tape, or (3) the format of the $CLASSIFY processor card is incorrect.
AN ERROR HAS OCCURRED IN GROUPING CLASSES INTO CATEGORIES. CHECK THE FOLLOWING: NOT ALL OF THE CLASSES HAVE BEEN ASSIGNED TO A CATEGORY. A CLASS NAME ON THE CATEGORY CARD HAS BEEN MISPELLED. CLASS NAMES FROM SAVTAP FILE ARE: _____. CLASS NAMES FROM CATEGORY CARDS ARE: _____.	When an error occurs in grouping classes into categories, either one or more class names (1) have not been assigned or (2) have been mispelled. The program lists the class names as submitted from the SAVTAP file or cards. Check these for errors. If neither (1) nor (2) is applicable, check the module STAT file to assure that class names are left justified in the field.

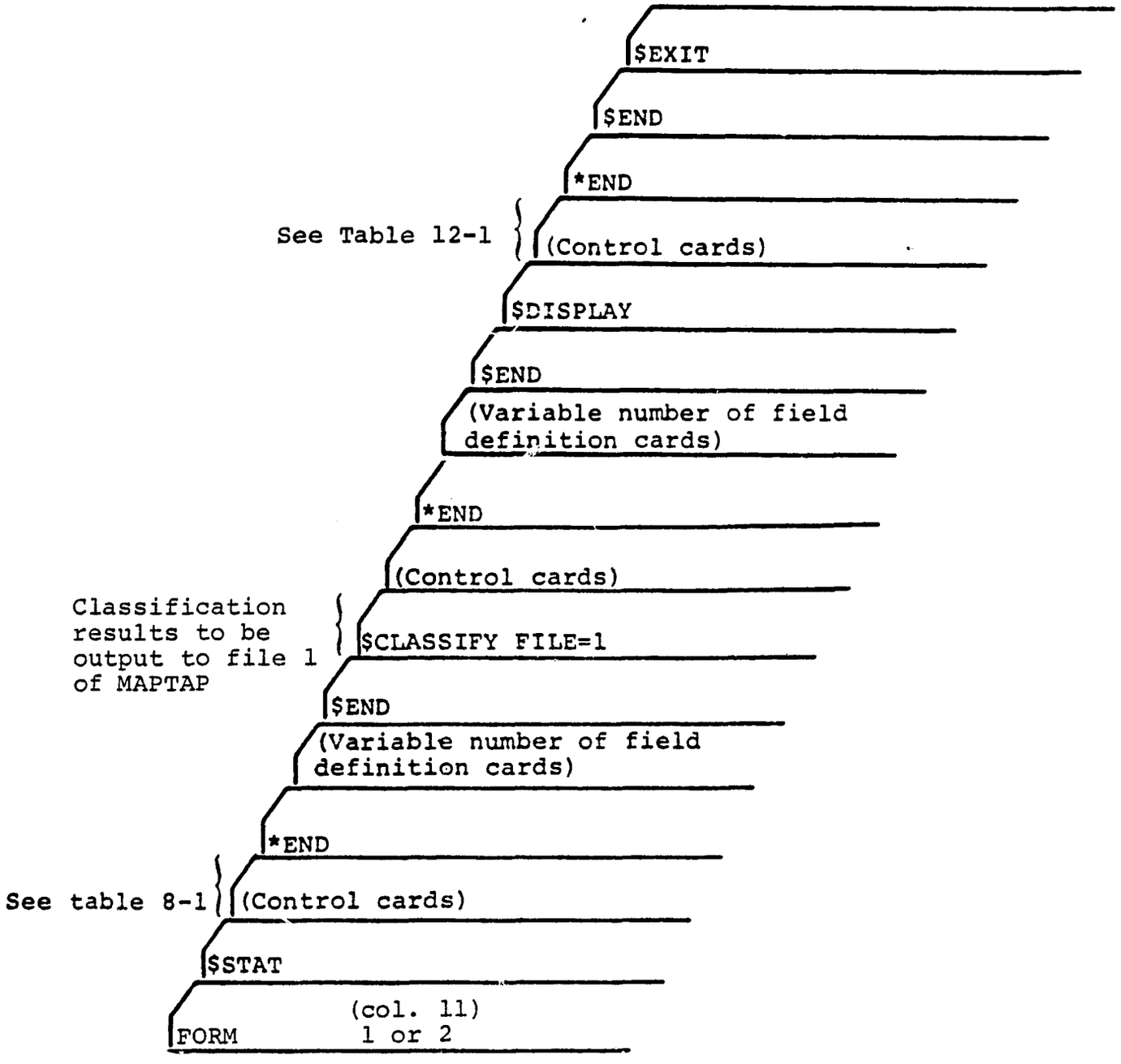


Figure 11-1.— Deck setup for the CLASSIFY processor for execution back to back with the STAT and DISPLAY processors. In remote processing, a card image file is used.

12. DISPLAY PROCESSOR

12.1 DESCRIPTION

Although the CLASSIFY processor does the actual classification, the DISPLAY processor allows the analyst to examine and interpret these results. Display performs the following functions:

a. Provides a line printer map of each classified field on MAPTAP. The training and test fields within the classified image are outlined.

b. Produces classification summaries for each classified field, which counts the pixels classified into, and the number of pixels thresholded from, each subclass, class, and category.

c. Produces an intensive test site (ITS) classification summary for a single crop type versus all other crop types; the user-specified crop may be a category, class, or subclass.

d. Allows the user to designate fields to be excluded from the classification summaries. Fields may be designated "unidentifiable" or "other." Pixels within the unidentifiable fields are counted and are not considered in the classification summaries. Pixels within the designated "other" fields are counted as a separate crop type regardless of how they were classified. These pixels are included in category "other" in the ITS report. All pixels within the designated areas are printed with the pount (#) symbol.

e. Assigns thresholded pixels to the threshold class if thresholding is requested.

f. Allows threshold to be determined by user input, chi-square option, empirical option, or Fisher F distribution option.

g. Produces plots of the empirical distribution function when OPTION PLOT is exercised.

h. Performs a four-nearest-neighbors spatial filtering on the classified image.

i. Outputs the classified image onto tape (MAPUNT) in either LARSYS III or JSC-Universal format via the FORMAT control card.

j. Provides classification performance summaries for ground truth areas within the classified image. The following six performance summaries are available to the user. The fields in these reports are either training fields used in the STAT or ISOCLS processor and transmitted to DISPLAY via the MAPTAP file, or test fields input directly to DISPLAY.

- Field by Subclass
- Field by class
- Field by category
- Class by subclass
- Class by class
- Class by category

12.2 INPUT/OUTPUT

The only input file required for DISPLAY is the MAPTAP file output by CLASSIFY. This file must be assigned to logical unit 2.

The DISPLAY processor can generate a file of the classified image on Unit 16 (MAPUNT).

Both test and designated fields are optional input to DISPLAY. However, both types of fields cannot be input in the same execution of DISPLAY. If no test fields are input, the ground-truth summaries will be for training fields. When input, test fields must be identified with a previously defined class or subclass. Designated fields contain pixels to be excluded from the proportion estimates.

12.3 PROCEDURE 1

The DISPLAY processor can also meet LACIE Procedure 1 image processing requirements by accepting the dot data file, DOTUNT: by providing a dot classification performance summary by dot categories; and by providing a dot classification performance summary for each dot on the analyst's specified file (DOTUNT). The bias correction can also be done by the use of Type 2 dots from the dot file (DOTUNT).

12.4 SAMPLE RUN

Job setups for the execution of the DISPLAY processor independently and back to back with the CLASSIFY processor are shown in Figure 12-1. Table 12-1 lists control cards relevant to DISPLAY. Diagnostics from DISPLAY are given in Table 12-2. A full discussion of control cards, and of processor diagnostics is given in section 12 of Volume II.

Section 20 illustrates an application of EOD-LARSYS which includes the use of the DISPLAY processor.

TABLE 12-1.– CONTROL CARDS FOR DISPLAY

Required cards

Keyword	Parameter and default values	Function
$DISPLAY		Calls processor.
MAPTAP	INPUT/UNIT=n,FILE=m (Usually n=2,m=1)	Unit and file number of classification map.
*END		Ends control cards.
FIELDS ...		
$END		Ends processor cards.

Optional cards

Keyword	Parameter and default values	Function
ACREAGE	TOTAL=X,CROP=Y,OTHER=Z	The total acreage in the ITS is X; acreage of the crop named on the CROP control card is Y; and the acreage of all other crop types in the ITS is Z. X, Y, and Z are floating-point numbers. This input is meaningful only if the CROP control card is input.
ANALYST	Any 18 characters. Default: Blanks.	Name of the data analyst printed in the heading for the ITS summary report.
CROP	NAME Default: No ITS report.	Initiates the option for printing the ITS summary report for the crop indicated. Name must match a category, class, or subclass name used in CLASSIFY.
FORMAT	NAME Default: No output classification map tape is generated by DISPLAY.	If NAME=UNIVERSAL, the output classification tape (MAPUNT) will be generated in the Universal format. If NAME=LARSYS, the MAPUNT tape will be generated in the LARSYS II format.
OPTION	CHI SQUARE Default: See note a.	Computes thresholds from the chi-square distribution using the confidence levels input on the THRESHOLD control card.
OPTION	EMPIRICAL Default: See note a.	Computes the empirical threshold values using the percentages input on the THRESHOLD control card.
OPTION	FILTER Default: Spatial filtering is not performed.	Performs four-nearest-neighbors spatial filtering on the classified image.
OPTION	FISHER Default: See note a.	Computes thresholds from the Fisher F-distribution using the confidence levels input on THRESHOLD control card.
OPTION	NOMAP Default: Map printed.	Instructs the processor not to print a map of the data; only a performance summary is printed.
OPTION	OUTLINE Default: Training fields are not outlined.	Outlines training fields with asterisks; has no effect on test fields. (Test fields are always outlined with "+" symbol.)
OPTION	PCT Default: Performance summary printed for classes only.	Prints a performance summary on a per-field as a per-class basis for ground-truth fields (i.e., training or test fields within the classified image).
OPTION	PLOT	Plots the empirical distribution functions obtained from the cumulative histograms of Q_i for each subclass.
OPTION	STAT Default: No statistics printed.	Prints statistics for subclasses used in the previous CLASSIFY run. These statistics are saved on the MAPTAP.

[a] If the THRESHOLD control card is input, one of the four options (CHI SQUARE, FISHER, EMPIRICAL, or THRESHOLD VALUE) should be input also. If the OPTION card is omitted and the THRESHOLD card is input, chi square is assumed. If more than one THRESHOLD option is input, only the last one read will be performed.

TABLE 12-1.– Concluded

Optional cards

Keyword	Parameter and default values	
PROCEDURE	Any 60 characters. Default: Blanks	Procedure used in classification of ITS; printed in the heading for the ITS summary report.
SITE	Any 24 characters. Default: Blanks	Name of the ITF; used in printing the heading for the ITS summary report.
SYMBOLS	$S_1,S_2,\ldots S_K$ k=number of subclasses on MAPTAP. Default: 1,2,...,9 A,B,C,D,...,Z, 1,2,3,4	Assigns symbols $S_1,S_2,\ldots$ to subclasses 1, 2, ...,
THRESHOLD	$T_1,T_2,\ldots T_K$	Uses the threshold values $t_1,t_2,\ldots$ for subclasses 1, 2, ..., respectively; thresholds must be positive floating-point numbers. One value must be specified for each subclass on the MAPTAP file. Thresholds may be specified also in the following format: $N_1*t_1,N_2*t_2,\ldots$ where N_1 and N_2 are integers which specify how many consecutive times the corresponding thresholds should be used. For the CHI SQUARE and the EMPIRICAL options, the numbers input on these cards are the confidence levels (i.e., t_1=0.99 means that the user wants to maintain 99% or reject 1%). The numbers input on the OPTION THRESHOLD VALUE card are the actual values to be used for thresholding (i.e., t_1=10.02 means that the threshold value for subclass 1 is 10.02).

Procedure 1 card

Keyword	Parameter and default values	Function
DOTFILE	UNIT=n,FILE=m Default: UNIT=19,FILE=1 No bias correction performance tables.	Initiates the input of dot data file, DOTUNT, from the designated (or default, if not designated) unit and/or file, and initiates the output of the dot data classification performance summaries. The parameter, m, designates the file to be processed by DISPLAY. n designates the FORTRAN unit number assigned to the input file, DOTUNT.

Ancillary cards

HED1, HED2, DATE, COMMENT (see Table 3-1)

TABLE 12-2.– DIAGNOSTICS FROM DISPLAY

*****DSPLAY/SETUP3...ERROR CONDITION ON ATTEMPT TO POSITION MAPTAP OVER _____ FILES. *****FSBSFL STATUS CODE = _____ --- ABORTING RUN*****	The system routine for positioning files (FSBSFL) has encountered difficulties in positioning MAPTAP to the correct file. Error occurred in SETUP3 routine for DISPLAY. User should make sure that the correct file number for the MAPTAP has been indicated and that MAPTAP does in fact have the correct number of files.
DSPLAY/SETUP3---CORE OVERFLOW---EXECUTION TERMINATED	Subroutine SETUP3 has computed the storage needed for the specific problem; if more is needed than is available, this diagnostic is printed.
AA0650 INVALID SUPERVISOR CONTROL CARD.	The invalid card is printed along with this message. Check spelling of the keyword.
WRITE ON UNIT N TERMINATED ABNORMALLY. MAPFIL TAPE NOT CREATED. ISTAT=_____.	Attempt to write on MAPUNT output tape failed. This usually indicates a bad tape. ISTAT is the status code returned from the system binary input/output routine NTRAN. Execution continues.
END OF TAPE ENCOUNTERED ON MAPFIL UNIT. LAST LINE=N.	The end-of-tape marker was encountered on the MAPUNT output tape. The last line written was N. Execution of DISPLAY continues without further attempts to write on the MAPUNT tape.
*****FISHER THRESHOLD REQUESTED - NOT PERFORMED ...NO. SAMPLES FOR SUBCLASS TNAME (=N) IS LESS THAN OR EQUAL TO NUMBER OF CHANNELS (=M).	The program compares the number of samples to the number of channels. If the number of samples ≤ number of channels, the threshold request is bypassed.
FDIST-OVERFLOW CONDITION IN FISHIN ROUTINE FOR SUBCLASS=XXXX. THRESHOLD SET TO 999.999.	The FISHIN system subroutine has returned an overflow condition. The threshold value is set to 999.999 by the program.

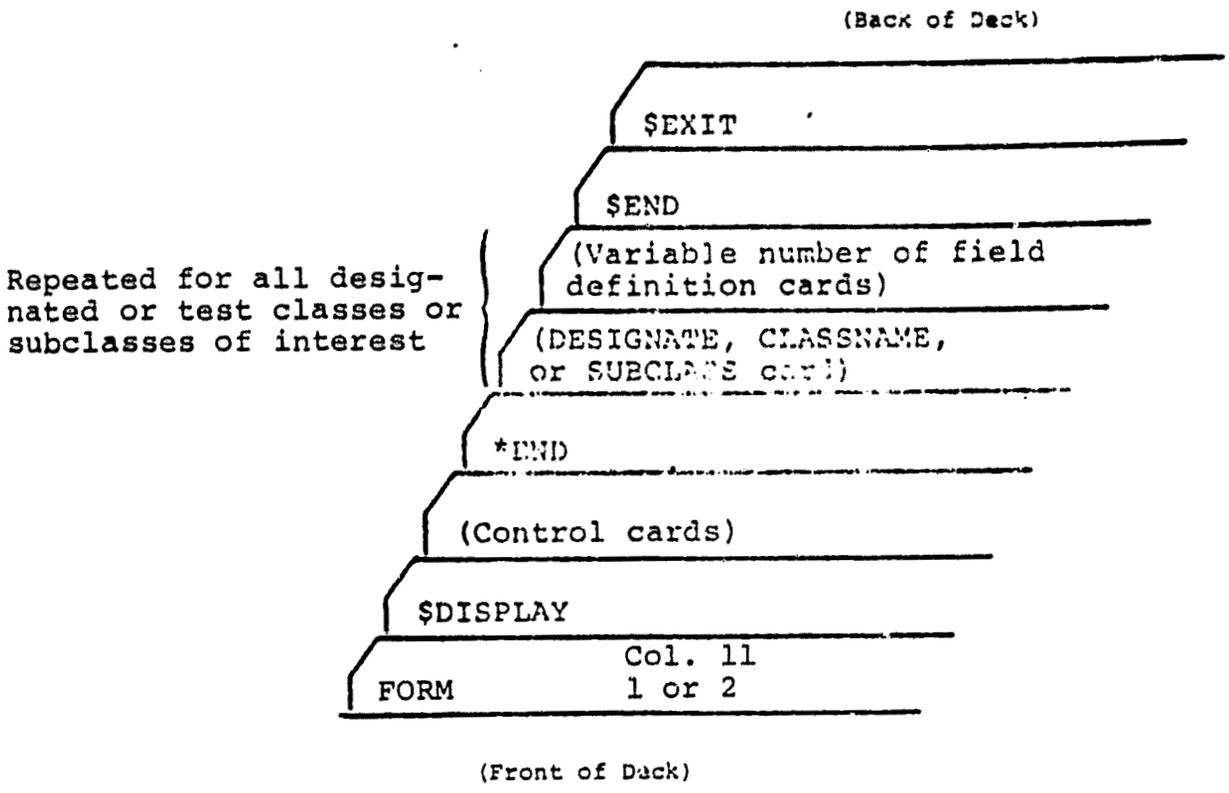


Figure 12-1.— Deck setup for the DISPLAY processor for independent execution. In remote processing, a card image file is used.

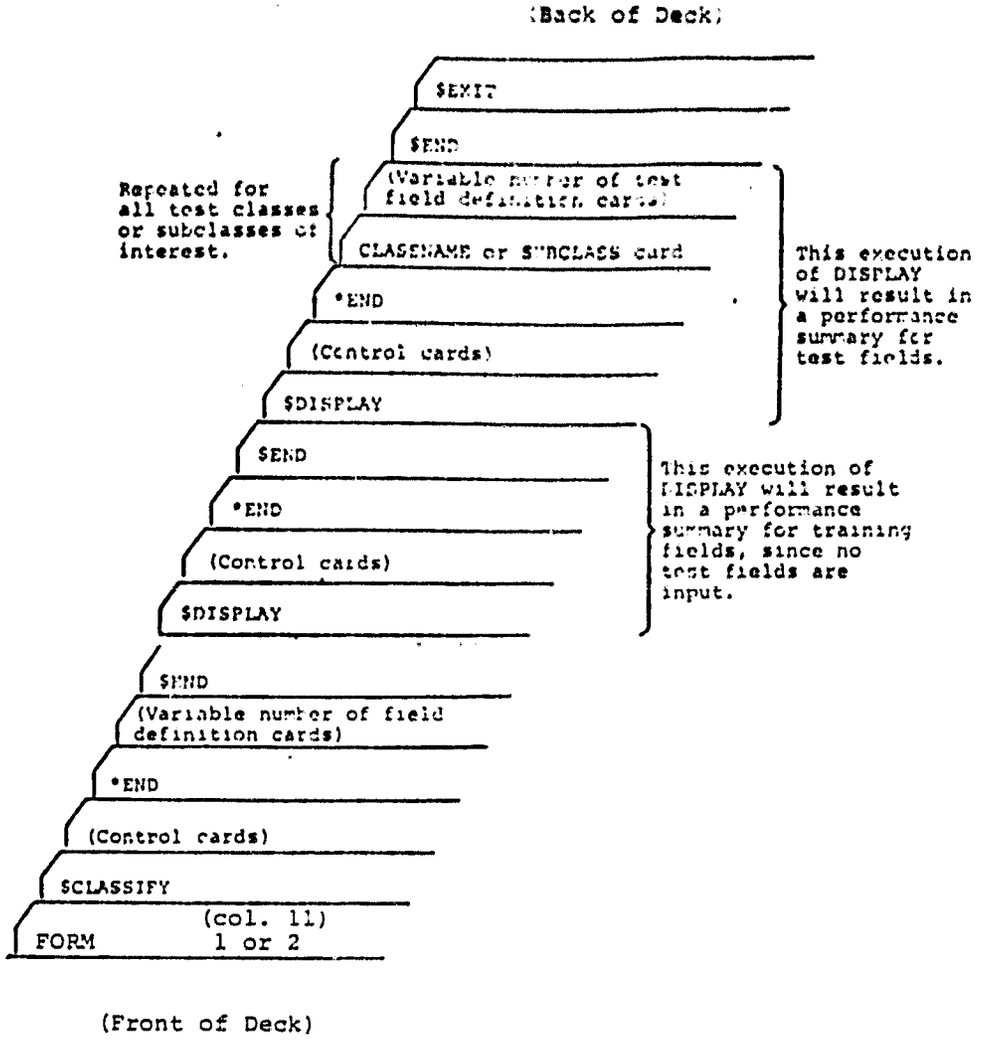


Figure 12-2.— Deck setup for the DISPLAY processor for execution back to back with the CLASSIFY processor.

13. DATA TRANSFORMATION PROCESSOR - DATATR

13.1 DESCRIPTION

Analysts may modify the data on an MSS image in many ways using this processor. He may use any matrix transformation that can be coded in the following form:

$$z = B\bar{x} + b$$

where $\bar{x}$ represents a pixel or data vector. With this processor, an analyst may apply standard transformations, such as a given affine transformation; apply complex transformations, such as extracting four Kauth greenness channels from a multitemporal Landsat image; scale the data after applying the matrix and bias vector in several ways; and scale the data without modifying it in any other way.

The user may rescale the data by direct input of parameters, by derivation of parameters from a histogram (the default method), or by another statistical method.

Control cards applicable to DATATR are given in Table 13-1. Diagnostics from DATATR are interpreted in Table 13-2.

13.2 INPUT/OUTPUT

An image tape must be furnished to this process for input. The transformed image is output on the TRFORM file, in either the Universal or LARSYS III format.

A B-matrix file must be input to this processor. The file may be obtained from a previous execution of SELECT. A module STAT file is optional input.

At least one field definition card must immediately follow the *END control card. An output file on unit 14 is created for each field definition input. The output field is rectangular and surrounds the vertices of the input field. All pixels outside the input field and within the rectangular output field are set equal to zero.

The DATA-TR processor can output the computed scaling parameters on cards. A full discussion of applicable control cards and of diagnostics from the DATATR processor is given in section 13 of Volume 2.

13.3 SAMPLE RUN

Job setups for various applications of DATATR are illustrated in figures 13-1 and 13-2.

TABLE 13-1.— CONTROL CARDS FOR DATATR

Required cards

Keyword	Parameters and Default Values	Function
$DATA-TR		
B-MATRIX	CARDS or FILE Default: None	CARDS indicates that the B-matrix is on cards immediately following. FILE indicates that the B-matrix is on file and initiates input of the BMFILE.
*END	Blank	Signals the end of the control cards.
FIELDS ...		
$END	Blank	Signals the end of all card input for the processing function.

Optional cards

BIAS	$b_1,b_2,b_3,\ldots b_k$ $N*b_1,b_{N+1},\ldots,b_k$ k = number of components in the transformed data set and N=an integer repetition factor for b_i $i \leq 16$ Default: $b_i=0.0$	All b's are decimal (floating point) numbers, separated by commas; they comprise the bias vector to be applied in the transformation of the input data set: $Z = \vec{B}(\vec{X}+b)$
DATAFILE	UNIT=N,FILE=M Default: N=11,M=1	N is the Fortran logical unit number to which the MSS data tape (DATAPE) has been assigned; M is the file number on the tape to be processed.
FORMAT	OUTPUT=LARSYS	The transformed data will be output in LARSYS III format.
FORMAT	OUTPUT=UNIVERSAL Default: LARSYS II	The transformed data will be output in Universal format.
LAM	N Default: N=2	An integer multiplied by the standard deviations of the input subclass statistics to derive an approximate range for rescaling the transformed data.
MAXPT	$M_1,M_2,M_3,\ldots,M_k$ $k \leq 30$ Default: 255,255,...	Maximum expected value of MSS data tape (DATAPE) input for each channel. M's are integers used in deriving an approximate range (MIN_i,MAX_i) of the transformed data set for the histogram method of rescaling.
MODULE	CARDS Default: If RESCALE is input, the histogram method is assumed.	Initiates reading of the module STAT file that must immediately follow this card; if rescaling is performed, it initiates the statistical method.
MODULE	FILE Default: If RESCALE is input, the histogram method is assumed.	Initiates reading of the SAVTAP file; if rescaling is performed, it initiates the statistical method.
OPTION	ORIG Default: No statistics printout.	Initiates the printout of the original (untransformed) statistics for the subclasses input for the statistical rescaling method.
OPTION	PUNCH Default: No cards punched.	Directs the program to punch the scaling parameters (CON_i,MIN_i) on cards.
OPTION	SCAFAC=(CON_1,MIN_1), (CON_2,MIN_2),...,(CON_i,MIN_i)	CON and MIN are floating point values separated by a comma. Blanks between the two values are ignored. The scaling parameters should be ordered according to the transformed data vector components.
OPTION	TRANSF Default: No statistics printout.	Initiates the printout of the transformed statistics.
PEROUT	N Default: N=5, in which case 5% of the transformed data set.	An integer which specifies the percentage of points to be deleted from the upper and lower tails of the transformed data distribution in computing an approximate range for rescaling. For the histogram method of rescaling, N/2% is deleted from both the upper and lower tails of the histogram.

TABLE 13-1.— Concluded

Optional cards

Keyword	Parameters and default values	Function
RESCALE	Blanks Default: No rescaling.	Initiates rescaling of the transformed data to the range of 0 to 255.
STATFILE	UNIT=N,FILE=M Default: N=20,M=1	N is the Fortran logical unit number to which the SAVTAP file has been assigned; M is (1) the file number on the tape to be processed or (2) if a module STAT file is input, the number of the file on which to store the training statistics. If M≠1, this control card must precede the module STAT file.
SUBCLASS	$S_1,S_2,S_3,\ldots,S_k$ k≤number of subclasses on SAVTAP≤60. Default: Statistics for all subclasses.	Integers which define a subset of subclasses $S_1,S_2,S_3,\ldots$ from the input statistics (SAVTAP) to be used in calculating the scaling factors and approximating R_i.

Procedure 1 card

OPTION	CLSWT Default: The weights are assigned to intersubclass pairs.	The processor determines the class-subclass correspondence (after any grouping of subclasses if the GROUP control card is used) and assigns a weight=1.0 to the subclass pairs associated with all interclass pairs. Interclass subclass pairs are given a weight=0.0. NOTE:(1): The WEIGHTS control card remains available to allow the user to set weights for specific subclass pairs. If used, the input subclass pair weights override the processor-set subclass pair weights. NOTE (2): The "WEIGHTS OTHERS" capability is not available when this option is exercised. In input, it is ignored by the processor.

Ancillary cards

HED1, HED2, DATE, COMMENT (See Table 3-1)

TABLE 13-2.— DIAGNOSTICS FROM DATATR.

Message	Explanation
*** BAD SUPERVISOR CONTROL CARD SETUP8 ***	Check spelling of keyword.
*** INVALID CONTROL CARD REJECTED SETUP8 ***	Check spelling of parameter.
*** THE CHANNEL NUMBER MUST LIE BETWEEN 1-30 ***	Incorrect channel number input.
*** BAD FIELD CARD FROM LNTRAN ***	Check format of field card.
*** THE NUMBER OF COMPONENTS IN Y-VECTOR TIMES THE NUMBER OF SAMPLES EXCEEDS THE SIZE OF STORAGE AREA - TERMINATE ***	Self-explanatory.
SETREM ERROR - THREE WERE XX SCALE FACTORS AND MINIMUM VALUES INPUT THROUGH THE SCAFAC OPTION. YY LINEAR COMBINATIONS WERE REQUESTED. THERE MUST BE A SCALE FACTOR AND A MINIMUM VALUE FOR EACH LINEAR COMBINATION. THE PROGRAM WILL TERMINATE THROUGH CMERR.	This message indicates that the input scaling parameter pairs are not in one-to-one correspondence with the number of components of the transformed data. Too many or too few pairs were input.

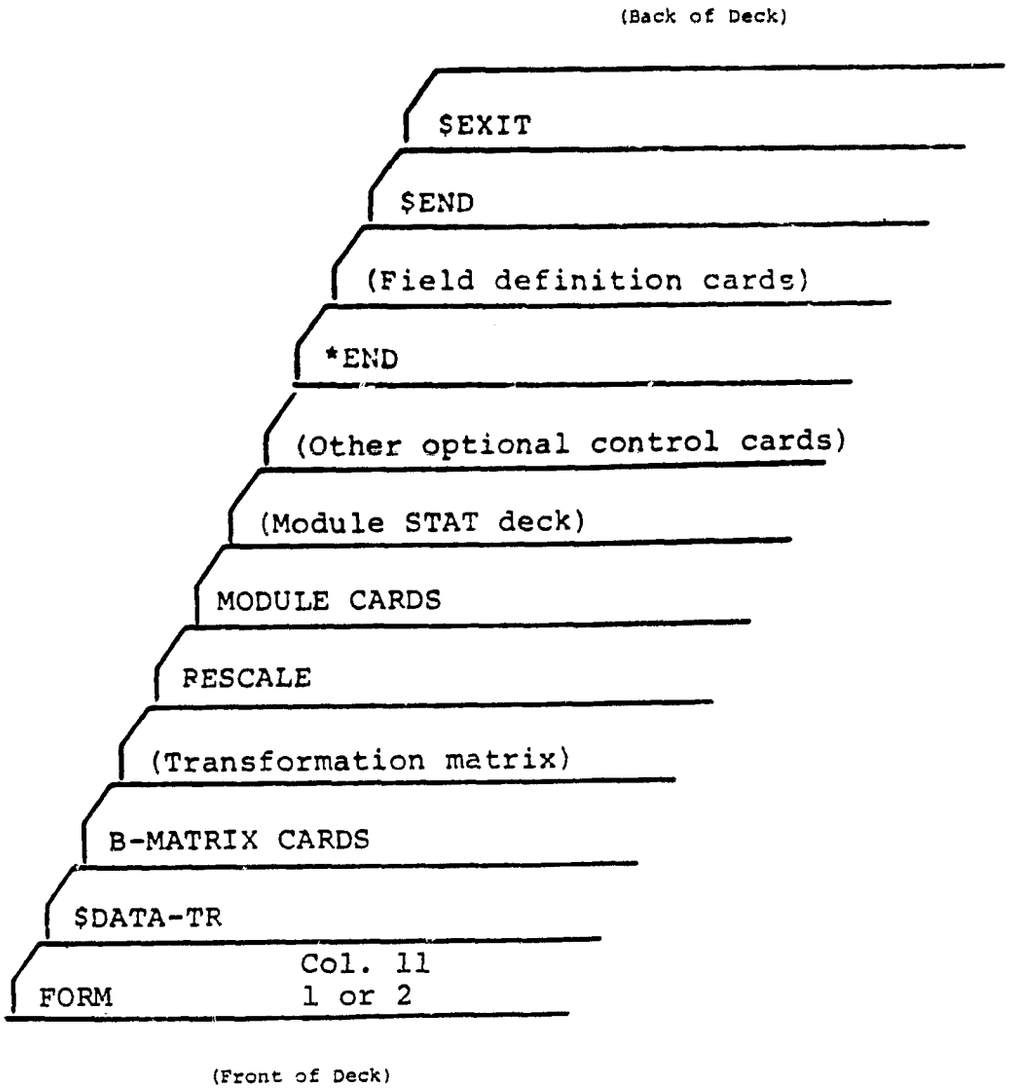


Figure 13-1 — Deck setup for the DATATR processor illustrating input of rescaling statistics and transformation matrix. In remote processing, a card image file is used.

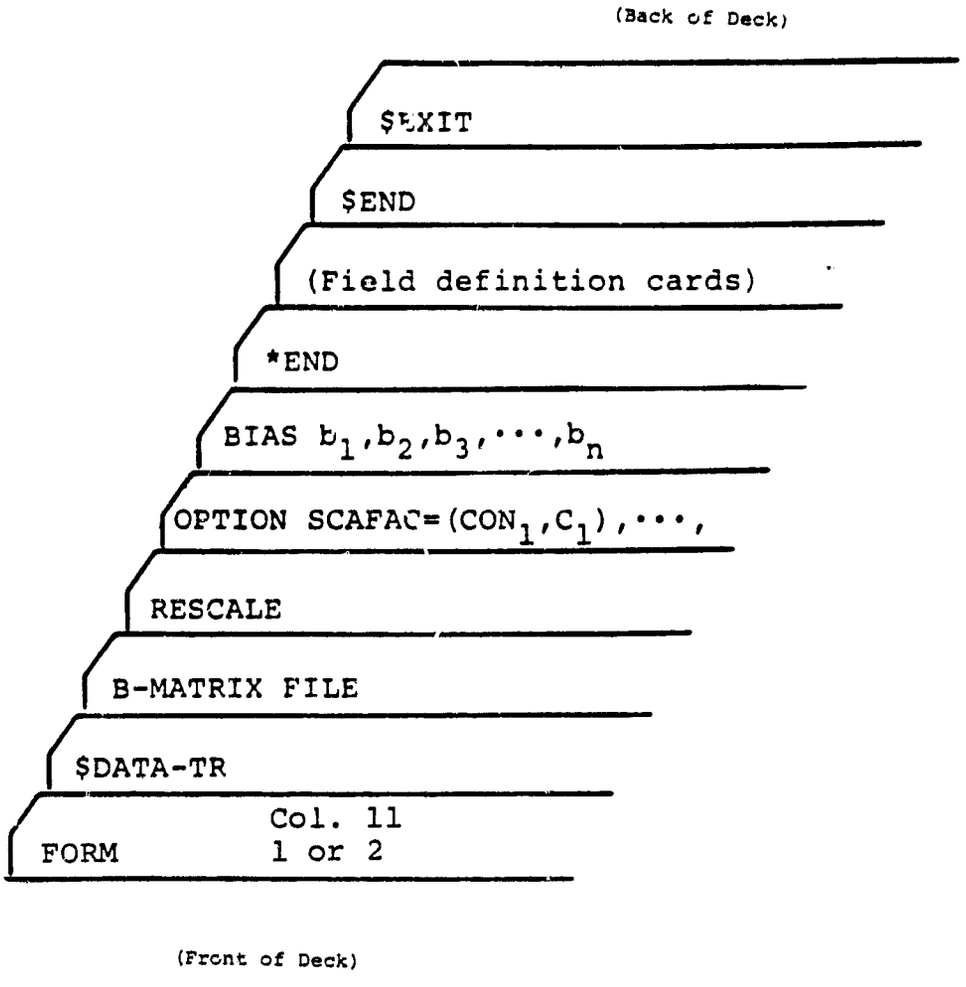


Figure 13-2.— Deck Setup for the DATATR processor illustrating input of a transformation matrix, scaling factors, and a transformation bias vector. In remote processing, a card image file is used.

14. STATISTICS TRANSFORMATION PROCESSOR - TRSTAT

14.1 DESCRIPTION

In some cases, it is more convenient to transform statistics of groups of pixels than to transform the pixels themselves. This processor takes a SAVTAP file (in memory or on tape) which has been produced by STAT or ISOCLS and transforms the means and covariance of the groupings (which may be fields, groupings of fields, or clusters).

This processor will read a SAVTAP file or card deck generated by STAT or ISOCLS, perform an affine transformation on the means and covariances, and output the transformed statistics on a new file. The equation for the transformation of the means is as follows:

$$\mu' = A\mu + b \qquad (14\text{-}1)$$

where

A = a k-by-n matrix $k \leq 15$ and $n \leq 30$

μ = an n-by-1 mean vector

b = a k-by-1 bias vector

μ'= a k-by-1 transformed mean vector

The equation for the transformation of the covariances is as follows:

$$K' = AKA^T \qquad (14\text{-}2)$$

where

K = an n-by-n covariance vector

A^T = an n-by-k transpose of A

K' = a k-by-k transformed covariance matrix

14.2 USE OF THE PROCESSOR

There are relatively few complications to the use of the processor. A SAVTAP file must be available on disk or in memory, or in a module STAT deck. An A-matrix b-vector must be furnished in the form of an A-matrix card file. The transformed means and covariance matrices are produced on a new SAVTAP file in memory or on disk. Pertinent control cards are given in Table 14-1.

Diagnostic messages are listed in Table 14-2. A full discussion of control cards, and of diagnostics from the TRSTAT processor, is given in section 14 of Volume II.

14.3 SAMPLE RUN

A job setup for the independent execution of the TRSTAT processor is shown in Figure 14-1.

TABLE 14-1,— CONTROL CARDS FOR TRSTAT

Required cards

Keyword	Parameter and default values	Function
$TRSTAT		Calls processor
CHANNELS	$N_1, N_2, N_3, \cdots, N_k$ k=number of matrix channels ≤ 30	N's are integer channel numbers referring to the SAVTAP file. The number of channels requested from SAVTAP must be equal to the number of channels on the A-matrix file.
A-MATRIX	Blank	Initiates input of the A-matrix and b-vector. The A-matrix deck immediately follows this card.
*END	Blank	Signals the end of the control cards.
$END	Blank	Signals the end of all card input for the processing function.

Optional cards

MODULE	Blank	Initiates input of the module STAT file, which immediately follows this card. (See section 3.1.4.1 for module STAT file format.)
OPTION	P,O,T	P punches the transformed statistics; O prints the original statistics; and T prints the transformed statistics.
STATFILE STATFILE	INPUT/UNIT=N, FILE=M OUTPUT/UNIT=L, FILES=S Default: N=20,; M=1; L=20; S=1	N is the Fortran logical unit number to which the tape containing the statistics to be transformed (SAVTAP) has been assigned; M is the number of the file to be processed; L is the Fortran logical unit number to which the transformed statistics are to be output; and S is the number of the next file to be created on output SAVTAP file.
SUBCLASS	$S_1 S_2, S_3, \cdots, S_k$ k=number of subclasses on SAVTAP ≤ 60 Default: Statistics for all subclasses defined	Transforms statistics for only subclasses $S_1, S_2, S_3, \cdots$.

Ancillary cards

HED1, HED2, DATE, COMMENT (see section 3.1)

TABLE 14-2.— DIAGNOSTICS FROM TRSTAT

Message	Explanation
*** BAD SUPERVISOR CONTROL CARD SETUP9***	Invalid control card. Check spelling of keyword.
NUMBER OF CHANNELS FROM STAT FILE DOES NOT EQUAL THE NUMBER OF CHANNELS ON A-MATRIX FILE. CHANNELS ON STAT FILE = _____. CHANNELS ON A-MATRIX = _____.	Self-explanatory.
INVALID CONTROL CARD REJECTED ***SETUP9 ***	The parameter field of the control card is in error.

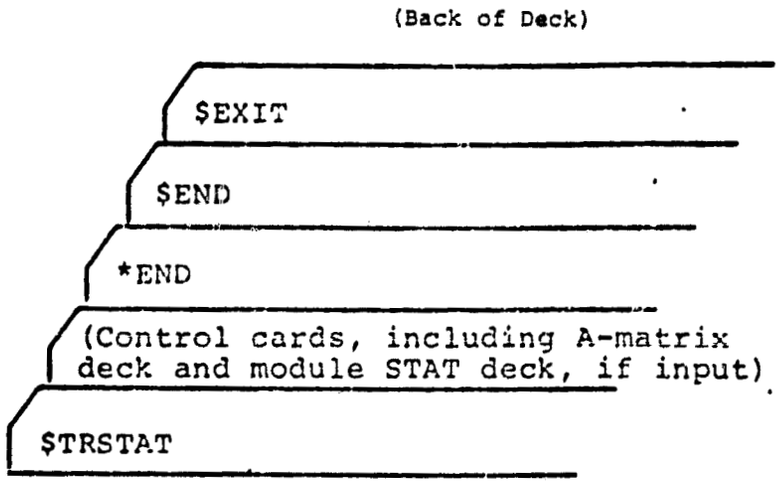


Figure 14-1.— Deck setup for executing the TRSTAT processor with the module STAT deck. In remote processing, a card image file is used.

15. N-DIMENSIONAL HISTOGRAM PROCESSOR - NDHIST

15.1 DISCUSSION

An analyst can prepare scatter plots (sometimes called spectral plots) under several options. To prepare scatter plot images on tape (for display on other devices) he would normally extract information from an image with this program, prepare the scatter plot tape using the SCTRPL processor, and view the color-coded image on the television screen of another computer. He may also see a scatter plot on paper from the SCTRPL program (see the sample program in the section on the SCTRPL processor).

15.2 CHANNELS

For each pixel in a field, this program extracts the necessary information for preparing a spectral plot and writes it on the NDIM tape. This is equivalent to preparing an N-dimensional histogram in the channels needed by the spectral plot. The program arranges these data on tape in a form appropriate for use by the SCTRPL processor.

There are two uses for channels and hence two kinds of channels, "plotting channels" and "color channels". Since a scatter plot has two formal axes, there must be at least two plotting axes. No more channels are necessary for making black and white scatter plots as shown in the sample scatter plot program.

Color-coded scatter plots must be displayed on television screens or on film. There must be three channels of color data to specify the color of each dot on the scatter plot, for the primary display colors of blue, yellowish-green, and red. As many as four color channels may be furnished.

Color assignments for scatter plots are made in the NDHIST or the SCTRPL processor. If made in NDHIST, the color codes are output on the NHSTUN tape. Color codes may be set in the following ways:

a. The original radiance value of the pixel (see CHANNELS control card, Table 15-1).

b. The mean value of the cluster or subclass to which the pixel was assigned during clustering or classification. In exercising this option, the user must input a classification or cluster map (see MAPFIL control card, Table 15-1) to this processor. To execute the SCTRPL processor, a SAVTAP file related to the MAPUNT file must be input (see CHANNELS and STATFILE control cards, section 16, Table 16-1). The subclass or cluster numbers assigned to the pixel during

classification or clustering are stored on the NHSTUN file, passed to the SCTRPL processor, and used for retrieving the means from the SAVTAP file.

c. The mean value of the test or training field from which the pixel was extracted (see OPTION MEANS card in Table 16-1).

d. User-defined colors (see COLOR control card, Table 16-1).

e. From any pass on the MSS data tape when using multiregistered Landsat data (see CHANNELS control card, Table 15-1).

It will be seen later that the SCTRPL processor allows the the use of up to M=16 plotting channels, provided only that a 2-by-M B-matrix is specified in SCTRPL to reduce M channels to the two display axes.

The N-dimensional histogram will be calculated on the basis of all channels, plotting channels as well as color channels. To be examined, the histogram must be displayed in some way by the SCTRPL processor.

15.3 INPUT/OUTPUT

An image tape, DATAPE (unit 11), must be furnished to this processor. The processor always produces an NHSTUN file (unit 4). Although messages are produced (Table 15-2), no data are printed on output listing. Data can only be examined using the SCTRPL processor.

Control cards applicable to NDHIST are given in Table 15-1. Diagnostics from NDHIST are interpreted in Table 15-2. A full discussion of applicable control cards, and of diagnostics from the NDHIST processor is given in section 15 of Volume II.

15.4 SAMPLE RUN

See Figure 15-1 for an application of NDHIST in combination with SCTRPL.

TABLE 15-1.– CONTROL CARDS FOR NDHIST

Required cards

Keyword	Parameter and default values	Function
$NDHIST	None	Calls processor.
CHANNELS	PLOT=$n_1,n_2,n_3,\ldots,n_i$ COLOR=$m_1,m_2,m_3,\ldots,m_j$	The n's are the channels for determining the position (X,Y) of the pixels to be output on the SCTRUN tape (unit k). If n_{k+1} defines the sample location and n_{k+2} the line location in the scatter plot tape (SCTRUN). If $k=2$, the pixels will be transformed by two components in the SCTPPL processor; component 1 will define the sample location and component 2 the line location in the scatter plot tape (SCTRUN). The m's represent the channels for the color guns (max 3). If two PLOT channels are input, the histogram is a function of both PLOT and COLOR channels; if the COLOR channels are omitted, the histogram is a function of only the PLOT channels. (See text for further information.)
*END		
FILLDS		
$END		

Optional cards

DATAFILE	UNIT=N,FILE=M Default: N=11,M=1	N is the logical unit number assigned to the MSS data tape (DATAFIL); M is the file number of the data to be processed.
HISFIL	UNIT=N Default: N=1	The logical unit number assigned to the "HIST" file.
MAPFILE	UNIT=N,FILE=M Default: None	N is the logical unit number assigned to the MAPPNT tape; M is the file number of the data to be processed. The order of the fields to be histogrammed must correspond to the order of the clustered or classified fields on the input MAPPNT tape.
OPTION	CLASS	Fields will be histogrammed on class bases.
OPTION	FIELD Default: Field bases.	Fields will be histogrammed on per-field bases.
OPTION	MEANS	The means of each field will be computed for the COLOR channels on the CHANNELS card and output on the "HIST" file.
OPTION	SUBCLS	Fields will be histogrammed on subclass bases.

Ancillary cards

HED1, HED2, DATE, COMMENT (see Table 3-1)

TABLE 15-2.— DIAGNOSTICS FROM NDHIST

Message	Explanation
INVALID CONTROL CARD - IGNORED	Check spelling of keyword.
ERROR ON CHANNELS CARD.	Check parameter field of CHANNELS control card.
ERROR ON DATA FILE CARD.	Check parameter field of DATAFILE control card.
ERROR ON MAP FILE CARD.	Check parameter field of MAPFIL control card.
ERROR ON N-DIM HISTOGRAM FILE CARD.	Check parameter field of HISFIL control card.
ERROR ON OPTION CARD.	Check parameter field of OPTION control card.
--VECTORS WERE NOT HISTO-GRAMMED, BUT USED IN COMPUTING FIELD MEANS, IF APPLICABLE.	The histogrammed vector table is full. N number of unique vectors were not histogrammed.
CORE LIMITS EXCEEDED. MAXIMUM NO. OF VECTORS ACCEPTED IS ___.	Self-explanatory.
TOO MUCH DATA REQUESTED. REDUCE NO. OF SAMPLES PER SCAN LINE AND/OR NO. OF CHANNELS.	Self-explanatory.
NOT ENOUGH DISK SPACE TO STORE MAP TAPE DATA.	Reduce amount of data being processed.

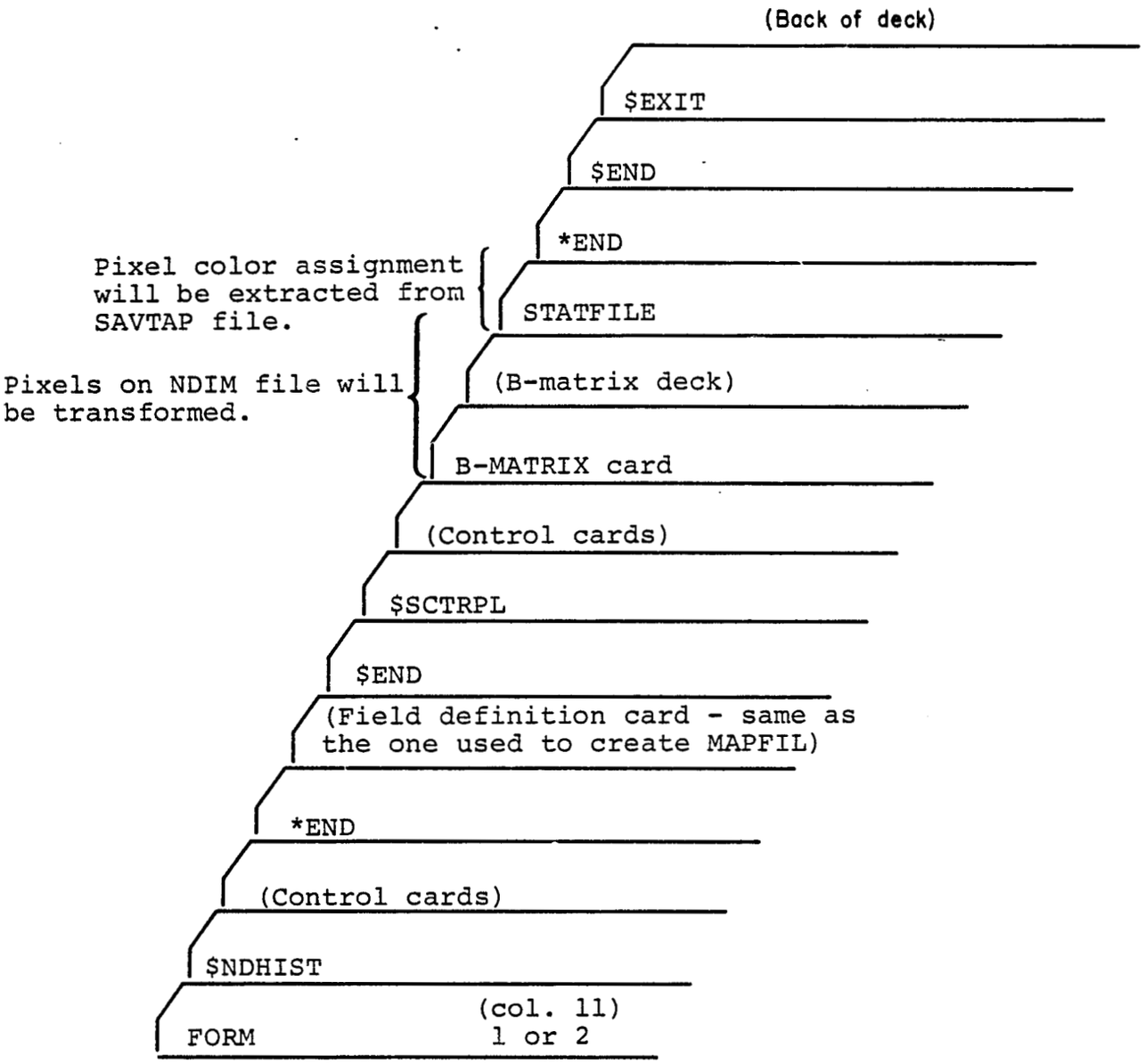


Figure 15-1.— Deck setup for execution of NDHIST back to back with the SCTRPL processor. In remote processing, a card image file is used.

TABLE 15-2.– DIAGNOSTICS FROM NDHIST

Message	Explanation
INVALID CONTROL CARD - IGNORED	Check spelling of keyword.
ERROR ON CHANNELS CARD.	Check parameter field of CHANNELS control card.
ERROR ON DATA FILE CARD.	Check parameter field of DATAFILE control card.
ERROR ON MAP FILE CARD.	Check parameter field of MAPFIL control card.
ERROR ON N-DIM HISTOGRAM FILE CARD.	Check parameter field of HISFIL control card.
ERROR ON OPTION CARD.	Check parameter field of OPTION control card.
--VECTORS WERE NOT HISTO-GRAMMED, BUT USED IN COMPUTING FIELD MEANS, IF APPLICABLE.	The histogrammed vector table is full. N number of unique vectors were not histogrammed.
CORE LIMITS EXCEEDED. MAXIMUM NO OF VECTORS ACCEPTED IS ___.	Self-explanatory.
TOO MUCH DATA REQUESTED. REDUCE NO. OF SAMPLES PER SCAN LINE AND/OR NO. OF CHANNELS.	Self-explanatory.
NOT ENOUGH DISK SPACE TO STORE MAP TAPE DATA.	Reduce amount of data being processed.

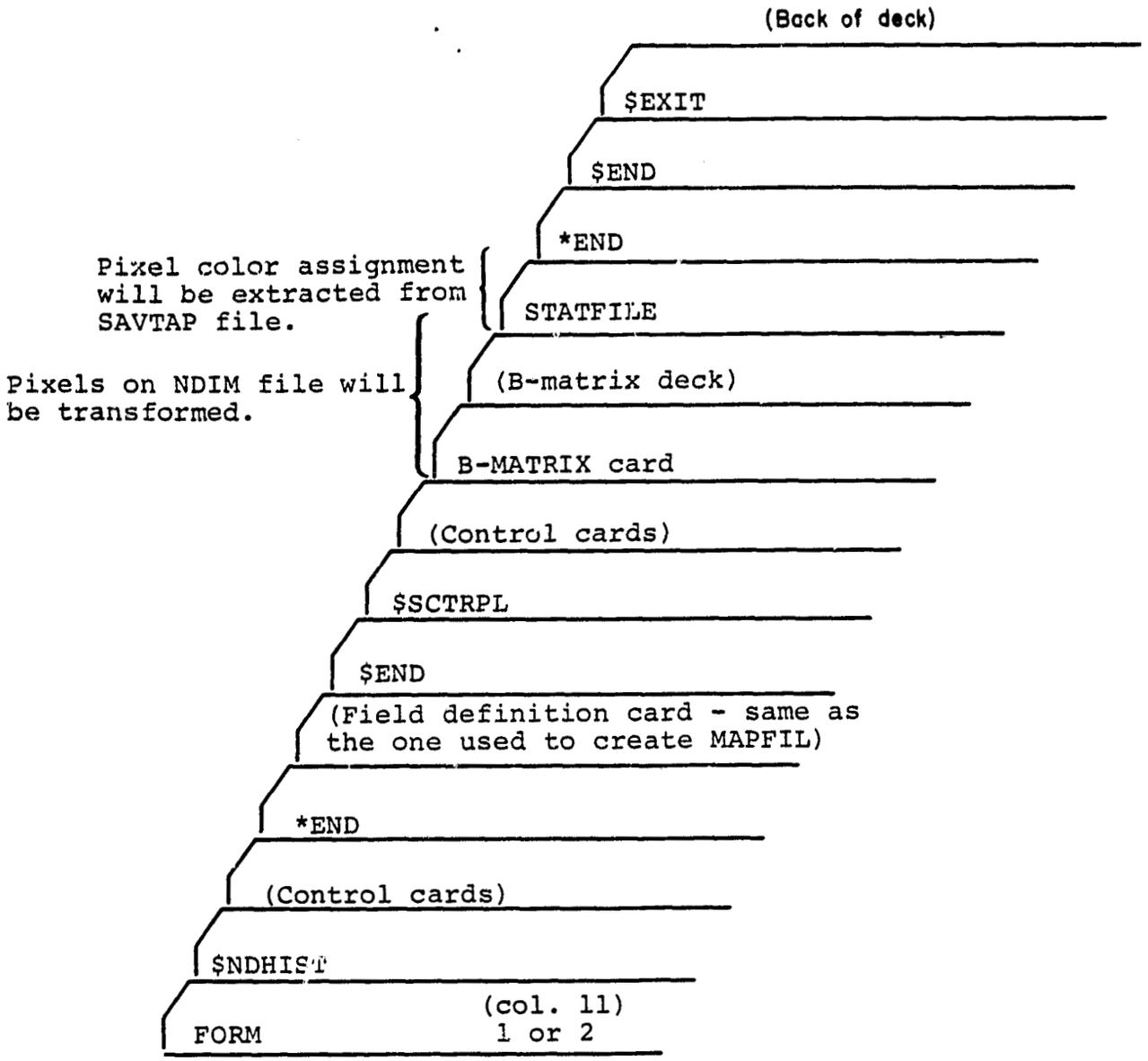


Figure 15-1.- Deck setup for execution of NDHIST back to back with the SCTRPL processor. In remote processing, a card image file is used.

16. SCATTER PLOT PROCESSOR - SCTRPL

An analyst can only use this processor in combination with the NDHIST processor to produce scatter plots. He can produce them on paper or he can produce color-coded display images. These scatter plots are also called spectral plots, but they are not the same as the spectral plots produced by the STAT processor.

Data are always taken from the NHSTUN file produced by the NDHIST processor. Color-coded scatter plots may be prepared on tape, if desired, or black and white plots can be prepared on paper directly.

16.1 CHANNELS

The two axes of the scatter plot are taken from the plotting channels of the NHSTUN file. If there are only two plotting channels, these will be used without further instructions. If there are more than two plotting channels, a B-matrix file must be furnished to produce two plotting channels from those in the NDIM file (the B-matrix deck will contain a 2-by-n matrix, where n is the number of plotting channels in the NHSTUN file). The plotting channels must have previously been identified by a CHANNELS card in the NDHIST processor, as shown in the following paragraph. An additive two-dimensional bias vector can also be furnished by the user.

The color channels will be the same color channels identified in the NDHIST program. There may be as many as four of them. These must have been defined by the CHANNELS card in the NDHIST processor. A possible example is:

```
CHANNELS PLOT = 3, 4, 5      COLOR = 5, 6, 7, 8
```

16.2 THE SCATTER PLOT ON TAPE

A file, called SCTRUN, will be produced by this processor if the PLOTAP control card is used. The file contains an image in the JSC Universal format. The image itself contains 65 lines and 129 samples per line and is reproduced in five channels; the first four channels are the color channels and the fifth is a frequency-of-occurrence channel. (If fewer than four color channels were furnished, the remaining channels contain only axes.)

Scaling of the scatter plot is controlled by the SIZE cards.

The SCTRUN file on tape is ready for display on standard image display devices such as the Image-100 computer system.

16.3 INPUT/OUTPUT

As noted above, an NHSTUN file is required input to the processor, and a SCTRUN file is normal (but not required) output from it.

Other items must be input for certain options. If the plotting channels must be reduced to two channels, a B-matrix must be furnished by deck unless it can be read from a file. If the color codes are assigned from clusters or classes (see description of NDHIST), then a SAVTAP file from STAT or ISOCLS must be furnished. (For this option, a MAPUNT file must have been furnished to the NDHIST program for preparation of the NHSTUN tape.)

Control cards applicable to the SCTRPL processor are given in Table 16-1. Diagnostics from SCTRPL are interpreted in Table 16-2. A full discussion of relevant control cards and of diagnostics from the SCTRPL processor is given in Section 16 of Volume II.

16.4 SAMPLE RUN

Figure 16-1 shows the job setup for an exeution of SCTRPL back to back with NDHIST.

TABLE 16-1.— CONTROL CARDS FOR SCTRPL

Required cards

Keyword	Parameter and default values	Function
$SCTRPL		
END		
$END*		

Optional cards

Keyword	Parameter and default values	Function
BCKGND	N Default: N=255	If N=0, background will be black; if N=255, background will be white.
B-MATRIX	CARDS Default: None	The B-matrix is being input by cards.
B-MATRIX	FILE Default: None	The B-matrix is being input by file.
BVEC	$T_1,T_2,\ldots,T_n$ n=number of linear combinations in B-matrix. Default: T_n=0.0	Elements of the additive vector to be used in the transformation; T is a floating-point number.
CHANNELS	$n_1,n_2,n_3,\ldots,n_i$ i≤number of channels on SAVTAP≤30. Default: First 4 channels from NHSTUN file.	Statistics for these channels will be extracted from the SAVTAP file; n_i must be a subset of channels on the SAVTAP file.
COLOR	$(m_1),(m_2),\ldots,(m_p)$ or $L*(m_1),K*(m_{L+1})$ L and K are integer repetition factors. Default: No user input of color codes.	$m_1=n_1,n_2,\ldots n_i$ is the color assignment for cluster 1; $m_2=n_1,n_2,\ldots,n_i$ is the color assignment for cluster 2; $m_p=n_1,n_2,\ldots,n_i$ is the color assignment for cluster n. p≤60 and i≤4; $0\leq n_i\leq 255$.
HISFIL	UNIT=N Default: N=13	N is the logical unit number assigned to the NHSTUN file.
MODULE	Blank	Initiates the input of the module STAT file which immediately precedes this card (see section 3.1.4.1 for format).
PIXPLT	FREQ	Line printer pixel scatter plot of the frequency of occurrence will be printed.
PIXPLT	LOG	Line printer pixel scatter plot of the log of frequency of occurrence will be printed.
PIXPLT	RESCALE Default: No rescaling. XSIZ=101, YSIZE=101; the range for x-axis is XLOW+XSIZE-1; the range for y-axis is YLOW+YSIZ-1.	The frequency of occurrence of the pixel for the line printer scatter plot will be rescaled to ranges XLOW, XHIGH, YLOW, and YHIGH. XSIZ will determine the number of bins on the x-axis; YSIZ, the number of bins on the y-axis. (See SIZE control cards.)
PLOTAP	UNIT=N	N is the logical unit number assigned to the spectral plot tape.
SCALE	FILE	The scale factors will be computed from the NHSTUN file.

TABLE 16-1.— Concluded

Optional cards

Keyword	Parameter and default value	Function
SCALE	RESCALE: Default: No rescaling of the transformed data.	The transformed data will be rescaled to the range of XLOW, XHIGH, YLOW, and YHIGH. (See SIZE control card.)
SCALE	[a]XMAX=T Default: XMAX will be computed from the NHSTRUN file.	The upper range for the transformation of the sample values (x-axis); T is a floating-point number.
SCALE	[a]XMIN=T Default: XMIN will be computed from the NHSTRUN file.	The lower range for the transformation of the sample values (x-axis); T is a floating-point number.
SCALE	[a]YMAX=T Default: YMAX will be computed from the NHSTUN file.	The upper range for the transformation of the line values (y-axis); T is a floating-point number.
SCALE	[a]YMIN=T Default: YMIN will be computed from the NHSTUN file.	The lower range for the transformation of the line values (y-axis); T is a floating-point number.
SIZE	XHIGH=N Default: XHIGH=100	The upper limit of the radiance value for the sample axis (x-axis); N≤255.
SIZE	XLOW=N Default: XLOW=0	The lower limit of the radiance value for the sample axis (x-axis); 0≤n≤XHIGH.
SIZE	XSIZ=N Default: XSIZ=101	The number of samples per line to output on the scatter plot tape; N≤200.
SIZE	YHIGH=N Default: YHIGH=100	The upper limit of the radiance value for the line axis (y-axis); N≤255.
SIZE	YLOW=N Default: YLOW=0	The lower limit of the radiance value for the line axis (y-axis); 0≤N≤255.
SIZE	YSIZ=N Default: YSIZ=101	The number of lines to output on the scatter plot tape; N≤200.
STATFILE	UNIT=N,FILE=M Default: None	N is the logical unit number assigned to the SAVTAP file; M is the number of the file to be processed.
SYMBOLS	$S_1,S_2,S_3,\ldots,S_k$ k≤32 Default: Two sets of 10 symbols overprinted.	Character set separated by commas, with a maximum of 32 characters. The number of symbols/2 determines the number of bin levels. The first set of symbols is overprinted by the second set. A blank is not a legitimate character.

[a]If one of the parameters XMIN, XMAX, YMIN, or YMAX is input, all four parameters must be input.

TABLE 16-2.- DIAGNOSTICS FROM SCTRPL

Message	Explanation
INVALID CONTROL CARD -- IGNORED.	Check spelling of keyword.
ERROR ON CHANNELS CARD.	Check parameter field of CHANNELS card.
ERROR ON STAT FILE CARD.	Check parameter field of STATFILE card.
ERROR ON NDIM HISTOGRAM FILE CARD.	Check parameter field of HISFIL card.
ERROR ON OPTION CARD.	Check parameter field of OPTION card.
ERROR ON TAPE SIZE CARD.	Check parameter field of SIZE card.
ERROR ON SCATTER PLOT TAPE CARD.	Check parameter field of PLOTAP card.
ERROR ON SCALING CARD.	Check parameter field of SCALE card.
DATA MUST BE RESCALED BEFORE PIXEL FREQUENCY PLOT OPTION MAY BE SELECTED.	Transformed data must be rescaled for line printer plot.
NO. OF PLOTTING CHANNELS, NO. OF B-MATRIX CHANNELS MUST BE EQUAL. CHANNELS ARE _____, RESPECTIVELY.	Number of channels to be transformed, must equal the number of channels in transformation matrix.
A TOTAL OF ____ POINTS WERE NOT DISPLAYED ON THE LINE PRINTER GRAPH. THE POINTS WERE OUT OF RANGE IN EITHER THE X DIRECTION OR Y DIRECTION.	Data may be rescaled to a resolution of 100.

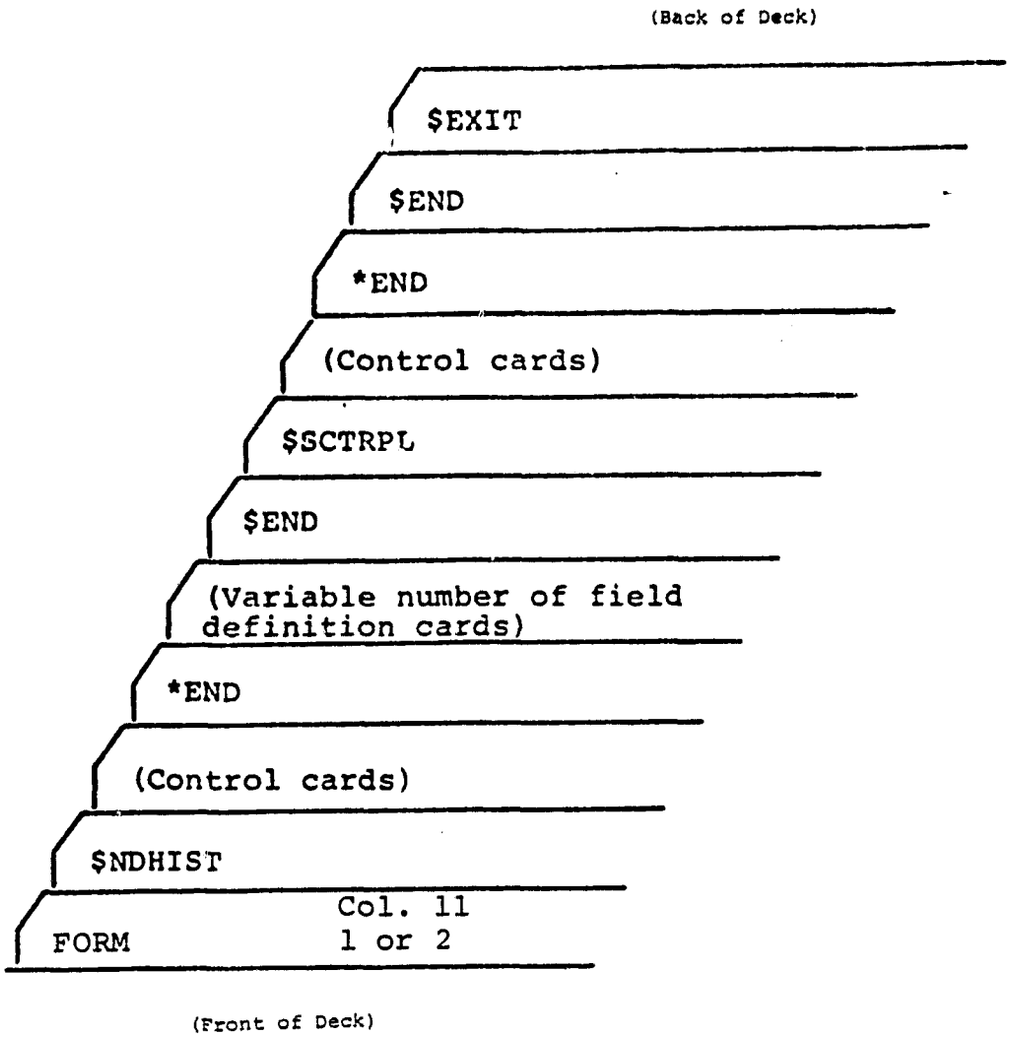


Figure 16-1.— Deck setup for the SCTRPL processor for execution back to back with NDHIST. In remote processing, a card image file is used.

17. DOT DATA PROCESSOR - DOTDATA

17.1 DISCUSSION

In Procedure 1, an analyst needs to be able to label certain pixels, otherwise known as dots. These dots are a preselected set of grid points used to initialize clustering, to label clusters, and to perform other functions.

The current version of LACIE Procedure 1 uses a standard grid of 209 dots. They are spread uniformly over the standard LACIE image (117 lines of 196 pixels each), in all an 11-by-19 grid, as shown in Table 17-3.

Dots may be labeled or not labeled, and labeled dots may be classified as type 1 or type 2. Unlabeled dots are not given a type.

Type 1 dots (labeling dots) are used for labeling clusters (in the LABEL processor) as well as for initializing the clustering algorithm. Type 2 dots are called bias correction dots; they are used to quantify the bias in classification results so that a correction can be applied.

17.2 INPUT/OUPUT

There are few complications to the use of this processor. A user must furnish an image tape, as usual. He may select the dots in DOTDATA and label and type them in DOTDATA, or he may select them in DOTDATA and label them and type them in the LABEL processor. However, he may not label dots later that have not been at least selected in the DOTDATA processor.

This processor actually produces two files, one of type 1 dots and the other of type 2 dots. As a result, to change the type of a dot, an analyst must execute this processor again. Note that a dot can be typed even though it lacks a label, but in this case a label must be furnished in the LABEL processor.

Control cards applicable to DOTDATA are given in Table 17-1. Diagnostics from DOTDATA are interpreted in Table 17-2. A full discussion of applicable control cards, and of diagnostics from the DOTDATA processor, is given in section 17 of Volume II.

17.3 FIELDS

An analyst selects dots by field cards. The order of field cards determines the order of the dots in the dot data file, DOTUNT, the mandatory output file for user processing. In general, the analyst will need to know the position of the dots for defining starting vectors in ISOCLS and for labeling/relabeling the dots in LABEL.

As shown below, the type for each dot is defined by a TYPE card, and the label is defined by the CLASSNAME card. If the CLASSNAME card is omitted, the unlabeled dots must either be labeled by the control card DOTLABEL of the LABEL processor or excluded from the set by the control card EXCLUDE in the LABEL processor.

The following example illustrates a field data set for this processor.

```
*END*
TYPE          1
CLASSNAME     WHT (optional)
LAB1          (10,10), (10,10), (196,10)      (dots 1-19)
LAB2          (10,10), (10,20), (196,20)      (dots 20-38)
CLASSNAME     NWHT (optional)
LAB3          (10,10), (10,50), (100,50)      (dots 39-48)
TYPE          2
CLASSNAME     WHT (optional)
BIA1          (10,10), (10,50), (196,40)      (dots 1-19)
CLASSNAME     NWHT (optional)
BIA2          (10,10), (10,70), (196,70)      (dots 20-38)
$END*
```

Two files will be written. File 1 will contain 38 wheat dots followed by 10 NONWHT dots, all of which are type 1 dots.

File 2 will contain 19 WHT dots followed by 19 NWHT dots, all of which are type 2 dots.

If the CLASSNAME cards were omitted, file 1 would contain 48 unlabeled type 1 dots. File 2 would contain 19 unlabeled type 2 dots.

In both cases, the reference number for the dots in file 1 defined by LAB1 field card would be 1 through 19; LAB2 field card would be 20 through 38; and LAB3 field card would be 39 through 48. The reference number for the dots in file 2 defined by field card would be 1 through 19; and BIA2 field card would be 20 through 38. Care should be taken that the CLASSNAMES begin in column 11.

In the event the LACIE option is invoked, the field cards are as follows.

There are no TYPE or CLASSNAME card images. Each dot card has the following format (see Table 17-3).

Columns 1-3	DOT
Column 5	1 or 2 (TYPE 1 or TYPE 2)
Column 7	One-character category name
Columns 9-72	n_1, n_2, ..., n_N are LACIE dot numbers; n_1 would specify pixel (10,10); i.e., the pixel in line 10, column 10.

TABLE 17-1.– CONTROL CARDS FOR DOTDATA

Required cards

Keyword	Parameter	Function
$DOTDATA		
CHANNEL	DATE=$n_1,n_2,\ldots,n_{30}$ Default: None.	Integer numbers separated by commas referring to the channels on the MSS data tape.
*END		Indicates the end of the control card inputs.
$END*	Field cards (see text and sample program).	Indicates the end of all the card inputs.

Optional control cards

Keyword	Parameter	Function
DATAFILE	UNIT=n,FILE=m Default: n=20,m=1	n is the FORTRAN unit number assigned to the MSS data tape; m is the file number of the data to process.
DOTFIL	INPUT/UNIT=n,FILE=m Default: n=19,m=1	n is the FORTRAN unit number assigned to the dot data file output by this processor; m is the number of the file to output.
OPTION	PRINT Default: No line printer output	Prints the dot data file information on the line printer.
OPTION	LACIE	Dot input will be in LACIE format.

Ancillary cards

HED1, HED2, DATE, COMMENT (see Table 3-1)

TABLE 17-2.— DIAGNOSTICS FROM DOTDATA

Message	Explanation
INVALID CONTROL CARD-IGNORED	Check spelling of keyword.
ERROR ON DATAFILE CARD	Check parameter field.
ERROR ON DOTFILE CARD	Check parameter field.
ERROR ON OPTION CARD	Check format and spelling of parameters.
Note	
TOTVEC WAS GREATER THAN 250, THEREFORE TOTVEC WAS SET TO 250 ****	Total number of dots allowable is 250 of type 1 and 250 of type 2.

TABLE 17-3.– DOTS IN LACIE PROCEDURE 1

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38
39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57
58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76
77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114
115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133
134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152
153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171
172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190
191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209

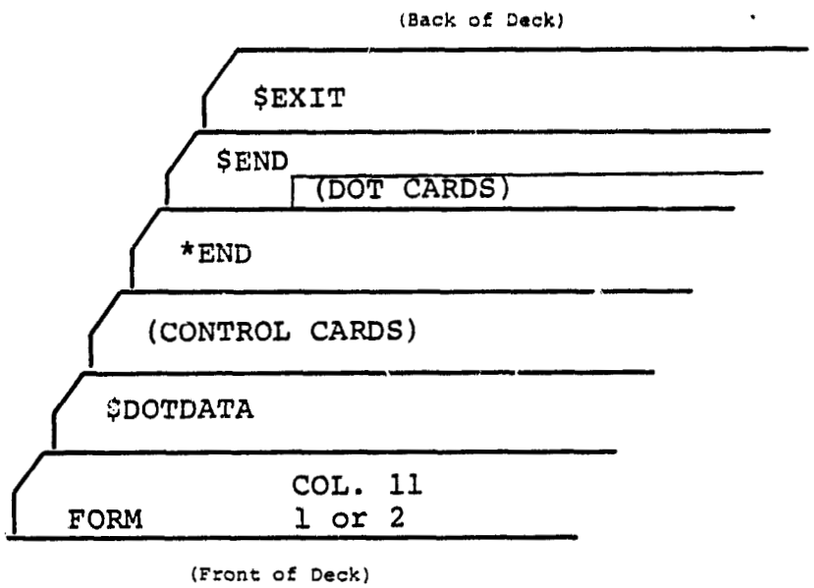


Figure 17-1.— Deck setup for the DOTDATA processor for independent execution.

18. LABEL PROCESSOR - LABEL

18.1 DISCUSSION

This processor allows the analyst to automatically label clusters produced by ISOCLS, using the k-nearest-neighbor procedure or the all-of-a-kind procedure.

This processor also allows the analyst to relabel dots in the DOTUNT file and relabel clusters on SAVTAP. He or she may also produce a map and list the new dotfile and statistics on the line printer.

18.2 LABELING PROCEDURES

The k-nearest-neighbor procedure polls the k labeling (type 1) dots that are closest in L1 or L2 distance to the cluster mean. The label of the majority of the k dots is chosen as the label of the cluster. For example if k is 5 and three of the five closest dots are labeled W, then the cluster is also labeled W. If a tie occurs, then K - 1 closest dots are considered.

For the all-of-a-kind procedure, all of the labeling dots within a cluster are polled. If all the dots are of one category, the cluster labels that category. If the cluster contains dots for more than one category, the label with the majority of the dots labels the cluster. If there are no labeling dots within a cluster, the labeling defaults to the k-nearest-neighbor procedure.

18.3 INPUT/OUTPUT

If (1) the all-of-a-kind procedure is selected, (2) if a conditional or mixed cluster map is output, or (3) if a DISPLAY interface tape is output, a MAPUNT file must be input, and a field card defining the area of the unconditional cluster map (input MAPUNT) must also be input. The vertices must reflect the sample number and line number of the MSS data tape used to create the unconditional cluster map. That is, the field card must be identical to the field card input to ISOCLS.

If (1) the all-of-a-kind procedure is not to be executed, (2) if a MAPUNT file not output, or (3) if a MAPTAP is not output, a field card is not required.

Example of the data set:

- MAPUNT file is being input

```
*END
FIELD        (1,1), (1,1), (196,117), (1,117)
$END
```

- MAPUNT file is not being input

```
*END
$END
```

Control cards used by the LABEL processor are listed in Table 18-1.

The following files, mostly on disk, may be produced by this processor.

- Labeled statistics file (SAVTAP), using the k-nearest-neighbor procedure (see section 4.1 of User Documentation EOD-LARSYS for format of file)
- Labeled statistics file (SAVTAP), specified by control card.
- Relabeled dot data file (DOTUNT), specified by control card.
- A conditional cluster map (see section 5.1 of User Documentation EOD-LARSYS for format of file)
- A mixed cluster map.
- An unconditional cluster map in the format acceptable by the DISPLAY processor (see appendix C of Volume II.)

In addition the following can be output on the line printer:

- Summary of selected options
- Table of L_1 or L_2 distances from cluster means to dots.
- Summary of the labeling dots within a cluster for the all-of-a-kind procedure
- Summary of the labeling dots for the k-nearest-dots to a cluster for the k-nearest-neighbor procedure
- Spatial and spectral information of relabeled DOTFIL.
- Means and covariances of labeled or relabeled statistics.

Optionally, a conditional cluster map may be output. A cluster is tagged as conditional if the distance between the nearest identically labeled labeling dot and mean of the cluster is greater than the analyst input threshold value t.

Optionally, a mixed cluster map may be output. A cluster is tagged as mixed if the labeling dots within a cluster are of more than one category.

Optionally, an unconditional cluster map may be output in the format acceptable to the DISPLAY processor. Information used in the thresholding procedure in DISPLAY is dummied. If thresholding of the clustered data is desired, it can be performed by exercising the conditional map option in this processor.

Diagnostics given by the LABEL processor are listed in Table 18-2. For a full discussion of control cards and diagnostics, see Section 18 of Volume II.

18.4. SAMPLE RUN

Figure 18-1 shows the job setup for a run of LABEL back to back with DOTDATA and ISOCLS.

Section 20 illustrates an application of EOD-LARSYS which includes the use of the LABEL processor.

TABLE 18-1.- CONTROL CARDS FOR LABEL

Required cards

Keyword	Parameter	Function
$LABEL		Calls processor.
CHANNEL	STAT=$n_1,n_2,\cdots,n_{30}$, DATA=$m_1,m_2,\cdots,m_{30}$, (Default: n_i = (all channels on SAVTAP file) m_i = (all channels on DOTFIL file)	n_i and m_i are integer numbers separated by commas referring to the channels on the SAVTAP file and the MSS data tape, respectively.
DOTFILE	INPUT/FILE=m,UNIT=n	Defines the unit and file for the input dot data file DOTUNT. n is the Fortran unit number assigned to the input DOTFIL; m is the number of the input file to process.
STATFILE	INPUT/FILE=m,UNIT=n (Default: NONE)	Defines the unit and file for the input SAVTAP file. n is the Fortran unit number assigned to the input SAVTAP file; m is the number of the file to process.
STATFILE	OUTPUT/FILE=m,UNIT=n	Defines the unit and file to which the labeled/relabeled SAVTAP file is output. n is the Fortran unit number assigned to the output SAVTAP file; m is the number of the file to output.
*END		Indicates the end of control card input.
$END		End

Optional cards

Keyword	Parameter	Function
DOTFIL	OUTPUT/FILE=m,UNIT=n (Default: NONE)	Defines the unit and file to which the relabeled DOTUNT file is output. n is the Fortran unit number assigned to the output DOTUNT file; m is the number of the file to output.
MAPTAP	OUTPUT/FILE=m,UNIT=n (Default: no DISPLAY interface tape will be output.)	Defines the unit and file to which the unconditional cluster map, MAPTAP, is output. n is the Fortran unit number assigned to the output MAPTAP file.
MAPFILE	INPUT/FILE=16,UNIT=n (Default: m=1)	Defines the unit and file for the input oncondit-ional cluster map, MAPUNT, that is output by ISOCLS ISOCLS during the clustering process. n = 16 is the Fortran unit number assigned to unit 16 in executing back to back with ISOCLS); m is the number of the file to process.
MAPFILE	OUTPUT/FILE=m,UNIT=n (Default: n=16 m=1	Defines the unit and file to which the conditional or mixed cluster map is output.
		The DOTUNT file is labeled or relabeled by this card. Category name is the label the analyst is assigning to the dots $n_1,\cdots,$ i.
	Category name, $n_1,n_2,\cdots,n_{250}$	The category name may be composed of a maximum of 6 characters. n_i are integer numbers separated by commas referring to the position of the dot on the DOTFIL file.

TABLE 18-1.– Concluded

Keyword	Parameter	Function
STAL	class name, n_1, $n_2,\cdots,n_{250}$ (Default: NONE)	The SAVTAP file may be manually relabeled by this card. n_j (j=1,2,...,i) are the numbers of the subclasses on the SAVTAP that are to be regrouped into another class. Class name is the name of the class to which the sublcass n_j are to be reassigned. Class name must match a name on the SAVTAP file.
DISTANCE	L1 (Default: L_1 distance)	The L_1 distance will be used in computing the distance between the means of the cluster and the labeling dots.
DISTANCE	L2 (Default: L_1 distance)	The L_2 distance will be used in computing the distance between the means of the cluster and the labeling dots.
OPTION	COND (Default: NONE)	A conditional cluster map will be output.
OPTION	MIXED (Default: NONE)	A mixed cluster map will be output.
THRESHOLD	T (Default: T=25.0)	T is the threshold parameter used in creating the conditional cluster map. T is a floating point number.
NEAREST	K (Default: K=1)	K is the number of dots to be used in the k-nearest-neighbor procedure. K is an integer number. K≤11.
PROCED	NAME (Default: N=K-NEAREST	NAME is an alphabetic word. NAME=K-NEAREST (Use the k-nearest-neighbor procedure.) NAME=ALL (use the all-of-a-kind procedure.) NAME=MANUAL (Use the manual procedure of relabeling the DOTUNT or SAVTAP file.)
MODULE	(Blank)	Initiates the input of the module STAT card file. The file must immediately follow this card.
EXCLUDE	$n_1,n_2,\cdots,n_{250}$ (Default: All dots will be used.)	n_i are integer numbers referring to the dots on the DOTUNT file that are to be excluded in all calculations (i.e., dots within a DO/DU area).
SUNANG	$m_1,m_2,\ ,m_i$	m_j are integer sun angle numbers used in computing the L_1 or L_2 distances. A sun angle must be input for each acquisition of interest. An acquisition is assumed to be a 4 channel pass. Example: If the distance is computed using 16 channels, 4 sun angles (m_1, m_2, m_3, m_4) must be input.
SUNANG	FILE (Default: No sun angle correction will be applied.)	Sun angles will be extracted from the DOTUNT file.

Ancillary cards

HED1, HED2, DATE, COMMENT (see Table 3-1)

TABLE 18-2.— DIAGNOSTICS FROM LABEL

Message	Explanation
CATEGORIES HAVE NOT BEEN DEFINED	Control card missing from input file.
ERROR IN INPUT OF CLASS NAMES. NAMES ON STAT FILE ARE:_____. NAMES INPUT ARE: _____.	Self-explanatory.
NO OF STAT CHANNEL AND DOTDATA CHANNELS MUST BE EQUAL	Self-explanatory.
A LABELING PROCEDURE MAY NOT BE CHOSEN WHEN UPDATING THE DOTNUT OR SAVTAP FILES	Self-explanatory.
USER HAS NOT INPUT ONE OF THE REQUIRED FILES: SAVTAP MAPUNT OR DOTUNT	Control cards missing.
NOT ENOUGH CORE DISK SPACE TO STORE ---	Revise data parameters.
ERROR ON --- CARD	Check spelling, format, and parameters.

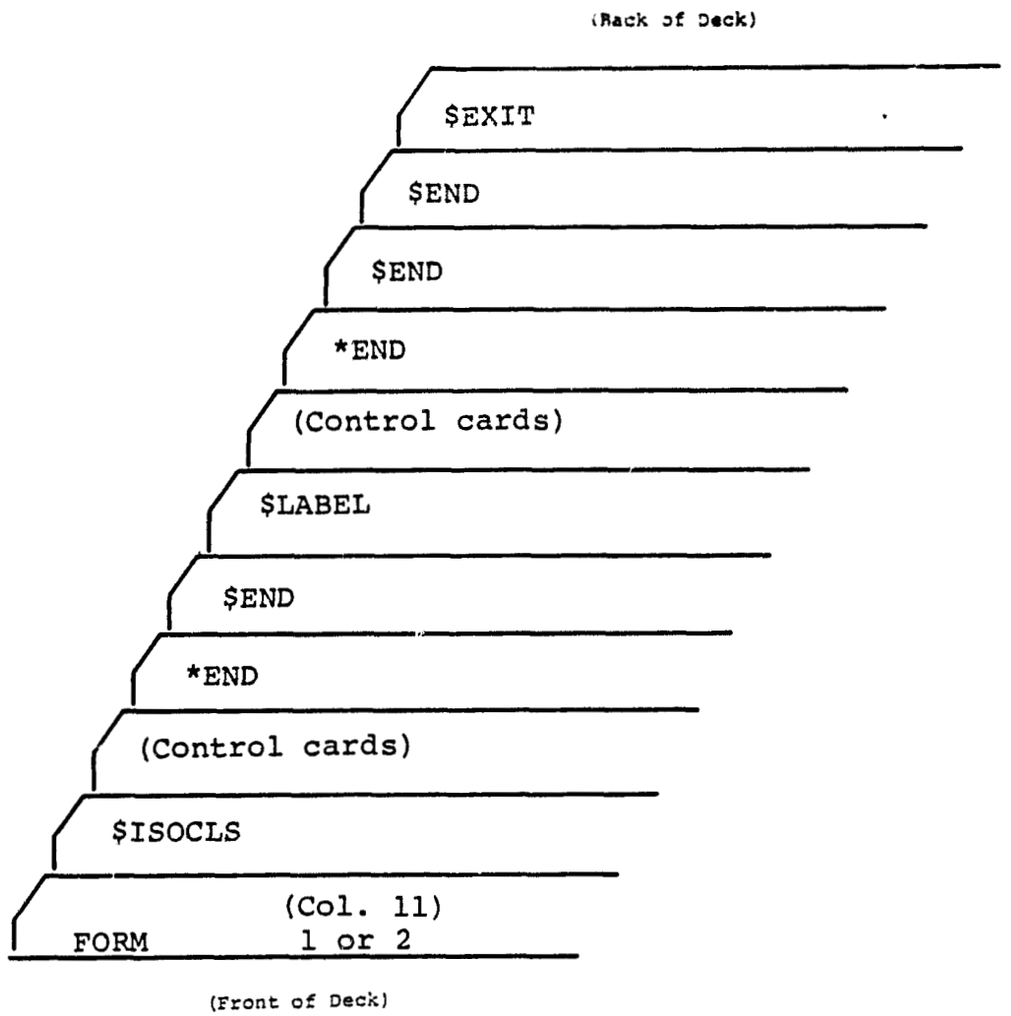


Figure 18-1.— Deck setup for the LABEL processor for execution back to back with ISOCLS.

19. APPLICABLE DOCUMENTS

GENERAL

The following documents constitute parts of the documentation developed in relation to the EOD-LARSYS.

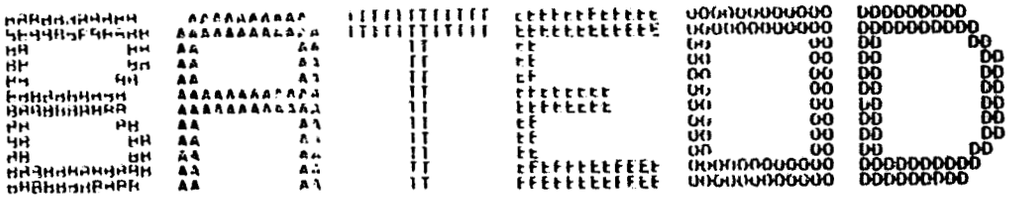
- User Documentation, EOD-LARSYS. Earth Observations Division Version of the Laboratory for Applications of Remote Sensing System, LEC-3984, Revision 4, July 1977.
- "As-Built" Design Specification for EOD-LARSYS Procedure 1, LEC-11293, October 1977.
- TIRF 77-0054, EOD-LARSYS P1 Follow-on: Best K of N passes.
- TRF 77-0057.
- Technical Memorandum. Project Development Plan for the EOD-LARSYS Conversion, LEC-11203, August 1977.
- Technical Memorandum. Acceptance Test Plan for the EOD-LARSYS Conversion, LEC-11748, January 1978.
- FIRF 77-0070, "As-Built" Design Specification for LACIE Formatted Dot Cards in EOD-LARSYS.
- As Built Document for the EOD-LARSYS system. IBM 370/148 version, Volume II.
- As-Built Document for the EOD-LARSYS system. IBM 370/148 version, Volume III.
- As-Built Document for the EOD-LARSYS system. IBM 370/148 version, Volume IV, program listing.

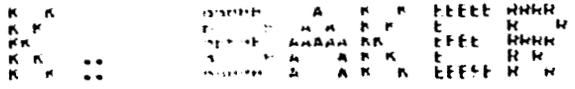
20. APPLICATIONS OF THE EOD-LARSYS

The following is a Procedure 1 execution, which should be a useful model in setting up control cards.

** VM/370 VERSION 03 LEVEL 00 PLC 0019 ********** CLASS A ********** PRINTED 07/26/78 AT 11.49.35 AT JSCTEXAS **********

USER NAME K. HAKER
USERID HAKER
SPOOL FILE NAME TYPE
CREATION DATE 07/25/78 18:44:59
SPOOL FILE ID 7276
RECORD COUNT 4074





PLEASE BE ADVISED OF THE CHANGE TO CLASSIFY
MAPTAP FILE AND UNIT NUMBER 004 APPEAR AS

AND DISPLAY PROCESSOR CARD IMAGES
ORDINARY CONTROL CARDS FIRST ONES AFTER PROCESSOR CARD

[illegible] JOHNSON SPACE CENTER
[illegible] TEXAS

```
ADDTDATA

          INPUT SUMMARY

DATA      UNIT=11,FILE=1
OUTF      OUTPUT/UNIT=19,FILE=1
CHAN      DATA=1,2,3,4,5,6,7,8
OPTI      PRINT
COMM      PROCEDURE 1 RUN
OPTI      LACIE
*END

USER HAS REQUESTED THE FOLLOWING OPTIONS :

SELECTED CHANNELS ARE  1  2  3  4  5  6  7  8
PRINT DATA VECTORS
LACIE FORMATTED DOT CARDS USED AS END-LAPSYS FIELD CARDS

SUN ANGLES :     54    49    60    68    [illegible]    56    [illegible]    60


INPUT IMAGE DATA TAPE INFORMATION

     FORMAT                    UNIVERSAL
     NO. OF CHANNELS             [illegible]
     NO. OF PIXELS/LINE         196
     FIRST SCAN LINE NO.          1
     FIRST PIXEL REFERENCE PT     1
```

LYNDON B. JOHNSON SPACE CENTER
HOUSTON, TEXAS

PROCEDURE 1 RUN

INPUT FIELDS

FIELD	CLASS	SUBCLASS	VERTICES (SAMPLE,LINE)
1	1	1	(20, 10)
2	1	1	(180, 30)
3	1	1	(30, 40)
4	1	1	(40, 50)
5	1	1	(180, 50)
6	1	1	(150, 60)
7	1	1	(40, 70)
8	1	1	(70, 70)
9	1	1	(80, 70)
10	1	1	(170, 100)
11	1	1	(70, 110)
12	1	1	(80, 110)
13	2	1	(140, 10)
14	2	1	(10, 20)
15	2	1	(10, 30)
16	2	1	(50, 30)
17	2	1	(40, 40)
18	2	1	(60, 40)
19	2	1	(100, 40)
20	2	1	(180, 50)
21	2	1	(190, 50)
22	2	1	(40, 60)
23	2	1	(170, 60)
24	2	1	(190, 60)
25	2	1	(110, 70)
26	2	1	(180, 70)
27	2	1	(10, 80)
28	2	1	(20, 80)
29	2	1	(10, 100)
30	2	1	(30, 100)
31	2	1	(10, 110)
32	2	1	(60, 110)

DATA

NO.	SAMPLE	LINE	TYPE	CATEGORY	CH(1)	CH(2)	CH(3)	CH(4)	CH(5)	CH(6)	CH(7)	CH(8)
1.	20	10	1	1	25	24	57	25	30	30	32	13
2.	180	30	1	1	23	20	45	24	30	33	36	14
3.	30	40	1	1	24	25	54	25	28	33	35	15
4.	40	50	1	1	20	24	54	25	23	24	24	9
5.	180	50	1	1	33	33	49	21	31	32	35	14
6.	150	60	1	1	27	23	54	20	30	33	36	15
7.	40	70	1	1	25	24	51	20	24	22	22	10
8.	70	70	1	1	27	28	54	23	31	33	32	13
9.	80	70	1	1	25	25	53	25	28	30	35	13
10.	170	100	1	1	24	19	41	22	28	29	35	14
11.	70	110	1	1	33	30	54	24	32	35	35	15
12.	80	110	1	1	33	32	54	24	32	35	38	16
13.	140	10	1	2	27	26	54	20	36	38	46	19
14.	10	20	1	2	20	20	39	15	35	37	41	16

15.	10	30	1	2	31	25	51	23	28	31	33	13
16.	50	30	1	2	32	32	51	25	34	36	53	19
17.	40	40	1	2	24	28	54	26	28	29	39	15
18.	60	40	1	2	24	26	51	23	28	29	38	16
19.	100	40	1	2	24	24	51	23	31	35	39	14
20.	100	50	1	2	30	28	55	26	36	40	44	18
21.	190	50	1	2	26	26	41	19	32	35	38	16
22.	40	60	1	2	27	28	49	21	28	31	45	17
23.	170	60	1	2	31	31	37	16	25	28	25	11
24.	190	60	1	2	24	26	37	17	25	26	45	19
25.	110	70	1	2	27	25	56	26	32	35	44	16
26.	180	70	1	2	25	25	47	21	31	30	42	18
27.	10	80	1	2	33	28	46	21	36	34	44	17
28.	20	80	1	2	30	24	51	23	32	32	41	17
29.	10	100	1	2	27	25	48	22	32	38	42	15
30.	30	100	1	2	25	25	54	24	32	35	42	16
31.	10	110	1	2	33	32	49	21	36	40	41	17
32.	60	110	1	2	35	35	46	20	36	37	44	17

SUN ANGLES : 54 49 61 60 60 60 60 60

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INPUT IMAGE DATA TAPE INFORMATION

FORMAT	UNIVERSAL
NO. OF CHANNELS	4
NO. OF PIXELS/LINE	196
FIRST SCAN LINE NO.	1
FIRST PIXEL REFERENCE PT	1

LYNDON B. JOHNSON SPACE CENTER
HOUSTON, TEXAS

PROCEDURE 1 RUN

INPUT FIELDS

FIELD	CLASS	SUBCLASS	VERTICES (SAMPLE,LINE)
1	1	1	(60, 20)
2	1	1	(70, 20)
3	1	1	(180, 20)
4	1	1	(30, 30)
5	1	1	(190, 30)
6	1	1	(170, 40)
7	1	1	(30, 50)
8	1	1	(70, 50)
9	1	1	(90, 50)
10	1	1	(160, 50)
11	1	1	(50, 60)
12	1	1	(160, 60)
13	1	1	(20, 70)
14	1	1	(140, 70)
15	1	1	(190, 70)
16	1	1	(90, 80)
17	1	1	(150, 80)
18	1	1	(160, 80)
19	1	1	(130, 90)
20	1	1	(180, 90)
21	1	1	(150, 110)
22	2	2	(70, 10)
23	2	2	(110, 10)
24	2	2	(20, 20)
25	2	2	(40, 20)
26	2	2	(70, 30)
27	2	2	(170, 30)
28	2	2	(10, 40)
29	2	2	(70, 40)
30	2	2	(80, 40)
31	2	2	(20, 60)
32	2	2	(30, 60)
33	2	2	(60, 60)
34	2	2	(80, 60)
35	2	2	(130, 60)
36	2	2	(140, 60)
37	2	2	(30, 70)
38	2	2	(90, 70)
39	2	2	(120, 70)
40	2	2	(60, 80)
41	2	2	(70, 90)
42	2	2	(120, 80)
43	2	2	(170, 80)
44	2	2	(20, 90)
45	2	2	(40, 90)
46	2	2	(70, 90)
47	2	2	(80, 90)
48	2	2	(170, 90)
49	2	2	(70, 100)
50	2	2	(80, 100)
51	2	2	(180, 100)
52	2	2	(20, 110)
53	2	2	(50, 110)
54	2	2	(190, 110)

NO.	SAMPLE	LINE	TYPE	CATEGORY	DATA CH(1)	CH(2)	CH(3)	CH(4)	CH(5)	CH(6)	CH(7)	CH(8)
1.	60	20	2	1	26	24	51	30	30	30	30	13
2.	70	20	2	1	30	26	54	26	27	29	31	12
3.	180	20	2	1	24	20	54	25	23	24	27	11
4.	30	30	2	1	31	24	54	24	25	28	30	12
5.	190	30	2	1	27	26	51	25	30	33	36	14

6.	170	40	2	1	24	20	57	31	21	24	23	10
7.	30	50	2	1	30	28	54	23	24	25	28	13
8.	70	50	2	1	26	24	61	29	31	35	35	14
9.	90	50	2	1	33	28	56	25	32	35	41	16
10.	160	50	2	1	24	19	54	26	27	29	31	13
11.	50	60	2	1	31	25	59	26	22	23	25	10
12.	160	60	2	1	27	26	54	25	30	33	36	16
13.	20	70	2	1	25	25	64	27	31	33	38	15
14.	140	70	2	1	25	24	64	32	27	29	29	12
15.	190	70	2	1	24	18	70	35	24	21	22	10
16.	90	80	2	1	24	19	61	31	23	24	27	11
17.	150	80	2	1	20	15	54	33	24	24	35	16
18.	160	80	2	1	24	15	61	31	24	25	27	11
19.	130	90	2	1	31	28	56	25	33	33	48	18
20.	180	90	2	1	23	16	70	41	25	23	28	12
21.	150	110	2	1	26	19	56	26	32	35	33	14
22.	70	10	2	2	24	20	51	24	36	38	41	17
23.	110	10	2	2	27	25	44	20	34	32	35	14
24.	20	20	2	2	30	30	54	23	37	40	44	20
25.	40	20	2	2	26	22	61	31	30	35	34	14
26.	70	30	2	2	27	26	49	23	33	36	42	17
27.	170	30	2	2	27	30	37	16	30	31	37	15
28.	10	40	2	2	32	40	51	23	31	33	45	19
29.	70	40	2	2	27	25	57	28	32	38	47	21
30.	80	40	2	2	27	29	51	24	35	38	42	16
31.	20	60	2	2	32	31	51	23	34	36	45	17
32.	30	60	2	2	27	23	49	23	30	33	40	15
33.	60	60	2	2	36	35	56	24	41	45	50	21
34.	0	60	2	2	24	22	59	30	30	33	45	17
35.	130	60	2	2	31	31	54	25	30	33	45	17
36.	140	60	2	2	27	26	59	27	34	42	48	18
37.	30	70	2	2	29	32	51	23	32	33	42	18
38.	90	70	2	2	25	25	54	26	32	35	47	18
39.	120	70	2	2	24	19	64	30	31	30	39	16
40.	60	80	2	2	33	28	46	21	36	37	46	17
41.	70	80	2	2	26	24	54	27	31	32	44	18
42.	120	80	2	2	33	35	49	17	32	34	35	14
43.	170	80	2	2	24	24	27	13	32	37	38	14
44.	20	90	2	2	27	28	49	22	30	28	42	17
45.	40	90	2	2	31	31	41	17	34	36	45	17

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46.	70	90	2	2	31	31	51	24	34	39	48	17
47.	80	90	2	2	31	28	51	24	30	36	45	17
48.	170	90	2	2	23	21	33	16	33	36	37	16
49.	70	100	2	2	27	28	51	24	31	30	42	18
50.	80	100	2	2	24	21	48	23	31	29	44	19
51.	180	100	2	2	20	19	67	33	24	25	32	12
52.	20	110	2	2	30	26	51	22	36	35	41	16
53.	50	110	2	2	26	26	51	27	36	40	49	19
54.	190	110	2	2	30	26	54	25	36	41	44	17

TIME FOR DUTDATA 0.215 MINUTES

PLEASE BE ADVISED OF THE CHANGE TO CLASSIFY AND DISPLAY PROCESSOR CARD IMAGES
MAPTAP FILE AND UNIT NUMBER NOW APPEAR AS ORDINARY CONTROL CARDS FIRST ONES AFTER PROCESSOR CARD

9/1 2009

LYNDON B. JOHNSON SPACE CENTER
HOUSTON, TEXAS

PROCEDURE 1 RUN

```
$ISOCLS


INPUT SUMMARY

      DATA    UNIT=11,FILE=1
      DOTF    INPUT/UNIT=19,FILE=1
      STAT    OUTPUT/UNIT=20,FILE=1
      CHAN    DATA=1,2,3,4,5,6,7,8
      CHAN    STAT=1,2,3,4,5,6,7,8
      SEP     1.0
      FORM    UNIVERSAL
      OPTI    CLUSTER
      STDM    15.0
      DLMI    0
      NMIN    20
      PMIN    20
      ISTO    1
      OPTI    STATS
      FORM    UNIVERSAL
      COMM    PROCEDURE 1 RUN
      DOTS    1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23
      DOTS    24,25,26,27,28,29,30,31,32
      *END


YOU HAVE SELECTED THE FOLLOWING PARAMETER VALUES AND  OPTIONS

STOP AFTER    1 ITERATION(S)
ALLOW A MINIMUM OF    20 PIXELS PER CLUSTER
PRINT A CLUSTER SUMMARY EVERY   20 ITERATION(S)
PRINT A CLUSTER MAP EVERY   20 ITERATION(S)
ALLOW A MAXIMUM OF   60 CLUSTERS PER CLASS
THE STATISTICS FILE WILL BE WRITTEN AFTER   1 CLASS(ES) HAVE BEEN CLUSTERED
CHANNELS ARE---  1  2  3  4  5  6  7  8
DLMIN =  0.0
STDMAX= 15.000
PERCENT =   80
PMIN =   20
NSDOTS =   32
NO. SUN ANGLES FROM CARDS =    0
SUN ANGLE TAPE SW =    0

SEP   =  1.000
WRITE A CLUSTER MAP OUTPUT TAPE IN UNIVERSAL FORMAT


INPUT IMAGE DATA TAPE INFORMATION

    FORMAT                  UNIVERSAL
    NO. OF CHANNELS           8
    NO. OF PIXELS/LINE       196
    FIRST SCAN LINE NO.        1
    FIRST PIXEL REFERENCE PT   1


DESIGNATED OTHER OR UNIDENTIFIABLE FIELDS INPUT

DESIGNATE UNIDENTIFIABLE
DU1         (2,2),(77,2),(103,2),(102,9),(88,18),(73,5)
DU2         (2,5),(95,20),(115,20),(99,34),(88,28)
DU3         (2,2),(153,12),(162,12),(162,21),(140,36),(127,22)
DU4         (2,2),(142,42),(153,36),(160,41),(150,52)
DU5         (2,2),(87,101),(121,86),(133,110),(129,117),(100,117)
DU6         (2,2),(136,91),(160,88),(169,96),(140,110)
DU7         (2,2),(164,104),(183,110),(178,117),(150,117)
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ORIGINAL PAGE IS OF POOR QUALITY

LYNDON B. JOHNSON SPACE CENTER
HOUSTON, TEXAS

PROCEDURE 1 RUN

FIELDS TO BE CLUSTERED FOR CLASS WHEA

	FIELD NAME	SAMPLE INC.	LINE INC.	VERTICES (SAMPLE,LINE)
1	SEGM	2	2	(2, 2) (196, 2) (196, 117) (2, 117)

DO/DU CLUSTER POP FOR THIS CLASS 703 0

20-11
120

PROCEDURE 1 RUN

FINAL CLUSTER SUMMARY FOR CLASS WHEA

TOTAL NUMBER OF CLUSTERS = 32

TOTAL NUMBER OF POINTS = 5684

CLUSTER	SYMBOL	POINTS IN CLUSTER
1	1	242
2	2	108
3	3	139
4	4	257
5	5	114
6	6	179
7	7	273
8	8	84
9	9	128
10	A	193
11	B	94
12	C	165
13	D	247
14	E	140
15	F	130
16	G	171
17	H	179
18	I	154
19	J	192
20	K	135
21	L	164
22	M	117
23	N	106
24	O	184
25	P	129
26	Q	160
27	R	154
28	S	119
29	T	165
30	U	266
31	V	75
32	*	703

MEANS

CLUSTER	CH(1)	CH(2)	CH(3)	CH(4)	CH(5)	CH(6)	CH(7)	CH(8)
1	25.27	22.88	56.11	26.46	26.36	27.86	30.10	12.39
2	24.98	24.18	47.07	22.04	29.35	30.67	36.71	13.94
3	25.18	23.68	53.14	24.61	29.35	30.27	35.65	14.28
4	25.98	23.43	53.77	25.28	23.73	24.65	25.65	10.75
5	31.00	32.42	44.03	19.31	30.11	32.29	36.04	14.32
6	26.37	23.81	57.49	26.78	31.26	32.91	37.52	15.14
7	25.20	21.29	61.41	29.53	23.41	24.42	24.97	10.66
8	29.68	28.54	55.20	24.77	28.12	30.11	33.18	13.20
9	28.14	25.30	60.46	27.63	27.47	29.20	32.68	13.19
10	24.12	19.82	64.31	31.36	26.59	27.85	30.96	12.88
11	32.26	30.44	56.37	24.96	30.34	33.12	36.47	14.65
12	32.41	32.40	54.91	24.20	32.35	35.58	41.95	16.70
13	28.91	27.85	53.70	24.70	35.11	36.17	46.84	18.51
14	24.06	24.95	30.94	13.84	31.80	34.67	37.88	14.91
15	29.07	28.46	50.33	22.83	25.66	28.29	31.09	12.73
16	32.43	33.08	53.82	24.10	35.28	39.62	49.26	19.27
17	24.03	21.09	55.34	26.41	28.56	29.68	41.63	17.34
18	22.78	18.51	64.83	32.22	29.57	30.27	43.31	18.06
19	29.14	29.25	50.06	22.43	31.71	33.98	39.35	15.79
20	31.35	29.92	60.81	27.96	35.54	40.67	50.04	20.22
21	26.86	28.32	39.98	17.46	30.76	33.16	37.51	14.91
22	28.41	28.52	49.31	22.62	30.49	34.65	44.91	18.38
23	26.66	27.67	37.25	16.76	26.14	27.54	28.25	11.65
24	26.67	24.00	59.27	27.48	32.25	34.61	44.92	18.15
25	25.28	24.42	46.57	21.71	29.60	29.74	41.48	17.15

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26	30.76	29.69	46.86	21.39	37.00	36.35	44.47	17.57
27	29.81	26.60	52.37	23.83	31.43	33.48	42.06	17.17
28	26.62	25.48	47.79	21.94	33.82	30.44	42.39	16.66
29	26.03	24.65	53.40	24.69	32.77	35.33	43.88	17.49
30	32.19	31.19	51.00	22.85	35.31	36.66	44.49	17.63
31	32.77	35.08	45.13	19.52	32.48	37.26	41.09	16.07
32	255.00	255.00	255.00	255.00	255.00	255.00	255.00	255.00

STANDARD DEVIATIONS

CLUSTER	CH(1)	CH(2)	CH(3)	CH(4)	CH(5)	CH(6)	CH(7)	CH(8)
1	1.93	2.27	2.35	1.39	1.57	1.45	1.93	0.89
2	1.54	2.48	2.60	1.47	1.92	2.25	2.57	1.06
3	1.32	1.95	2.03	1.06	2.02	2.11	2.02	0.94
4	2.18	2.78	3.02	1.55	1.52	1.83	2.43	0.90
5	1.96	2.41	3.36	1.53	1.72	2.15	2.66	1.00
6	1.99	2.64	2.66	1.58	1.88	2.27	2.09	1.06
7	2.05	2.54	3.30	2.08	1.66	2.36	3.12	1.21
8	2.20	2.21	1.64	0.96	1.74	1.67	2.15	1.02
9	2.46	2.42	1.98	1.41	1.54	1.58	2.90	1.14
10	1.80	2.07	4.22	2.41	1.85	2.03	3.04	1.23
11	1.86	2.66	3.06	1.44	1.84	2.08	2.26	1.16
12	2.03	3.11	2.63	1.31	1.73	1.96	2.27	1.22
13	2.07	2.17	2.17	1.26	2.17	2.45	2.59	1.14
14	1.81	2.49	3.30	1.55	2.10	3.22	3.13	1.23
15	2.65	2.76	2.57	1.26	1.48	1.97	2.54	1.12
16	2.16	2.34	2.55	1.24	1.45	2.32	2.42	1.23
17	1.60	2.11	2.66	1.54	1.82	1.97	3.33	1.67
18	2.02	2.26	3.95	2.18	2.11	2.99	4.28	2.08
19	2.05	1.94	1.96	1.00	1.52	2.11	2.24	1.10
20	2.75	3.30	3.62	2.31	2.47	3.49	4.46	1.92
21	2.05	2.53	2.75	1.49	1.52	2.49	2.69	1.12
22	2.11	1.92	2.27	1.25	1.51	2.17	2.18	1.27
23	2.76	3.32	4.22	1.87	2.08	2.66	3.22	1.32
24	2.27	2.43	2.44	1.67	1.60	2.64	2.96	1.51
25	1.78	2.37	2.88	1.58	1.78	2.26	2.24	1.28
26	1.75	2.00	2.98	1.48	1.69	2.12	2.26	0.85
27	1.56	1.72	2.02	1.02	1.47	2.33	2.09	1.08
28	1.72	2.06	2.11	1.21	2.34	1.68	2.40	1.18
29	1.49	2.05	1.75	0.98	1.80	2.32	2.79	1.39
30	1.72	2.38	1.81	0.96	1.70	1.71	2.05	0.83
31	1.93	3.14	3.22	1.52	1.51	2.27	2.54	0.96
32	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DISTANCES BETWEEN CLUSTERS

CLUSTER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	0.0	5.96	4.60	4.00	9.43	6.19	4.62	4.42	3.27	4.09	7.29	10.59	12.52	13.06	4.62
2	5.96	0.0	3.41	7.36	5.36	5.55	9.08	5.69	7.45	7.89	6.47	7.88	8.75	8.13	3.89
3	4.60	3.41	0.0	7.35	7.68	3.29	8.32	4.10	5.17	6.72	5.78	7.48	8.33	12.27	4.64
4	4.00	7.36	7.35	0.0	10.13	9.32	3.51	6.49	6.10	5.94	9.34	12.69	14.66	13.45	4.97
5	9.43	5.36	7.68	10.13	0.0	7.78	11.85	7.10	9.43	11.16	5.45	8.38	8.81	7.25	5.18
6	6.19	5.55	3.29	9.32	7.78	0.0	8.85	4.79	4.34	6.04	4.23	5.49	6.57	12.29	6.54
7	4.62	9.08	8.32	3.51	11.85	8.85	0.0	7.97	5.43	3.85	9.81	12.79	14.24	15.08	7.49
8	4.42	5.69	4.10	6.49	7.10	4.79	7.97	0.0	4.18	7.64	3.27	6.69	9.35	14.61	3.39
9	3.27	7.45	5.17	6.10	9.43	4.34	5.43	4.18	0.0	4.09	5.05	8.16	10.17	15.51	5.98
10	4.09	7.89	6.72	5.94	11.16	6.04	3.85	7.64	4.09	0.0	8.62	10.96	11.90	13.77	7.77
11	7.29	6.47	5.78	9.34	5.45	4.23	9.81	3.27	5.05	8.62	0.0	3.55	6.74	12.06	5.19
12	10.59	7.80	7.48	12.69	8.38	5.49	12.79	6.69	8.16	10.96	3.55	0.0	4.03	12.24	7.95
13	12.52	8.75	8.33	14.66	8.81	6.57	14.24	9.35	10.17	11.90	6.74	4.03	0.0	12.81	10.23
14	13.86	8.13	12.27	13.45	7.25	12.29	15.08	14.61	15.51	13.77	12.06	12.24	12.81	0.0	10.72
15	4.62	3.89	4.64	4.97	5.18	6.54	7.49	3.39	5.98	7.77	5.19	7.65	10.23	10.72	0.0
16	15.00	10.96	11.14	16.77	9.42	14.02	16.34	11.13	12.06	14.31	7.92	4.53	3.18	13.51	11.83
17	6.35	5.81	4.14	8.72	9.38	3.48	8.31	6.59	5.59	6.03	7.24	7.79	7.25	12.23	7.14
18	8.21	9.22	8.02	10.26	12.60	5.56	8.24	9.72	6.65	5.14	9.02	9.48	8.85	14.33	10.23
19	9.40	4.86	5.56	11.23	4.46	5.82	12.48	6.09	8.78	11.01	4.17	3.72	5.49	10.77	6.80
20	12.44	10.28	9.73	14.20	9.77	7.21	13.05	9.92	9.62	10.95	7.17	5.25	3.85	13.16	10.90
21	11.11	5.13	8.77	11.50	3.48	9.32	13.31	10.41	12.22	12.04	8.41	8.69	9.89	4.17	7.48
22	10.98	6.51	7.08	12.75	6.41	8.20	13.26	8.12	9.54	11.35	6.32	4.87	4.97	10.50	7.96
23	8.76	5.84	9.02	7.32	5.70	10.25	9.72	9.60	10.72	10.03	9.26	11.10	12.85	6.89	5.86
24	4.61	8.28	6.73	12.21	4.89	4.44	11.05	8.01	7.01	8.16	6.15	5.32	4.41	13.75	9.44
25	9.01	4.11	5.29	10.69	6.08	5.44	11.39	7.66	8.78	9.37	6.96	6.68	6.61	7.83	6.72
26	13.06	7.89	8.97	14.95	6.00	9.75	15.23	9.64	11.26	13.05	6.63	4.15	4.28	9.11	9.45
27	10.02	6.46	6.00	12.31	6.84	4.94	12.75	6.69	8.28	10.71	4.62	3.31	3.78	12.30	7.53

28	11.12	5.50	6.49	12.92	8.33	8.40	13.05	8.73	10.55	11.50	6.82	5.50	4.70	9.10	8.27
29	9.61	6.49	5.38	11.93	8.57	8.37	12.04	7.38	8.33	9.86	6.19	4.96	3.11	13.23	8.28
30	14.50	9.64	10.86	16.55	7.46	8.36	16.72	10.42	12.36	14.56	6.95	3.61	3.45	15.10	10.85
31	12.56	7.84	9.61	13.81	3.99	8.55	14.71	9.33	11.42	13.27	6.30	4.91	6.98	8.43	8.46
32	12.63	10.33	10.66	14.40	4.64	9.60	14.77	9.47	11.41	13.90	6.61	4.85	6.81	7.88	8.84

DISTANCES BETWEEN CLUSTERS

CLUSTER	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1	15.00	6.35	8.21	9.40	12.44	11.11	10.98	8.70	9.61	9.01	13.06	10.02	11.12	9.61	14.50
2	10.46	5.81	9.22	4.86	10.28	9.13	6.51	5.84	6.28	4.11	7.89	6.46	5.58	6.49	9.64
3	11.14	4.14	8.02	5.56	9.73	7.77	7.08	9.02	6.73	5.29	8.97	6.00	6.59	5.38	10.86
4	16.77	8.72	10.26	11.23	14.20	11.50	12.75	7.32	12.21	10.69	14.95	12.31	12.92	11.93	16.55
5	9.42	9.38	12.00	4.46	4.77	3.45	6.41	5.70	9.69	9.86	6.00	6.84	6.33	8.57	7.46
6	9.02	3.88	5.56	5.62	7.21	6.32	6.80	10.25	4.04	5.98	7.76	4.94	6.48	4.37	8.36
7	16.34	8.31	8.24	12.48	13.05	13.31	13.26	9.72	11.09	11.39	15.23	12.75	13.55	12.84	16.72
8	11.13	6.59	9.72	6.09	9.92	10.41	8.12	9.60	8.01	7.66	9.64	8.73	8.73	7.38	10.42
9	12.06	5.59	6.65	8.78	9.62	12.22	9.54	10.72	7.01	8.78	11.26	8.28	10.55	8.33	12.38
10	14.31	6.03	5.14	11.01	10.95	12.04	11.45	10.03	8.16	9.37	13.05	10.71	11.50	9.86	14.36
11	7.92	7.24	9.02	4.17	7.17	3.41	6.32	9.26	6.15	6.96	6.63	4.62	6.82	6.19	6.95
12	4.53	7.79	9.48	3.72	5.25	6.64	4.87	11.10	5.32	6.68	4.15	3.31	5.50	4.96	3.61
13	3.18	7.25	8.85	5.49	3.85	6.64	4.47	12.85	4.41	6.61	4.28	3.78	4.70	3.11	3.45
14	13.51	12.23	14.33	10.77	13.16	4.17	10.50	6.09	13.75	7.83	9.11	12.30	9.18	13.23	13.18
15	11.83	7.14	10.23	6.00	10.90	7.40	7.96	5.86	9.44	6.72	9.45	8.27	8.28	8.28	10.85
16	0.0	10.03	11.06	6.97	3.55	10.73	6.40	13.95	6.58	8.75	4.89	6.11	6.84	6.26	3.35
17	10.03	0.0	4.64	7.22	8.20	9.72	6.08	10.12	4.42	4.75	8.82	6.08	7.27	4.80	10.14
18	11.06	4.64	0.0	10.75	7.54	12.57	9.57	12.37	4.68	8.37	10.98	9.34	10.08	7.98	12.18
19	6.97	7.22	10.75	0.0	7.66	6.52	3.83	9.20	7.13	4.38	3.82	2.96	3.45	4.78	4.95
20	3.55	8.20	7.54	7.66	0.0	11.10	7.26	12.95	4.34	8.66	6.58	6.42	7.59	5.99	5.98
21	10.73	9.72	12.57	6.52	11.10	0.0	7.14	5.34	11.06	5.21	6.27	8.42	6.11	9.69	9.55
22	6.40	6.08	9.57	3.83	7.26	7.14	0.0	10.23	6.34	3.32	3.98	3.20	4.43	4.58	5.76
23	13.95	10.12	12.37	9.20	12.95	5.34	10.23	0.0	12.54	8.06	10.76	11.04	9.85	11.77	13.32
24	6.58	4.42	4.68	7.13	4.34	11.06	6.34	12.54	0.0	6.76	7.15	5.08	6.86	4.94	7.47
25	8.75	4.75	8.37	4.38	8.66	5.21	3.32	8.06	6.76	0.0	5.54	4.63	4.10	5.61	7.75
26	4.89	8.82	10.98	3.82	6.58	6.27	3.98	10.76	7.15	5.54	0.0	4.07	3.46	3.94	2.93
27	6.11	6.08	9.34	2.96	6.42	8.42	3.20	11.04	5.08	4.63	4.07	0.0	3.94	3.13	4.66
28	6.84	7.27	10.08	3.48	7.59	6.11	4.43	9.85	6.86	4.10	3.46	3.94	0.0	4.97	4.98
29	6.26	4.80	7.98	4.78	5.99	4.99	4.20	11.77	3.88	4.94	5.61	3.13	4.97	0.0	5.84
30	3.35	10.14	12.18	4.95	5.96	9.55	5.76	13.32	7.47	7.75	2.93	4.66	4.98	5.84	0.0
31	6.65	10.47	12.47	4.62	8.08	8.29	6.06	9.13	9.15	6.94	3.68	6.35	5.57	8.13	4.98
32	5.19	12.06	12.13	6.03	6.72	8.49	6.48	9.76	11.53	8.80	7.98	4.58	7.12	6.32	8.67

DISTANCES BETWEEN CLUSTERS

CLUSTER	31	32
1	12.56	12.63
2	7.84	10.33
3	9.61	10.66
4	13.81	14.40
5	3.99	4.64
6	8.55	9.60
7	14.71	14.77
8	9.33	9.47
9	11.42	11.41
10	13.27	13.90
11	6.30	6.61
12	4.91	4.85
13	6.98	6.81
14	8.43	7.80
15	8.46	8.84
16	6.65	5.19
17	10.47	12.06
18	12.47	12.13
19	4.62	6.03
20	8.08	6.72
21	5.29	6.48
22	6.06	6.48
23	9.13	9.76
24	9.15	11.53
25	6.94	8.80
26	3.60	7.90
27	6.35	4.58
28	5.57	7.12
29	8.13	6.32
30	4.98	8.67
31	0.0	3.98
32	3.98	0.0

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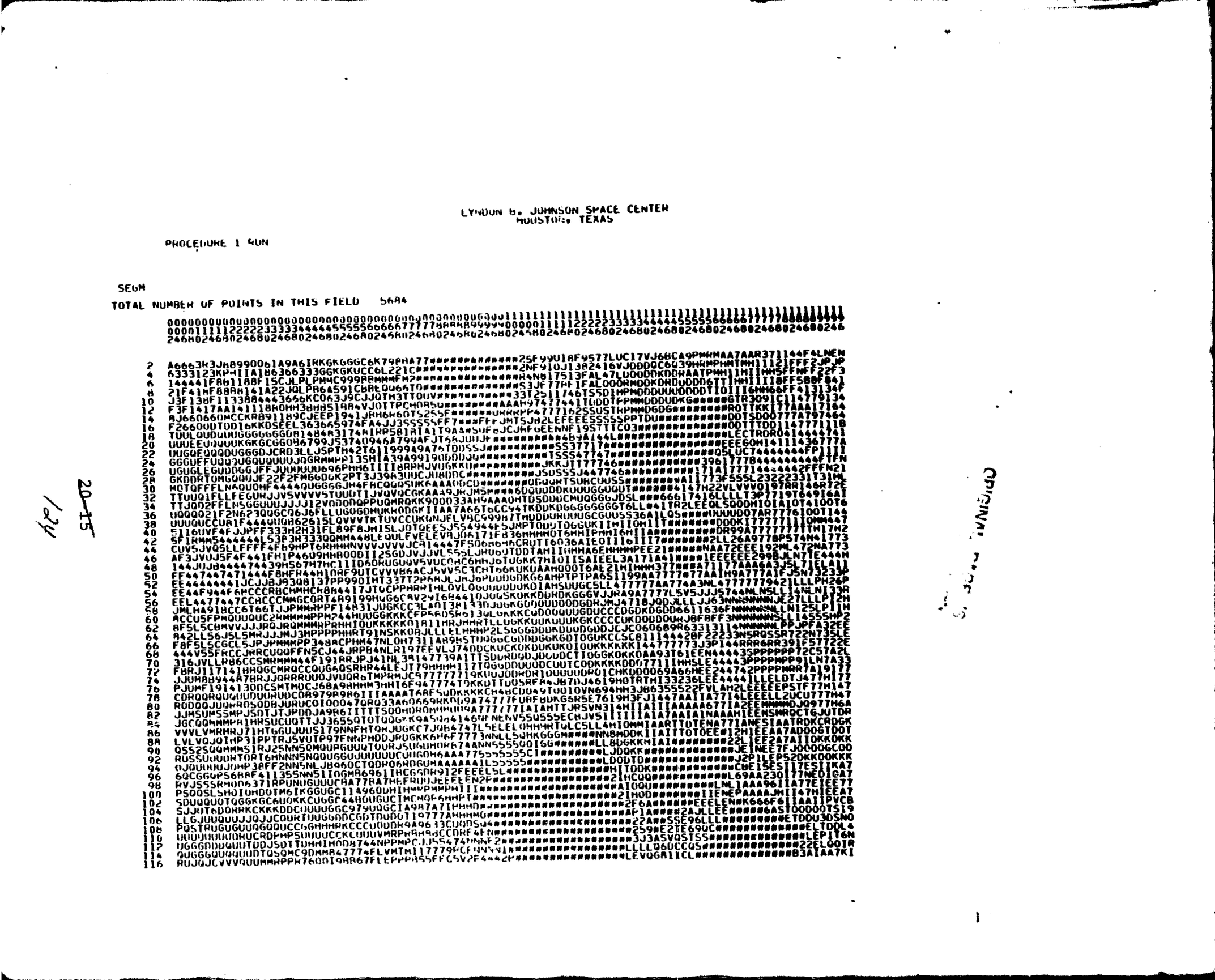
LYNDON B. JOHNSON SPACE CENTER
HOUSTON, TEXAS

PROCEDURE 1 RUN

SEGM

TOTAL NUMBER OF POINTS IN THIS FIELD 5684



POINTS PER CLUSTER	CLUSTER SYMBOL	IN THIS FIELD POINTS
1	1	242
2	2	108
3	3	139
4	4	257
5	5	114
6	6	179
7	7	273
8	8	84
9	9	128
10	A	193
11	B	94
12	C	165
13	D	247
14	E	140
15	F	139
16	G	171
17	H	179
18	I	154
19	J	192
20	K	135
21	L	164
22	M	117
23	N	106
24	O	184
25	P	129
26	Q	169
27	R	154
28	S	119
29	T	165
30	U	266
31	V	75
32	*	703

20-16
13,

LYNDON B. JOHNSON SPACE CENTER
HOUSTON, TEXAS

PROCEDURE 1 RUN

FILE NO. - 1
FIELD NAME - SEGM
FORMAT - UNIVERSAL
NO. OF SCAN LINES - 50
NO. OF COLUM KEY SCAN LINES - 0

CLASS : #HEA
SUBCLASS: #H01

MEAN: 25.27 22.88 56.11 26.46 26.34 27.86 30.10 12.39

COVARIANCE MATRIX:

3.71							
2.33	5.15						
0.90	0.51	5.51					
-0.07	-0.61	1.65	1.92				
-0.43	-0.19	-0.34	-0.10	2.47			
0.46	0.11	0.09	-0.06	0.41	2.09		
-1.17	-1.10	-0.99	-0.12	0.64	0.42	3.73	
-0.45	-0.45	-0.25	0.06	0.32	0.19	0.95	0.78

CLASS : #HEA
SUBCLASS: #H02

MEAN: 24.98 24.18 47.07 22.04 24.35 30.67 34.71 13.94

COVARIANCE MATRIX:

2.37							
2.09	6.15						
1.13	1.26	6.74					
0.01	-0.42	2.48	2.15				
0.82	0.61	1.10	0.14	3.69			
0.63	-0.17	0.85	0.38	2.36	5.06		
0.75	0.38	1.32	0.68	1.33	2.11	6.59	
0.22	-0.18	0.01	0.09	0.49	0.88	1.55	1.12

CLASS : #HEA
SUBCLASS: #H03

MEAN: 25.14 23.68 53.24 24.61 29.35 30.27 35.65 14.28

COVARIANCE MATRIX:

1.73							
1.32	3.79						
-0.49	-0.83	4.12					
-0.17	-0.65	1.21	1.13				
0.17	0.32	-0.61	-0.35	4.07			
0.15	0.02	0.27	0.15	1.83	4.47		
0.39	0.29	-0.42	-0.12	0.08	-0.20	4.88	
0.14	-0.01	-0.15	-0.14	0.15	-0.15	1.17	0.89

CLASS : WHEA
SUBCLASS: WH04

MEAN: 25.98 23.43 53.77 25.28 23.73 24.65 25.65 10.75

COVARIANCE MATRIX:

4.76							
3.58	7.72						
1.76	1.05	9.15					
0.01	-0.71	3.52	2.41				
0.16	0.79	0.40	0.04	2.32			
0.22	0.16	0.59	0.24	1.13	3.36		
0.55	0.06	0.30	0.19	1.42	1.73	5.92	
-0.21	-0.29	-0.13	-0.03	0.43	0.62	1.43	0.81

CLASS : WHEA
SUBCLASS: WH05

MEAN: 31.00 32.42 44.03 19.31 30.11 32.29 36.04 14.32

COVARIANCE MATRIX:

3.82							
1.10	5.79						
0.18	0.90	11.31					
-0.08	-0.13	4.36	2.67				
-0.11	-0.46	0.15	-0.18	2.95			
0.16	0.08	-0.81	-0.66	1.53	4.63		
-0.62	-0.54	1.17	0.91	0.58	0.60	7.07	
0.05	-0.61	0.28	0.21	0.33	0.38	1.86	1.01

CLASS : WHEA
SUBCLASS: WH06

MEAN: 26.37 23.81 57.49 26.78 31.26 32.91 37.52 15.14

COVARIANCE MATRIX:

3.96							
2.61	6.97						
0.57	0.17	7.09					
-0.16	-1.37	2.54	2.51				
0.08	0.66	-0.03	-0.17	3.54			
1.05	0.26	-0.37	-0.13	0.63	5.17		
-0.03	1.31	-0.27	-0.63	0.25	0.69	4.36	
0.02	0.02	-0.22	-0.09	0.28	-0.05	1.19	1.11

CLASS : WHEA
SUBCLASS: WH07

MEAN: 25.20 21.24 61.41 29.53 23.41 24.42 24.97 10.66

COVARIANCE MATRIX:

4.19							
3.33	6.46						
-0.43	-1.33	10.92					
-1.09	-2.21	5.22	4.34				
-0.15	0.02	0.34	0.36	2.74			
0.50	0.12	-0.27	0.22	2.23	5.59		
0.93	0.09	0.42	0.58	2.95	5.44	9.74	
-0.24	-0.33	0.11	0.33	1.21	2.07	3.01	1.46

CLASS : WHEA
SUBCLASS: WH08

MEAN: 29.68 28.54 55.20 24.27 24.12 [illegible]11 33.18 13.20

COVARIANCE MATRIX:

4.86							
1.63	4.87						
1.02	1.50	2.69					
-0.32	-0.47	0.28	0.91				
-0.37	-0.16	-0.34	0.04	3.01			
-0.95	-0.43	-0.12	-0.08	0.95	2.79		
-0.73	-0.79	-0.74	-0.11	0.53	0.15	4.62	
-0.09	-0.56	-0.45	-0.03	0.40	0.10	1.44	1.04

20-20

CLASS : WHEA
SUBCLASS: WH09

MEAN: 28.14 25.30 60.46 27.63 27.47 29.20 32.68 13.19

COVARIANCE MATRIX:

6.04							
3.63	5.83						
-0.24	-0.61	3.94					
0.08	-0.83	1.34	2.00				
-1.03	-0.80	0.45	0.46	2.37			
-0.06	-0.22	0.32	0.29	0.78	2.49		
-1.11	-1.37	0.71	0.42	1.59	1.75	8.42	
-0.59	-0.95	0.21	0.42	0.82	0.47	2.28	1.29

CLASS : #HEA
SUBCLASS: WH10

MEAN: 24.12 19.82 64.31 31.36 26.59 27.85 30.96 12.88

COVARIANCE MATRIX:

3.23							
1.98	4.27						
-0.18	-1.33	17.80					
-0.69	-1.80	8.38	5.81				
0.37	0.37	-0.53	-0.42	3.44			
0.60	0.34	-0.65	-0.54	1.97	4.10		
-0.35	-0.34	-2.59	-0.80	1.67	1.55	9.23	
-0.14	-0.19	-0.94	-0.20	0.58	0.47	2.78	1.51

CLASS : #HEA
SUBCLASS: WH11

MEAN: 32.26 30.44 56.37 24.96 30.34 33.12 36.47 14.65

COVARIANCE MATRIX:

3.45							
2.42	7.08						
1.44	1.48	9.38					
-0.10	-0.57	3.19	2.06				
-0.24	-1.04	-0.25	-0.26	3.37			
-0.15	-0.76	1.20	0.06	1.60	4.32		
-1.86	-1.16	-1.00	0.06	1.01	-0.08	5.12	
-0.73	-0.56	-0.25	0.06	0.60	0.17	1.78	1.36

20-21
130

CLASS : #HEA
SUBCLASS: WH12

MEAN: 32.41 32.40 54.91 24.20 32.35 35.58 41.95 16.70

COVARIANCE MATRIX:

4.12							
3.37	9.65						
0.99	1.37	6.92					
-0.34	-0.83	2.15	1.72				
0.23	0.63	1.17	0.20	2.98			
1.18	0.82	0.68	-0.29	1.39	3.86		
-1.09	-1.31	-0.00	0.62	-0.14	-0.82	5.14	
-0.44	-1.00	-0.25	0.25	0.24	-0.07	1.69	1.50

CLASS : WHEA
SUBCLASS: WH13

MEAN: 28.91 27.85 53.70 24.70 35.11 38.17 46.84 18.51

COVARIANCE MATRIX:

4.29
1.51 4.70
0.71 -0.21 4.69
-0.12 -0.65 1.79 1.58
-0.45 -1.22 -0.42 -0.04 4.71
-0.58 -1.25 -0.41 0.22 2.50 6.02
-0.96 -0.83 -0.36 0.50 -0.17 0.57 6.73
-0.38 0.03 -0.15 0.16 0.11 -0.25 1.93 1.30

CLASS : WHEA
SUBCLASS: WH14

MEAN: 24.06 24.95 30.94 13.84 31.80 34.67 37.88 14.91

COVARIANCE MATRIX:

3.26
2.98 6.18
2.71 3.46 10.88
1.09 1.18 4.06 2.39
0.25 0.34 0.02 -0.22 4.39
-0.07 0.13 -1.16 -0.79 4.87 10.35
-0.43 -0.11 0.50 0.27 2.87 4.53 9.81
0.24 0.19 0.89 0.45 0.95 1.39 2.88 1.51

20-22
131

CLASS : WHEA
SUBCLASS: WH15

MEAN: 29.07 28.46 50.33 22.83 26.66 28.29 31.09 12.73

COVARIANCE MATRIX:

7.00
3.69 7.63
1.19 -0.53 6.58
-0.17 -0.93 2.28 1.58
-0.77 0.31 -0.93 -0.25 3.98
0.63 0.29 -0.38 -0.31 1.72 3.87
0.09 -0.63 -0.90 -0.22 1.28 1.74 6.46
-0.02 -0.05 -0.90 -0.36 0.62 0.80 2.07 1.26

CLASS : WHEA
SUBCLASS: WH16

MEAN: 32.43 33.08 53.82 24.10 35.28 39.62 49.26 19.27

COVARIANCE MATRIX:

4.67							
2.37	5.47						
2.05	1.08	6.51					
0.44	0.16	2.31	1.53				
1.06	0.75	0.25	-0.09	3.79			
1.47	1.59	0.10	-0.11	2.34	5.38		
-1.43	-0.47	-1.20	0.00	0.09	0.16	5.88	
-0.17	0.24	0.08	0.31	0.25	0.21	1.60	1.52

CLASS : WHEA
SUBCLASS: WH17

MEAN: 24.03 21.09 55.34 26.41 28.56 28.68 41.63 17.34

COVARIANCE MATRIX:

2.55							
1.89	4.46						
-0.17	-0.70	7.09					
-0.49	-1.23	2.68	2.38				
-0.11	0.17	-0.61	-0.48	3.30			
0.32	0.78	-0.19	-0.37	1.68	3.87		
-0.46	-0.17	-0.33	-0.69	0.83	-0.24	11.12	
-0.12	0.04	-0.19	-0.24	0.24	-0.66	4.53	2.80

20-23
13-1

CLASS : WHEA
SUBCLASS: WH18

MEAN: 22.78 18.51 64.83 32.22 29.57 30.27 43.31 18.06

COVARIANCE MATRIX:

4.08							
2.72	5.12						
-1.39	-2.67	15.59					
-1.08	-2.36	7.08	4.77				
1.15	1.25	-0.82	-0.32	4.45			
2.22	2.48	-1.84	-1.13	3.94	8.95		
0.06	0.95	0.69	1.15	1.75	0.07	18.35	
-0.15	-0.02	0.43	0.81	0.34	-1.00	7.70	4.34

CLASS : SUBCLASS:	#HEA #H19							
MEAN:	29.14	29.25	50.06	22.43	31.71	33.98	39.35	15.79

COVARIANCE MATRIX:

4.21							
0.77	3.76						
0.07	-0.16	3.83					
-0.29	-0.29	1.22	1.01				
0.20	0.22	0.03	-0.06	2.32			
0.47	-0.09	0.15	-0.03	1.11	4.44		
-0.28	1.12	-0.05	-0.22	0.25	0.59	5.02	
0.17	0.51	0.13	-0.03	0.31	0.27	1.52	1.21

CLASS : SUBCLASS:	#HEA #H20							
MEAN:	31.35	29.92	60.81	27.96	35.84	40.67	50.04	20.22

COVARIANCE MATRIX:

7.56							
5.96	10.86						
-0.55	1.15	13.12					
-1.51	-1.16	6.72	5.34				
1.07	1.82	-0.73	-0.99	6.12			
1.75	3.60	1.92	0.64	5.57	12.20		
-0.38	4.79	5.18	3.60	2.55	8.80	19.87	
-0.02	1.74	2.37	2.00	0.47	2.91	7.00	3.68

20-24
133

CLASS : SUBCLASS:	#HEA #H21							
MEAN:	26.86	28.32	38.98	17.46	30.76	33.16	37.51	14.91

COVARIANCE MATRIX:

4.21							
2.75	6.41						
0.13	0.02	7.57					
-0.46	-0.67	3.33	2.22				
0.74	0.72	0.01	-0.23	2.30			
1.76	1.77	0.47	-0.40	2.18	6.18		
0.22	1.13	1.32	0.33	0.68	1.74	7.24	
0.12	0.21	0.35	0.13	0.27	0.37	2.04	1.25

CLASS : WHEA
SUBCLASS: WH22

MEAN: 28.41 28.52 49.31 22.62 30.49 30.65 44.91 18.38

COVARIANCE MATRIX:

4.46							
1.79	3.70						
-0.04	-0.42	5.14					
-0.41	-0.50	2.06	1.57				
-0.30	-0.06	-0.44	-0.10	2.27			
0.39	0.72	-0.16	-0.13	1.44	4.72		
0.28	0.06	0.10	0.27	0.10	0.11	4.75	
-0.16	-0.10	0.25	0.36	0.33	-0.04	1.77	1.62

CLASS : WHEA
SUBCLASS: WH23

MEAN: 26.66 27.67 37.25 16.76 26.14 27.54 28.25 11.65

COVARIANCE MATRIX:

7.62							
6.99	11.03						
5.97	6.77	17.79					
1.91	2.26	7.00	3.48				
0.28	0.83	-0.15	0.12	4.33			
0.42	0.33	-1.75	-0.67	3.63	7.06		
-0.42	-1.26	-0.72	-0.34	4.35	6.33	10.34	
-0.35	-0.51	-0.72	-0.21	1.66	2.62	3.53	1.76

20-25
134

CLASS : WHEA
SUBCLASS: WH24

MEAN: 26.67 24.00 59.27 27.88 32.25 34.61 44.92 18.15

COVARIANCE MATRIX:

5.15							
3.07	5.90						
0.61	0.50	5.95					
-0.27	-1.05	2.41	2.79				
-0.28	-0.17	-0.18	-0.09	2.57			
0.07	0.20	0.69	0.40	1.67	6.99		
-1.20	0.61	-0.60	0.24	-0.16	0.05	8.74	
-0.60	0.26	0.05	0.32	-0.16	-0.52	2.91	2.27

CLASS : SUBCLASS:	WHEA WH28							
MEAN:	26.62	25.48	47.79	21.94	33.82	36.48	42.39	16.66

COVARIANCE MATRIX:

2.97							
0.79	4.23						
0.73	-0.41	4.44					
-0.06	-0.69	1.81	1.47				
-0.26	-0.47	0.26	-0.09	5.50			
0.42	-0.05	-0.18	-0.17	1.37	2.84		
-0.72	0.50	-0.54	-0.14	-0.61	0.38	5.74	
-0.35	-0.04	-0.11	0.05	0.17	0.12	1.54	1.40

CLASS : SUBCLASS:	WHEA WH29							
MEAN:	26.03	24.65	53.40	24.69	32.77	35.33	43.88	17.49

COVARIANCE MATRIX:

2.22							
1.20	4.20						
0.66	0.67	3.08					
0.09	-0.08	0.84	0.95				
-0.18	-0.62	0.14	0.22	3.26			
0.33	-0.57	0.53	0.15	1.22	5.36		
-0.27	0.70	-0.39	0.31	0.04	-1.12	7.79	
-0.31	0.13	-0.09	0.09	0.02	-0.83	2.81	1.93

20-27
136

CLASS : SUBCLASS:	WHEA WH30							
MEAN:	32.14	31.19	51.00	22.85	35.31	38.66	44.49	17.63

COVARIANCE MATRIX:

2.97							
0.96	5.67						
0.58	-0.20	3.28					
0.07	-0.38	0.97	0.88				
0.12	-0.64	0.23	0.11	2.88			
0.55	-0.06	0.16	0.03	0.74	2.92		
-0.32	0.44	-0.08	0.11	-0.32	0.03	4.19	
-0.02	0.24	0.21	0.04	0.06	-0.12	0.58	0.69

CLASS : WHEA
SUBCLASS: WH31

MEAN:	32.77	35.08	45.13	14.52	32.46	37.20	41.09	16.07

COVARIANCE MATRIX:

3.72							
2.67	9.69						
3.19	2.66	10.38					
1.29	0.04	4.14	2.30				
-0.37	0.23	-0.45	-0.17	2.28			
-0.38	-0.43	-1.20	-0.56	1.22	5.17		
-0.41	0.70	1.44	0.81	0.85	0.10	6.46	
0.32	0.22	0.66	0.39	0.06	-0.56	1.37	0.92

THE STATISTICS FILE FOR 1 CLASSES AND 31 SUBCLASSES WAS BEEN WRITTEN

THE STATS FOR A PARTICULAR CLASS OR SUBCLASS SHOULD BE REFERRED TO IN LATER RUNS BY THE FOLLOWING NAMES AND NUMBERS (W WICHEVER APPLICABLE)

CLASS 1 WHEA SUBCLASSES (TOTAL= 31)

1	WH01
2	WH02
3	WH03
4	WH04
5	WH05
6	WH06
7	WH07
8	WH08
9	WH09
10	WH10
11	WH11
12	WH12
13	WH13
14	WH14
15	WH15
16	WH16
17	WH17
18	WH18
19	WH19
20	WH20
21	WH21
22	WH22
23	WH23
24	WH24
25	WH25
26	WH26
27	WH27
28	WH28
29	WH29
30	WH30
31	WH31

TIME FOR ISOCLS 6.924

PLEASE BE ADVISED OF THE CHANGE TO CLASSIFY AND DISPLAY PROCESSOR CARD IMAGES
MAPTAP FILE AND UNIT NUMBER NOW APPEAR AS ORDINARY CONTROL CARDS FIRST ONES AFTER PROCESSOR CARD

20-28
137

LYNDON B. JOHNSON SPACE CENTER
HOUSTON, TEXAS

PROCEDURE 1 RUN

```
$LABEL

          INPUT SUMMARY

DOTF      INPUT/UNIT=19,FILE=1
STAT      INPUT/UNIT=20,FILE=1
STAT      OUTPUT/UNIT=20,FILE=2
MAPF      INPUT/UNIT=16,FILE=1
MAPF      OUTPUT/UNIT=16,FILE=2
MAPT      OUTPUT/UNIT=2,FILE=1
PROC      K-NEAREST
NEAR      1
OPTI      COND
DIST      L1
THRE      25.0
COMM      PROCEDURE 1 RUN
*END

USER HAS REQUESTED THE FOLLOWING OPTIONS :

CLUSTER/CLASSIFICATION TAPE IS BEING INPUT
MAPTAP FILE WILL BE OUTPUT
K-NEAREST PROCEDURE WILL BE USED
L1 DISTANCE WILL BE USED
THRESHOLD DISTANCE =      25.000
  1-NEAREST DOTS WILL BE USED
NO SUN ANGLE CORRECTION WILL BE APPLIED
DOTFIL FILE IS BEING INPUT
SAVTAP FILE IS BEING INPUT
CONDITIONAL CLUSTER MAP WILL BE OUTPUT


INPUT IMAGE DATA TAPE INFORMATION

    FORMAT                    UNIVERSAL
    NO. OF CHANNELS               1
    NO. OF PIXELS/LINE           9A
    FIRST SCAN LINE NO.           1
    FIRST PIXEL REFERENCE PT      1
```

20-29
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LYNDON B. JOHNSON SPACE CENTER
HOUSTON, TEXAS

PROCEDURE 1 RUN

INPUT FIELDS

FIELD	CLASS	SUBCLASS	VERTICES (SAMPLE,LINE)
1	S	1 S	(20, 10)
2	S	1 S	(140, 30)
3	S	1 S	(30, 40)
4	S	1 S	(40, 50)
5	S	1 S	(180, 50)
6	S	1 S	(150, 60)
7	S	1 S	(40, 70)
8	S	1 S	(70, 70)
9	S	1 S	(80, 70)
10	S	1 S	(170, 100)
11	S	1 S	(70, 110)
12	S	1 S	(80, 110)
13	N	2 N	(140, 10)
14	N	2 N	(10, 20)
15	N	2 N	(10, 30)
16	N	2 N	(50, 30)
17	N	2 N	(40, 40)
18	N	2 N	(60, 40)
19	N	2 N	(100, 40)
20	N	2 N	(100, 50)
21	N	2 N	(190, 50)
22	N	2 N	(40, 60)
23	N	2 N	(170, 60)
24	N	2 N	(190, 60)
25	N	2 N	(110, 70)
26	N	2 N	(180, 70)
27	N	2 N	(10, 80)
28	N	2 N	(20, 80)
29	N	2 N	(10, 100)
30	N	2 N	(30, 100)
31	N	2 N	(10, 110)
32	N	2 N	(60, 110)

20-30
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LYNDON B. JOHNSON SPACE CENTER
HOUSTON, TEXAS

PROCEDURE 1 RUN

CLUSTER-DOT INTER-DISTANCE TABLE

DOTS	CLST (1)	CLST (2)	CLST (3)	CLST (4)	CLST (5)	CLST (6)	CLST (7)	CLST (8)	CLST (9)	CLST (10)	CLST (11)	CLST (12)	CLST (13)	CLST (14)	CLST (15)
1.	12.00	14.05	10.60	25.28	40.84	15.[illegible]	33.40	14.61	14.72	25.45	23.94	40.27	44.99	53.37	23.60
2.	31.00	14.38	14.63	40.69	31.26	22.46	50.97	30.58	35.98	38.69	29.60	41.48	44.79	40.50	31.26
3.	21.23	16.73	9.20	30.28	34.61	16.34	44.60	17.27	21.98	34.69	20.38	33.88	35.99	42.77	26.00
4.	22.14	39.75	31.94	5.86	41.84	42.66	18.42	34.25	35.06	41.01	49.68	63.88	65.99	76.37	32.15
5.	48.69	22.29	32.21	55.86	4.79	37.42	72.00	28.15	43.11	64.45	21.53	27.87	47.26	46.47	27.85
6.	21.69	19.42	9.21	31.61	31.61	8.72	45.00	20.04	22.98	37.45	17.38	30.88	32.99	45.54	29.60
7.	22.46	45.75	38.29	13.81	60.46	41.66	16.51	39.85	33.06	37.01	52.94	69.27	73.99	82.37	40.15
8.	22.69	23.36	16.71	30.32	31.05	18.10	46.00	11.40	21.13	38.45	17.00	29.88	32.28	50.47	18.68
9.	15.00	17.97	10.29	26.28	39.84	15.26	34.40	13.49	12.36	26.45	22.94	39.27	43.99	52.47	24.60
10.	20.88	29.42	20.66	37.57	52.84	23.73	27.47	28.88	15.22	15.34	35.94	52.27	56.99	63.58	37.68
11.	39.69	31.06	24.37	47.32	25.40	24.55	53.00	19.15	34.11	55.45	9.87	13.67	28.85	50.78	28.53
12.	45.69	37.06	29.06	53.32	25.33	25.27	59.00	25.15	40.11	61.45	12.06	7.67	26.85	50.94	34.53
13.	51.69	47.06	37.84	60.75	51.33	31.27	75.00	40.04	46.39	67.45	35.53	26.95	6.84	60.94	49.60
14.	70.69	44.29	52.34	77.86	39.00	51.01	94.00	56.58	69.39	86.45	34.45	45.63	41.88	19.94	56.91
15.	27.69	19.06	19.90	34.86	22.84	10.42	51.00	9.23	22.48	43.45	20.60	32.48	40.26	53.47	9.45
16.	67.69	56.06	50.12	74.86	43.33	47.27	91.00	47.61	62.11	83.45	34.66	28.95	20.17	60.94	52.53
17.	21.00	24.42	13.79	32.57	45.12	14.24	48.47	25.49	24.39	28.69	31.45	39.08	41.99	50.91	32.60
18.	24.86	33.42	22.79	41.57	54.12	19.41	31.97	32.08	19.22	19.69	35.78	46.27	50.99	59.91	41.60
19.	40.69	24.06	22.90	47.86	22.98	23.06	64.00	21.51	35.11	56.45	17.74	19.48	25.26	41.37	21.68
20.	54.47	54.06	44.84	67.75	52.33	31.28	72.00	39.27	43.11	64.45	31.79	24.13	13.98	67.94	52.45
21.	50.69	24.25	32.34	57.86	23.00	31.01	76.00	42.58	49.39	66.45	38.45	37.48	40.79	19.94	40.91
22.	43.69	23.84	28.03	50.86	30.12	33.00	67.00	29.82	40.39	59.45	34.36	31.28	28.08	47.89	27.91
23.	51.43	48.62	58.43	44.16	35.51	70.42	59.00	46.37	57.19	70.30	55.72	66.48	80.26	51.47	34.48
24.	57.70	42.29	49.92	59.82	47.79	59.34	74.40	59.04	62.73	71.58	65.36	62.28	55.77	31.81	58.81
25.	36.47	36.06	26.84	49.75	46.33	13.28	56.00	32.63	29.98	48.45	25.79	21.38	21.99	49.94	44.68
26.	41.23	15.62	23.23	49.82	30.91	29.34	64.40	36.80	41.98	56.45	38.68	34.20	34.79	36.89	34.91
27.	62.69	36.29	44.34	69.86	28.33	42.27	86.00	43.23	57.11	78.45	33.94	24.78	25.04	47.29	42.77
28.	39.69	23.42	21.34	46.86	29.41	21.09	63.00	28.23	36.78	55.45	25.68	21.09	25.97	44.19	29.45
29.	46.69	22.14	28.34	53.86	32.33	26.55	70.00	38.58	43.98	62.45	34.45	26.43	24.79	35.94	36.91
30.	35.23	26.06	18.42	44.28	40.33	17.01	58.40	30.58	35.98	50.45	26.45	17.59	21.38	39.94	30.60
31.	66.69	44.14	48.34	73.86	30.33	46.27	90.00	46.15	61.11	82.45	33.86	19.42	26.78	55.94	45.85
32.	78.69	52.29	60.34	85.86	33.49	58.27	102.00	58.15	73.11	94.45	45.86	28.73	35.04	50.94	57.85

DOTS	CLST (16)	CLST (17)	CLST (18)	CLST (19)	CLST (20)	CLST (21)	CLST (22)	CLST (23)	CLST (24)	CLST (25)	CLST (26)	CLST (27)	CLST (28)	CLST (29)	CLST (30)
1.	59.61	23.67	39.82	34.72	40.81	43.09	37.44	44.74	31.75	28.87	52.27	32.87	39.71	38.86	53.43
2.	57.86	25.60	40.29	25.84	67.81	32.09	31.76	49.74	38.75	23.87	41.27	28.61	28.71	29.24	46.62
3.	50.01	20.55	41.44	25.72	57.81	34.27	33.15	47.74	30.75	26.63	43.27	23.87	38.71	21.75	44.63
4.	80.01	43.84	67.97	55.72	87.81	64.09	54.44	42.91	58.75	50.46	73.27	53.87	68.71	51.86	74.63
5.	43.01	51.35	70.29	21.94	61.27	29.20	30.15	43.06	53.41	31.03	26.69	31.44	33.97	43.87	33.56
6.	47.01	20.35	39.29	22.72	52.81	31.55	30.15	51.42	24.41	26.31	40.27	20.87	28.47	28.88	41.63
7.	88.01	45.16	63.97	63.72	85.81	72.09	60.48	50.91	56.75	57.82	81.27	61.87	68.71	59.86	82.63
8.	46.01	33.35	52.29	21.72	53.81	30.84	30.17	41.08	33.41	34.47	39.27	22.66	32.51	25.69	48.63
9.	58.01	21.80	37.97	33.72	57.81	42.09	46.44	45.74	30.75	28.63	51.27	31.87	38.71	29.75	52.63
10.	71.01	20.22	24.97	46.72	59.27	56.09	49.44	58.74	33.45	40.02	64.27	44.87	51.71	42.06	65.63
11.	30.36	40.35	59.29	16.56	42.27	35.08	31.31	56.08	35.18	39.47	27.38	19.22	31.51	26.87	25.25
12.	24.36	38.35	57.29	10.99	40.27	36.04	29.31	62.08	33.18	37.47	25.38	17.22	29.51	24.87	20.87
13.	18.45	34.42	48.55	29.06	23.13	46.08	24.57	72.08	20.55	37.43	24.31	22.35	22.82	15.76	18.77
14.	53.86	57.35	76.29	35.05	63.81	30.28	42.02	40.42	53.02	37.03	31.69	40.25	26.63	39.74	48.32
15.	48.86	37.48	58.44	20.45	58.81	33.37	28.32	36.08	46.41	31.87	34.76	24.44	35.51	36.87	35.63
16.	14.13	50.42	64.55	30.29	25.20	54.84	28.71	80.08	36.55	45.43	22.12	27.47	31.78	28.56	17.82
17.	56.01	8.73	29.97	31.72	81.81	43.24	34.44	53.74	32.75	25.02	49.27	29.87	36.71	27.06	50.63
18.	65.01	14.22	20.97	41.15	53.27	52.24	41.44	62.74	27.45	34.02	58.27	38.87	45.71	36.06	59.63
19.	35.86	35.35	54.29	5.76	45.81	24.45	14.31	49.08	32.18	26.47	21.27	14.10	20.51	21.87	22.63
20.	22.21	38.74	45.67	31.79	16.13	51.24	31.35	79.08	19.68	44.43	26.24	23.73	29.82	22.76	19.43
21.	53.86	43.35	62.29	21.75	53.81	11.40	32.62	35.74	39.52	23.03	27.58	27.45	19.22	27.93	40.32
22.	40.86	28.22	45.81	19.44	50.81	28.32	18.10	44.08	30.52	14.73	19.93	19.91	19.29	23.12	28.33
23.	82.86	72.84	96.97	54.94	94.97	37.89	59.43	14.19	86.41	57.18	59.69	64.44	66.97	76.87	69.32
24.	67.86	43.98	63.23	50.44	77.81	32.12	35.24	31.58	54.62	30.69	45.51	47.78	43.12	47.19	58.08
25.	36.01	23.41	33.67	24.06	33.81	41.68	26.17	66.42	8.18	28.72	29.27	16.90	20.68	9.93	30.63
26.	47.86	23.42	40.82	22.44	57.81	27.72	15.36	45.74	30.75	4.40	22.73	19.93	14.87	20.95	35.86
27.	30.44	40.09	61.67	20.78	41.44	31.60	21.20	57.08	36.91	25.28	18.87	20.47	13.24	26.58	17.31
28.	36.86	24.35	43.29	12.75	46.81	33.10	16.35	55.42	24.41	16.31	22.27	7.79	17.16	16.18	23.63
29.	37.86	34.09	52.29	16.63	47.81	27.08	22.02	52.42	28.18	16.72	18.57	17.45	6.51	17.22	24.32
30.	34.21	20.09	38.29	18.06	43.81	35.40	24.17	59.74	17.52	19.28	27.27	11.05	14.71	7.13	28.63
31.	21.20	51.35	70.29	22.28	35.80	41.04	30.15	67.08	45.68	35.88	17.08	26.62	22.58	33.68	11.61
32.	30.29	62.09	77.67	34.26	47.69	45.04	40.15	71.08	51.68	41.28	18.80	30.47	29.29	39.92	20.93

20-31
140

DOTS	CLST (31)
1.	58.04
2.	47.94
3.	49.04
4.	79.04
5.	19.48
6.	46.04
7.	87.04
8.	45.04
9.	57.04
10.	70.04
11.	28.49
12.	22.49
13.	40.36
14.	31.39
15.	40.04
16.	32.76
17.	55.04
18.	64.04
19.	27.04
20.	41.36
21.	26.35
22.	33.72
23.	55.35
24.	54.03
25.	40.85
26.	32.72
27.	20.21
28.	29.91
29.	24.45
30.	34.85
31.	16.00
32.	14.05

LY [illegible] JOHNSON SPACE CENTER
HOUSTON, TEXAS

PROCEDURE 1 RUN

LABELING BY 1-NEAREST NEIGHBOR PROCEDURE

LABEL : S
MEANS : 25.27 22.84 56.11 26.46 26.38 [illegible] 36.10 12.39

DOTS	ANALYST LABEL	DISTANCE
1.	S	12.00

TOTALS

LABEL	NO.
S	1
[illegible]	0

20-33
1442

LY [illegible] 4. JOHNSON SPACE CENTER
HOUSTON, TEXAS

PROCEDURE 1 RUN

LABELING BY 1-NEAREST NEIGHBOR PROCEDURE

LABEL : S

MEANS : 24.98 24.18 47.07 22.04 29.35 30.67 34.71 14.94

DOTS	ANALYST LABEL	DISTANCE
2.	S	14.38

TOTALS

LABEL	NO.
S	1
N	0

20-34
143

LYNDON B. JOHNSON SPACE CENTER
HOUSTON, TEXAS

PROCEDURE 1 RUN

LABELING BY 1-NEAREST NEIGHBOR PROCEDURE

LABEL : S

MEANS : 25.18 23.68 53.14 24.61 29.35 30.27 35.65 14.28

DOTS	ANALYST LABEL	DISTANCE
3.	S	9.20

TOTALS

LABEL	NO.
S	1
N	0

LYNDON B. JOHNSON SPACE CENTER
HOUSTON, TEXAS

PROCEDURE 1 RUN

LABELING BY 1-NEAREST NEIGHBOR PROCEDURE

LABEL : S
MEANS : 25.98 23.43 53.77 25.28 23.73 24.65 25.65 10.75

DOTS	ANALYST LABEL	DISTANCE
4.	S	5.88

TOTALS

LABEL	NO.
S	1
N	0

20-36

LYNDON B. JOHNSON SPACE CENTER
HOUSTON, TEXAS

PROCEDURE 1 RUN

LABELING BY 1-NEAREST NEIGHBOR PROCEDURE

LABEL : S

MEANS : 31.00 32.42 44.03 19.31 30.11 32.29 35.04 14.32

DOTS	ANALYST LABEL	DISTANCE
5.	S	8.79

TOTALS

LABEL	NO.
S	1
N	0

20-37
1976

LYNDON B. JOHNSON SPACE CENTER
HOUSTON, TEXAS

PROCEDURE 1 RUN

LABELING BY 1-NEAREST NEIGHBOR PROCEDURE

LABEL : S
MEANS : 26.37 23.81 57.49 26.78 31.26 42.91 37.52 15.14

DOTS	ANALYST LABEL	DISTANCE
6.	S	8.72

TOTALS

LABEL	NO.
S	1
W	0

141
20-38

LYNDON B. JOHNSON SPACE CENTER
HOUSTON, TEXAS

PROCEDURE 1 RUN

LABELING BY 1-NEAREST NEIGHBOR PROCEDURE

LABEL : 5
MEANS : 25.20 21.29 61.41 29.53 23.41 24.42 24.97 10.66

DOTS	ANALYST LABEL	DISTANCE
7.	5	16.51

TOTALS

LABEL	NO.
5	1
N	0

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LYNDON B. JOHNSON SPACE CENTER
HOUSTON, TEXAS

PROCEDURE 1 RUN

LABELING BY NEAREST NEIGHBOR PROCEDURE

LABEL : U

MEANS : 29.48 28.54 55.20 24.77 28.12 30.11 33.18 13.20

DOTS	ANALYST LABEL	DISTANCE
15.	N	9.23

TOTALS

LABEL	NO.
S	0
N	1

20-40

LYNDON B. JOHNSON SPACE CENTER
HOUSTON, TEXAS

PROCEDURE 1 RUN

LABELING BY 1-NEAREST NEIGHBOR PROCEDURE

LABEL : S

MEANS : 28.14 25.30 60.46 27.53 27.47 24.20 32.08 13.19

DOTS	ANALYST LABEL	DISTANCE
9.	S	12.36

TOTALS

LABEL	NO.
S	1
N	0

20-41
150

LYNDON B. JOHNSON SPACE CENTER
HOUSTON, TEXAS

PROCEDURE 1 RUN

LABELING BY 1-NEAREST NEIGHBOR PROCEDURE

LABEL : S

MEANS : 24.12 19.82 64.31 31.36 26.59 27.85 30.56 12.88

DOTS	ANALYST LABEL	DISTANCE
10.	S	15.34

TOTALS

LABEL	NO.
S	1
0	0

20-42
151

LYNDON B. JOHNSON SPACE CENTER
HOUSTON, TEXAS

PROCEDURE 1 RUN

LABELING BY 1-NEAREST NEIGHBOR PROCEDURE

LABEL : S

MEANS : 32.26 30.44 56.37 24.96 30.34 33.12 36.47 14.65

DOTS	ANALYST LABEL	DISTANCE
11.	S	9.87

TOTALS

LABEL	NO.
S	1
N	0

LYNDON B. JOHNSON SPACE CENTER
HOUSTON, TEXAS

PROCEDURE 1 RUN

LABELING BY 1-NEAREST NEIGHBOR PROCEDURE

LABEL : S
MEANS : 32.41 32.40 54.91 24.20 32.35 35.00 41.95 16.70

DOTS	ANALYST LABEL	DISTANCE
12.	S	7.67

TOTALS

LABEL	NO.
S	1
4	0

20-44
153

LYNDON B. JOHNSON SPACE CENTER
HOUSTON, TEXAS

PROCEDURE 1 6014

LABELING BY NEAREST NEIGHBOR PROCEDURE

LABEL : N

MEANS : 28.91 27.85 53.70 24.70 35.11 35.17 46.84 18.51

DOTS	ANALYST LABEL	DISTANCE
13.	N	6.04

TOTALS

LABEL	NO.
S	0
N	1

20-45
154

LYNDON B. JOHNSON SPACE CENTER
HOUSTON, TEXAS

PROCEDURE 1 RUN

LABELLING BY 1-NEAREST NEIGHBOR PROCEDURE

LABEL : N

MEANS : 24.06 24.95 30.96 13.86 31.90 34.97 17.98 14.91

DOTS	ANALYST LABEL	DISTANCE
21.	N	19.94

TOTALS

LABEL	OBS.
S	0
N	1

20-46
155

LYNDON B. JOHNSON SPACE CENTER
HOUSTON, TEXAS

PROCEDURE 1 RUN

LABELED BY 1-NEAREST NEIGHBOR PROCEDURE

LABEL : N

MEANS : 29.07 28.46 50.33 22.83 26.65 28.29 31.89 12.73

DOTS	ANALYST LABEL	DISTANCE
15.	N	9.45

TOTALS

LABEL	NO.
N	1

20-47

LYNDON B. JOHNSON SPACE CENTER
HOUSTON, TEXAS

PROCEDURE 1 RUN

LABELING BY 1-NEAREST NEIGHBOR PROCEDURE

LABEL : N
MEANS : 32.43 33.08 53.82 24.10 35.20 37.62 49.25 19.27

	HITS	NEAREST LABEL	DISTANCE
	16.	N	14.13

TOTALS

LABEL	NO.
S	0
N	1

20-48
157

LYNDON B. JOHNSON SPACE CENTER
HOUSTON, TEXAS

PROCEDURE 1 RUN

LABELING BY 1-NEAREST NEIGHBOR PROCEDURE

LABEL : N

MEANS : 24.03 21.09 55.34 26.41 28.56 23.65 41.63 17.34

DOTS	ANALYST LABEL	DISTANCE
17.	N	8.73

TOTALS

LABEL	NO.
N	17

20-49
158

LYNDON B. JOHNSON SPACE CENTER
HOUSTON, TEXAS

PROCEDURE 1 RUN

LABELING BY 1-NEAREST NEIGHBOR PROCEDURE

LABEL : N

MEANS : 22.76 18.51 64.83 32.22 29.57 30.27 43.31 18.06

DOTS	ANALYST LABEL	DISTANCE
16.	N	20.97

TOTALS

LABEL	NO.
S	0
N	1

151
20-50
159

LYNDON B. JOHNSON SPACE CENTER
HOUSTON, TEXAS

PROCEDURE 1 RUN

LABELING BY 1-NEAREST NEIGHBOR PROCEDURE

LABEL : N
MEANS : 29.14 29.25 50.06 22.43 31.71 34.69 39.35 15.79

DOTS	ANALYST LABEL	DISTANCE
19.	N	5.76

TOTALS

LABEL	NO.
S	0
N	1

20-51
1 of 2

LYNDON B. JOHNSON SPACE CENTER
HOUSTON, TEXAS

PROCEDURE 1 RUN

LABELING BY 1-NEAREST NEIGHBOR PROCEDURE

LABEL : N
MEANS : 31.35 29.92 60.81 27.96 35.84 40.07 50.04 20.22

OUTS	ANALYST LABEL	DISTANCE
20.	N	16.13

TOTALS

LABEL	NO.
N	0
	1

20-52

LYNDON B. JOHNSON SPACE CENTER
HOUSTON, TEXAS

PROCEDURE 1 RUN

LABELING BY 1-NEAREST NEIGHBOR PROCEDURE

LABEL : N

MEANS : 26.86 28.32 38.98 17.46 30.76 33.16 37.51 14.91

DOTS	ANALYST LABEL	DISTANCE
21.	N	11.40

TOTALS

LABEL	NO.
S	0
N	1

20-53
162

EARTH OBS. & JOHNSON SPACE CENTER
HOUSTON, TEXAS

PROCEDURE 1 RUN

LABELING BY 1-NEAREST NEIGHBOR PROCEDURE

LABEL : N

MEANS : 28.41 26.52 49.31 22.62 30.49 30.65 44.91 18.38

DOTS	ANALYST LABEL	DISTANCE
22.	N	8.16

TOTALS

LABEL	NO.
S	0
N	1

20-54
163

L.Y [illegible] JOHNSON SPACE CENTER
HOUSTON, TEXAS

PROCEDURE 1 RUN

LABELING BY 1-NEAREST NEIGHBOR PROCEDURE

LABEL : N
MEANS : 26.66 27.67 37.25 16.76 25.14 27.54 23.23 11.65

DOTS	ANALYST LABEL	DISTANCE
23.	N	14.19

TOTALS

LABEL	NO.
S	0
N	1

20-55
191

LYNDON B. JOHNSON SPACE CENTER
HOUSTON, TEXAS

PROCEDURE 1 RUN:

LABELING BY NEAREST NEIGHBOR PROCEDURE

LABEL : N
MEANS : 26.67 24.00 59.27 27.88 32.25 34.01 49.42 18.15

DOTS	ANALYST LABEL	DISTANCE
25.	N	8.18

TOTALS

LABEL	NO.
S	0
N	1

LYNDON B. JOHNSON SPACE CENTER
HOUSTON, TEXAS

PROCEDURE 1 RUN

LABELING BY 1-NEAREST NEIGHBOR PROCEDURE

LABEL : N
MEANS : 25.28 24.42 46.57 21.71 29.80 24.78 41.48 17.15

DOTS	ANALYST LABEL	DISTANCE
26.	N	4.40

TOTALS

LABEL	NO.
S	0
N	1

20-57
146

LYNDON B. JOHNSON SPACE CENTER
HOUSTON, TEXAS

PROCEDURE 1 RUN

LABELING BY 1-NEAREST NEIGHBOR PROCEDURE

LABEL = N

MEANS = 20.76 29.69 46.86 21.30 33.60 35.35 44.47 17.57

DOTS	ANALYST LABEL	DISTANCE
27.	N	10.87

TOTALS

LABEL	NO.
N	1

20558

LYNDON B. JOHNSON SPACE CENTER
HOUSTON, TEXAS

PROCEDURE 1 RUN

LABELING BY 1-NEAREST NEIGHBOR PROCEDURE

LABEL : N

MEANS : 29.81 26.60 52.37 23.83 31.93 33.4[illegible] 42.0[illegible] 17.17

DOTS	ANALYST LABEL	DISTANCE
2[illegible].	N	7.79

TOTALS

LABEL	NO.
S	0
N	1

~~20-59~~
168

LY [illegible] JOHNSON SPACE CENTER
HOUSTON TEXAS

PROCEDURE 1 RUN

LABELING BY NEAREST NEIGHBOR PROCEDURE

LABEL : N
MEANS : 26.62 25.48 47.79 21.94 33.82 [illegible] [illegible] 16.66

DOTS	NEAREST LABEL	DISTANCE
24.	4	0.51

TOTALS

LABEL	NO.
N	0
4	1

169
20-60

LY [illegible] JOHNSON SPACE CENTER
HOUSTON, TEXAS

PROCEDURE 1 RUN

LABELLED BY 1-NEAREST NEIGHBOR PROCEDURE

LABEL : N
MEANS : 26.03 24.65 53.40 24.69 32.77 35.31 43.88 17.49

OBS	ANALYST LABEL	DISTANCE
46.	N	7.13

TOTALS

LABEL	NO.
S	6
N	1

LY [illegible] JOHNSON SPACE CENTER
HOUSTON, TEXAS

PROCEDURE 1 MIN

LABELING BY 1-NEAREST NEIGHBOR PROCEDURE

LABEL : N
MEANS : 32.19 31.19 51.00 22.85 35.31 38.64 44.49 17.63

	POTS	ANALYST LABEL	DISTANCE
	31.	N	11.61

TOTALS

LABEL	NO.
S	0
N	1

20-62
1

PROCEDURE 1 RUN

CLASSIFY BY NEAREST NEIGHBOR PROCEDURE

LABEL : N

MEANS : 32.77 35.08 45.13 19.52 32.48 37.28 41.09 16.07

DOTS	ANALYST LABEL	DISTANCE
32.	N	14.05

TOTALS

LABEL	NO.
S	0
N	1

20-63

THE STATISTICS FILE FOR 2 CLASSES AND 31 SUBCLASSES HAS BEEN WRITTEN

THE STATS FOR A PARTICULAR CLASS OR SUBCLASS SHOULD BE REFERRED TO IN LATER RUNS BY
THE FOLLOWING NAMES AND NUMBERS (WHICHEVER APPLICABLE)

CLASS 1 S SUBCLASSES (TOTAL= 11)

1	S	01
2	S	02
3	S	03
4	S	04
5	S	05
6	S	06
7	S	07
8	S	08
9	S	09
10	S	10
11	S	11

CLASS 2 N SUBCLASSES (TOTAL= 20)

12	N	01
13	N	02
14	N	03
15	N	04
16	N	05
17	N	06
18	N	07
19	N	08
20	N	09
21	N	10
22	N	11
23	N	12
24	N	13
25	N	14
26	N	15
27	N	16
28	N	17
29	N	18
30	N	19
31	N	20

20-64
173

[illegible] JOHNSON SPACE CENTER
[illegible] HOUSTON, TEXAS

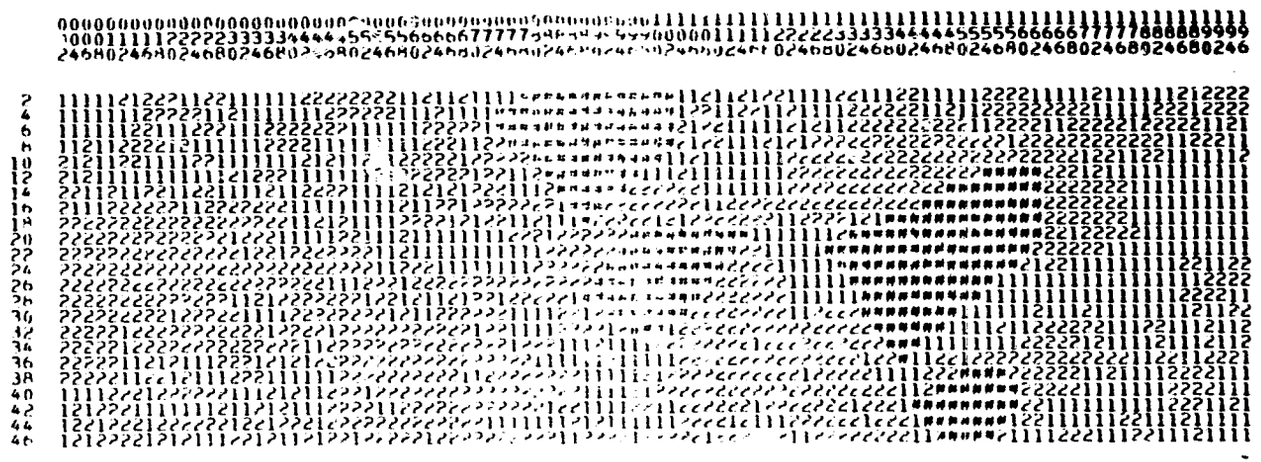
PROCEDURE 1 RUN

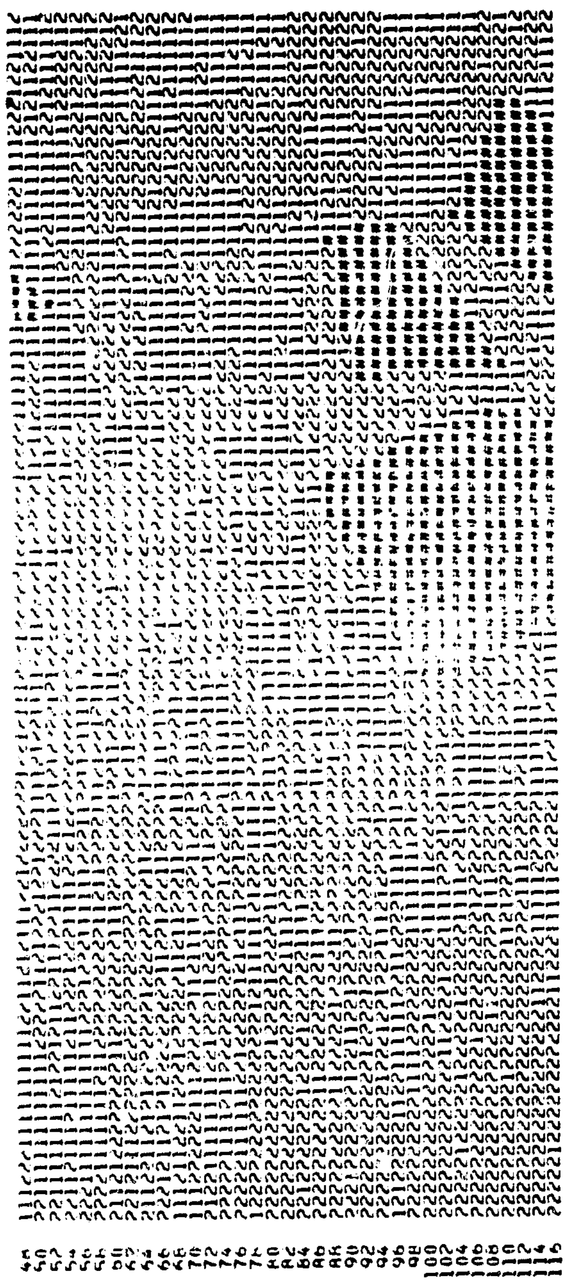
LABELED CLUSTER MAP

(** = DENOTES MIXED/CONO CLUSTER)
(* = DENOTES DO/DO AREA)

LABEL NO.	NAME	UNLABELED NO.	SUBCLASS LABELED NO.	NAME	SYMBOL
1	S	1	1	S 01	1
		2	2	S 02	1
		3	3	S 03	1
		4	4	S 04	1
		5	5	S 05	1
		6	6	S 06	1
		7	7	S 07	1
		9	8	S 08	1
		10	9	S 09	1
		11	10	S 10	1
		12	11	S 11	1
2	N	8	12	N 01	2
		13	13	N 02	2
		14	14	N 03	2
		15	15	N 04	2
		16	16	N 05	2
		17	17	N 06	2
		18	18	N 07	2
		19	19	N 08	2
		20	20	N 09	2
		21	21	N 10	2
		22	22	N 11	2
		23	23	N 12	2
		24	24	N 13	2
		25	25	N 14	2
		26	26	N 15	2
		27	27	N 16	2
		28	28	N 17	2
		29	29	N 18	2
		30	30	N 19	2
		31	31	N 20	2

CONDITIONAL CLUSTER MAP





NEW ORDERING AND COLOR KEY CODES

OLD	NEW CAT	COLOR CODES	CODES
1	1	1	77
2	1	1	77
3	1	1	77
4	1	1	77
5	1	1	77
6	1	1	77
7	1	1	77
8	2	1	207
9	1	1	77
10	1	1	77
11	1	1	77
12	1	1	77
13	2	1	207
14	2	1	207
15	2	1	207
16	2	1	207
17	2	1	207
18	2	1	207
19	2	1	207
20	2	1	207
21	2	1	207
22	2	1	207
23	2	1	207
24	2	1	207
25	2	1	207
26	2	1	207
27	2	1	207
28	2	1	207
29	2	1	207
30	2	1	207
31	2	1	207

TIME FOR LABEL 0.661 MINUTES

PLEASE BE ADVISED OF THE CHANGE TO CLASSIFY AND DISPLAY PROCESSOR CARD IMAGES
MAPTAP FILE AND UNIT NUMBER NOW APPEAR AS ORDINARY CONTROL CARDS FIRST ONES AFTER PROCESSOR CARD

20-67

[illegible] JOHNSON SPACE CENTER
HOUSTON, TEXAS

PROCEDURE 1 RUN

```
$CLASSIF
    MAPT        UNIT=2,FILE=2
    DATA        UNIT=11,FILE=1
    STAT        UNIT=20,FILE=2
    APRT        FILE
    CATE        FILE
    COMM        PROCEDURE 1 RUN
    $END
```

20-68

LY ...0... 4. JOHNSON SPACE CENTER
HOUSTON, TEXAS

PROCEDURE 1 RUN

THE FOLLOWING OPTIONS HAVE BEEN SELECTED:

CATEGORY CLASSIFIER OPTION HAS BEEN SELECTED.
ALSO CLASSES FROM STATFILE WILL BE CONSIDERED FOR CATEGORIES FOR CLASSIFICATION
APRIORI VALUES FROM STATFILE 2 APRIORI= ...0. PIXELS IN SUBCLASS/TOTAL NO. PIXELS IN ALL SUBCLASSES ***

SUPERVISOR INFORMATION :

FILE NUMBER	2
NO. OF FIELDS.....	1
NO. OF CLASSES.....	2
NO. OF SUBCLASSES.....	31
NO. OF CHANNELS.....	8

Category Wheat, Non-Wheat ← how is this different from Category File

8-1) 20-69

LY [illegible] JOHNSON SPACE CENTER
HOUSTON, TEXAS

PROCEDURE 1 RUN

AREA USED TO COMPUTE TRAINING STATISTICS

FIELD	CLASS	SUBCLASS	VERTICES (SAMPLE,LINE)
1 SEGM	1 S		(2, 2) (196, 2) (196, 117) (2, 117)

179
20-70

PROCEDURE 1 RUN

*** CLASSIFICATION STUDY *** [illegible]

SUBCLASSES CONSIDERED

SYMBOL	SUBCLASS	[illegible]
1	01	[illegible]
2	02	[illegible]
3	03	[illegible]
4	04	[illegible]
5	05	[illegible]
6	06	[illegible]
7	07	[illegible]
8	08	[illegible]
9	09	[illegible]
A	10	[illegible]
B	11	[illegible]
C	01	[illegible]
D	02	[illegible]
E	03	[illegible]
F	04	[illegible]
G	05	[illegible]
H	06	[illegible]
I	07	[illegible]
J	08	[illegible]
K	09	[illegible]
L	10	[illegible]
M	11	[illegible]
N	12	[illegible]
O	13	[illegible]
P	14	[illegible]
Q	15	[illegible]
R	16	[illegible]
S	17	[illegible]
T	18	[illegible]
U	19	[illegible]
V	20	[illegible]

CHANNELS CONSIDERED

TRAINING	RECOGNITION
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8

INPUT IMAGE DATA TAPE INFORMATION

FORMAT	UNIVERSAL
NO. OF CHANNELS	8
NO. OF PIXELS/LINE	196
FIRST SCAN LINE NO.	1
FIRST PIXEL REFERENCE PT	1

[illegible] • JOHNSON SPACE CENTER
[illegible] • TEXAS

PROCEDURE 1 RUN

[illegible] OF CLASSIFICATION

FIELD NAME SEGM	NO. OF VERTICES	SAMPLE INC.	LINE INC.	VERTICES					
	4	2	2	(2. 2)	(146. 2)	(146. 117)	(2. 117)	(2. 2)	

131
20-72

. JOHNSON SPACE CENTER
HOUSTON, TEXAS

PROCEDURE 1 RUN

CLASSIFIER CLASSIFICATION RESULTS

CATEGORY NO.	CATEGORY NAME	CLASS NO.	CLASS NAME	SUBCLASS NO.	SUBCLASS NAME	SYMBOL
1	S	1	S	1	S 01	1
				2	S 02	2
				3	S 03	3
				4	S 04	4
				5	S 05	5
				6	S 06	6
				7	S 07	7
				8	S 08	8
				9	S 09	9
				10	S 10	A
				11	S 11	B
2	N	2	N	12	N 01	C
				13	N 02	D
				14	N 03	E
				15	N 04	F
				16	N 05	G
				17	N 06	H
				18	N 07	I
				19	N 08	J
				20	N 09	K
				21	N 10	L
				22	N 11	M
				23	N 12	N
				24	N 13	O
				25	N 14	P
				26	N 15	Q
				27	N 16	R
				28	N 17	S
				29	N 18	T
				30	N 19	U
				31	N 20	V

[illegible]

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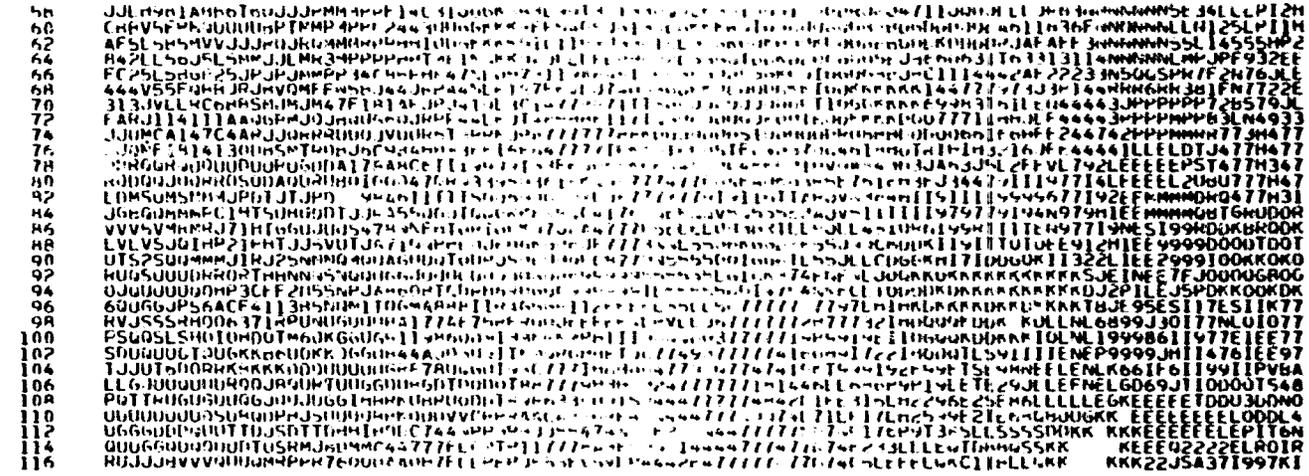
OF POOR QUALITY



AS THE COMPUTER CANNOT EXPERIMENT[illegible] ... 29 PTS WERE NOT CLASSIFIED IN THIS FIELD

*** SCLASSIFY - COMPLETED ***

TIME FOR CLASSIFY 7.384

PLEASE BE ADVISED OF THE CHANGE TO CLASSIFY ... DISPLAY PROCESSOR CARD IMAGES
MAPTAP FILE AND UNIT NUMBER ... PRINT CONTROL CARDS FIRST ONES AFTER PROCESSOR CARD

20-74

LYNDON B. JOHNSON SPACE CENTER
HOUSTON, TEXAS

PROCEDURE 1 RUN

```
$DISPLAY

     DOTF      INPUT/UNIT=19,FILE=2
     COMM      PROCEDURE 1 CLUSTER RESULTS
     *END


  YOU HAVE SELECTED THE FOLLOWING OPTIONS:

       PROCESS THE CLASSIFICATION RESULTS FROM [illegible] 1) UNIT    2  ,  FILE    1
       APPLY NO THRESHOLDING
       PRINT DOT DATA PERFORMANCE SUMMARIES FOR DOT DATA FROM FORTRAN UNIT 19 ,FILE NO.   2 ,TAPE (OR FILE)    L
       EXCLUDE PIXELS IN THE DESIGNATED AREAS FROM CLASSIFICATION SUMMARIES
```

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OF POOR QUALITY

[illegible] JOHNSON SPACE CENTER
[illegible] TEXAS

PROCEDURE 1 CLUSTER RESULTS

AREA USED TO COMPUTE TRAINING STATISTICS

FIELD	CLASS	SUBCLASS	VERTICES (SAMPLE,LINE)
1	1	1	(20, 10)
2	S	S	(180, 30)
3	S	S	(30, 40)
4	S	S	(40, 50)
5	S	S	(180, 50)
6	S	S	(150, 60)
7	S	S	(40, 70)
8	S	S	(70, 70)
9	S	S	(80, 70)
10	S	S	(170, 100)
11	S	S	(70, 110)
12	S	S	(80, 110)
13	N	N	(140, 10)
14	N	N	(10, 20)
15	N	N	(10, 30)
16	N	N	(50, 30)
17	N	N	(40, 40)
18	N	N	(60, 40)
19	N	N	(160, 40)
20	N	N	(160, 50)
21	N	N	(140, 50)
22	N	N	(40, 60)
23	N	N	(170, 60)
24	N	N	(130, 60)
25	N	N	(110, 70)
26	N	N	(130, 70)
27	N	N	(10, 80)
28	N	N	(20, 80)
29	N	N	(10, 100)
30	N	N	(30, 100)
31	N	N	(10, 110)
32	N	N	(60, 110)

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185

[illegible] JOHNSON SPACE CENTER
[illegible] TEXAS

PROCEDURE 1 CLUSTER RESULTS

[illegible] FIELDS

FIELD		VERTICES (SAMPLE,LINE)									
1	001	(73, 5)	(77, 2)	(103, 2)	(102, 9)	(88, 18)					
2	002	(88, 28)	(95, 20)	(115, 20)	(99, 34)						
3	003	(127, 22)	(153, 12)	(162, 12)	(162, 21)	(140, 36)					
4	004	(142, 42)	(153, 36)	(160, 41)	(150, 52)						
5	005	(87, 101)	(121, 86)	(133, 110)	(129, 117)	(100, 117)					
6	006	(138, 91)	(160, 88)	(163, 96)	(140, 110)						
7	007	(150, 117)	(164, 104)	(183, 110)	(178, 117)						

DOT FILE INFORMATION :

NO. DOT CATEGORIES =
TOTAL NO. OF DOTS = 54
DOT CATEGORY NAMES :

S [illegible]

DOT RECORD :

DOT NO.	SAMPLE	LINE	TYPE	CATEGORY
1	60	20	[illegible]	1
2	70	20		
3	180	20		
4	30	30		
5	190	30		
6	170	40		
7	30	50		
8	70	50		
9	90	50		
10	160	50		
11	50	60		
12	160	60		
13	20	70		
14	140	70		
15	190	70		
16	90	80		
17	150	80		
18	180	80		
19	130	90		
20	180	90		
21	150	110		
22	70	10		
23	110	10		
24	20	20		
25	40	20		
26	70	30		
27	170	30		
28	10	40		
29	70	40		
30	90	40		
31	20	50		
32	30	50		
33	60	50		
34	80	50		
35	130	50		
36	140	50		
37	30	60		

20-77

35	70	[illegible]	[illegible]	[illegible]
36	120	74	[illegible]	[illegible]
40	60	[illegible]	[illegible]	[illegible]
41	70	[illegible]	[illegible]	[illegible]
42	120	80	[illegible]	[illegible]
43	170	[illegible]	[illegible]	[illegible]
44	20	[illegible]	[illegible]	[illegible]
45	40	[illegible]	[illegible]	[illegible]
46	70	[illegible]	[illegible]	[illegible]
47	50	[illegible]	[illegible]	[illegible]
48	170	[illegible]	[illegible]	[illegible]
49	70	[illegible]	[illegible]	[illegible]
50	80	[illegible]	[illegible]	[illegible]
51	150	[illegible]	[illegible]	[illegible]
52	20	[illegible]	[illegible]	[illegible]
53	50	[illegible]	[illegible]	[illegible]
54	100	[illegible]	[illegible]	[illegible]

THERE IS A 1-1 CORRESPONDENCE BETWEEN THE CATEGORY NAMES FROM DUTFILE --
S N
AND THE CATEGORY NAMES FROM INPUT --
S N

2078

[illegible] SCALE CENTER
[illegible] TEXAS

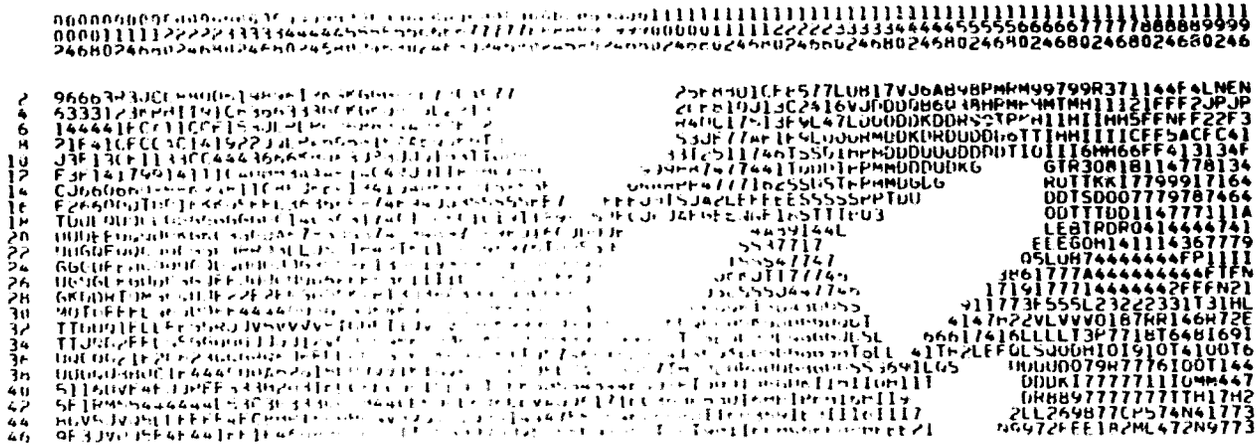
[illegible] 1 CLUSTER [illegible]

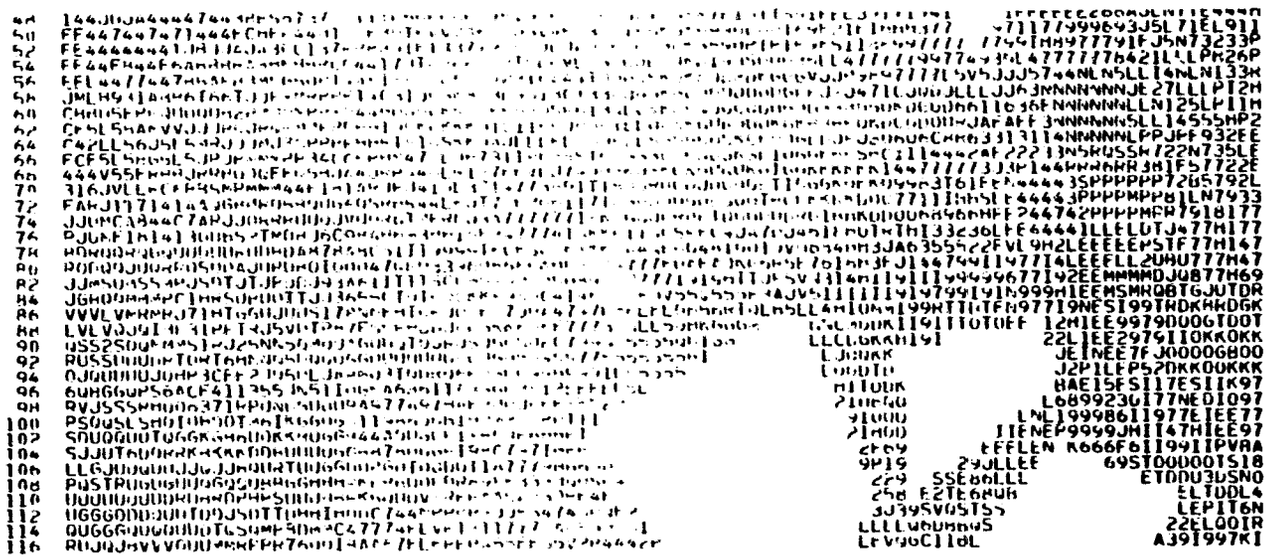
DISPLAY OF CLASSIFIED FILE[illegible]
CLASSIFICATION [illegible]
CLASSIFICATION: [illegible] OF CHANNELS
1

[illegible] CLASSIFIED CLASSIFICATION RESULTS

CATEGORY [illegible]	CLASS [illegible]	NO.	SUBCLASS NAME	SYMBOL
1	1	1	S 01	1
		2	S 02	2
		3	S 03	3
		4	S 04	4
		5	S 05	5
		6	S 06	6
		7	S 07	7
		8	S 08	8
		9	S 09	9
		10	S 10	A
		11	S 11	B
[illegible]	[illegible]	12	N 01	C
		13	N 02	D
		14	N 03	E
		15	N 04	F
		16	N 05	G
		17	N 06	H
		18	N 07	I
		19	N 08	J
		20	N 09	K
		21	N 10	L
		22	N 11	M
		23	N 12	N
		24	N 13	O
		25	N 14	P
		26	N 15	Q
		27	N 16	R
		28	N 17	S
		29	N 18	T
		30	N 19	U
		31	N 20	V

** DESIGNATED FIELDS SYMBOL IS *





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20-80

[illegible] JOHNSON SPACE CENTER
HOUSTON, TEXAS

PROCEDURE 1 CLUSTER RESULTS

CLASSIFICATION SUMMARY FOR FIELD [illegible]

TOTAL NUMBER OF SAMPLED POINTS [illegible]

SUBCLASS	PTS. BEFORE THRES.	PCT. OF TOTAL CLSF.FLD.	PTS. AFTER THRES.	PCT. OF TOTAL CLSF.FLD.	PCT. OF SUBCLASS	PTS. THRES.	PCT. OF TOTAL CLSF.FLD.	PCT. OF SUBCLASS THRES.
S 01	242	4.50	242	4.50	100.00	0	0.0	0.0
S 02	109	2.17	109	2.17	100.00	0	0.0	0.0
S 03	139	2.79	139	2.79	100.00	0	0.0	0.0
S 04	257	5.15	257	5.16	100.00	0	0.0	0.0
S 05	114	2.29	114	2.29	100.00	0	0.0	0.0
S 06	179	3.59	179	3.59	100.00	0	0.0	0.0
S 07	273	5.49	273	5.49	100.00	0	0.0	0.0
S 08	129	2.57	129	2.57	100.00	0	0.0	0.0
S 09	143	[illegible]	143	[illegible]	100.00	0	0.0	0.0
S 10	84	1.69	84	1.69	100.00	0	0.0	0.0
S 11	165	3.31	165	3.31	100.00	0	0.0	0.0
N 01	84	1.69	84	1.69	100.00	0	0.0	0.0
N 02	247	4.96	247	4.96	100.00	0	0.0	0.0
N 03	140	2.81	140	2.81	100.00	0	0.0	0.0
N 04	139	2.79	139	2.79	100.00	0	0.0	0.0
N 05	171	3.43	171	3.43	100.00	0	0.0	0.0
N 06	179	3.59	179	3.59	100.00	0	0.0	0.0
N 07	154	3.09	154	3.09	100.00	0	0.0	0.0
N 08	142	2.85	142	2.85	100.00	0	0.0	0.0
N 09	135	2.71	135	2.71	100.00	0	0.0	0.0
N 10	164	3.29	164	3.29	100.00	0	0.0	0.0
N 11	117	2.35	117	2.35	100.00	0	0.0	0.0
N 12	106	2.13	106	2.13	100.00	0	0.0	0.0
N 13	154	3.09	154	3.09	100.00	0	0.0	0.0
N 14	129	2.59	129	2.59	100.00	0	0.0	0.0
N 15	169	3.39	169	3.39	100.00	0	0.0	0.0
N 16	154	3.09	154	3.09	100.00	0	0.0	0.0
N 17	119	2.39	119	2.39	100.00	0	0.0	0.0
N 18	165	3.31	165	3.31	100.00	0	0.0	0.0
N 19	266	5.34	266	5.34	100.00	0	0.0	0.0
N 20	75	1.51	75	1.51	100.00	0	0.0	0.0

PTS. THRESHOLDED IN DISPLAY 0
PTS. THRESHOLDED IN CLASSIFY 0
TOTAL 0 PCT. = 0.0

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[illegible] JOHNSON SPACE CENTER
[illegible] TEXAS

PROCEDURE 1 CLUSTER RESULTS

CLASSIFICATION SUMMARY FOR FILE [illegible]

TOTAL NUMBER OF SAMPLES PROCESSED [illegible]

CLASS	PTS. BEFORE THRES.	PCT. OF TOTAL CLSF.FLD.	[illegible]	PCT.OF TOTAL CLSF.FLD.	PCT.OF CLASS	PTS. THRES.	PCT.OF TOTAL CLSF.FLD.	PCT. OF CLASS THRES.
S	1492	37. [illegible]	[illegible]	37.28	100.00	0	0.0	0.0
U	2510	62. [illegible]	[illegible]	62.72	100.00	0	0.0	0.0

PTS. THRESHOLDED IN CLASSIFY :
PTS. THRESHOLDED IN CLASSIFY TOTAL : PCT. = 0.0

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LYNDON B. JOHNSON SPACE CENTER
HOUSTON, TEXAS

PROCEDURE 1 CLUSTER RESULTS

CLASSIFICATION SUMMARY FOR FIELD [illegible]

TOTAL NUMBER OF SAMPLED POINTS [illegible]

CATEGORY	PTS. BEFORE THRES.	PCT. OF TOTAL CLSF.FLD.	PTS. AFTER THRES.	PCT.OF TOTAL CLSF.FLD.	PCT.OF CATEGORY	PTS. THRES.	PCT.OF TOTAL CLSF.FLD.	PCT. OF CATEGORY THRES.
S	1892	37.[illegible]	[illegible]	37.[illegible]	100.00	0	0.0	0.0
N	3089	62.[illegible]	[illegible]	62.[illegible]	100.00	0	0.0	0.0

PTS. THRESHOLDED IN DISPLAY [illegible]
PTS. THRESHOLDED IN CLASSIFY [illegible]
TOTAL [illegible] PCT. = 0.0

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192

(SUMMARY OF ANALYST LABELED VS CLASSIFIED CATEGORIES)

ANALYST LABELED DOT CATEGORY	TOTAL NUMBER ANALYST LABELED DOTS	PERCENT CORRECTLY CLASSIFIED	[illegible]	[illegible] CATEGORY [illegible]	BIAS CORRECTED CATEGORY PROPORTION
S	21	85.714	[illegible]	[illegible]	34.690
N	33	81.818	[illegible]	[illegible]	65.310

DOT CLASSIFICATION SUMMARY (ALPHA)

	S	N
S	18 (75.000)	3 (10.000)
N	6 (25.000)	27 (90.000)

20-84
/ 3

20-85

(70, 10) CATEGORY		
LABELED	CLASSIFIED(SUBCL)	
N	N	(S 14)

(110, 10) CATEGORY		
LABELED	CLASSIFIED(SUBCL)	
N	S	(S 05)

(60, 20) CATEGORY		
LABELED	CLASSIFIED(SUBCL)	
S	S	(S 08)

(70, 20) CATEGORY		
LABELED	CLASSIFIED(SUBCL)	
S	S	(S 08)

(180, 20) CATEGORY		
LABELED	CLASSIFIED(SUBCL)	
S	S	(S 04)

(20, 30) CATEGORY		
LABELED	CLASSIFIED(SUBCL)	
N	[illegible]	(N 19)

(40, 20) CATEGORY		
LABELED	CLASSIFIED(SUBCL)	
N	S	(S 06)

(30, 30) CATEGORY		
LABELED	CLASSIFIED(SUBCL)	
S	N	(N 04)

(190, 30) CATEGORY		
LABELED	CLASSIFIED(SUBCL)	
S	S	(S 03)

(70, 30) CATEGORY		
LABELED	CLASSIFIED(SUBCL)	
[illegible]	[illegible]	(N 17)

(170, 30) CATEGORY		
LABELED	CLASSIFIED(SUBCL)	
N	N	(N 10)

(170, 40) CATEGORY		
LABELED	CLASSIFIED(SUBCL)	
S	S	(S 07)

(10, 40) CATEGORY		
LABELED	CLASSIFIED(SUBCL)	
N	N	(N 19)

(70, 40) CATEGORY		
LABELED	CLASSIFIED(SUBCL)	
N	[illegible]	(N 13)

(80, 40) CATEGORY		
LABELED	CLASSIFIED(SUBCL)	
N	N	(N 17)

(30, 50) CATEGORY		
LABELED	CLASSIFIED(SUBCL)	
S	N	(N 04)

(70, 50) CATEGORY		
LABELED	CLASSIFIED(SUBCL)	
S	S	(S 06)

(90, 50) CATEGORY		
LABELED	CLASSIFIED(SUBCL)	
S	S	(S 11)

(100, 50) CATEGORY		
LABELED	CLASSIFIED(SUBCL)	
S	S	(S 01)

(50, 60) CATEGORY		
LABELED	CLASSIFIED(SUBCL)	
S	S	(S 04)

(140, 60)
CATEGORY

LABELED	CLASSIFIED(SUBCL)	
S	S	(S 06)

(80, 60)
CATEGORY

LABELED	CLASSIFIED(SUBCL)	
N	N	(N 13)

(140, 70)
CATEGORY

LABELED	CLASSIFIED(SUBCL)	
S	S	(S 09)

(120, 70)
CATEGORY

LABELED	CLASSIFIED(SUBCL)	
N	N	(N 07)

(60, 80)
CATEGORY

LABELED	CLASSIFIED(SUBCL)	
N	N	(N 15)

(30, 60)
CATEGORY

LABELED	CLASSIFIED(SUBCL)	
N	S	(S 02)

(140, 60)
CATEGORY

LABELED	CLASSIFIED(SUBCL)	
N	N	(N 02)

(30, 70)
CATEGORY

LABELED	CLASSIFIED(SUBCL)	
N	N	(N 16)

(150, 80)
CATEGORY

LABELED	CLASSIFIED(SUBCL)	
S	S	(S 09)

(120, 80)
CATEGORY

LABELED	CLASSIFIED(SUBCL)	
N	S	(S 05)

(60, 60)
CATEGORY

LABELED	CLASSIFIED(SUBCL)	
N	N	(N 05)

(20, 70)
CATEGORY

LABELED	CLASSIFIED(SUBCL)	
S	S	(S 06)

(90, 70)
CATEGORY

LABELED	CLASSIFIED(SUBCL)	
N	N	(N 18)

(160, 80)
CATEGORY

LABELED	CLASSIFIED(SUBCL)	
S	S	(S 07)

20-86

(130, 90)
CATEGORY

LABELED	CLASSIFIED(SUBCL)	
S	N	(N 02)

(150, 90)
CATEGORY

LABELED	CLASSIFIED(SUBCL)	
S	S	(S 04)

(20, 90)
CATEGORY

LABELED	CLASSIFIED(SUBCL)	
N	N	(N 11)

(40, 90)
CATEGORY

LABELED	CLASSIFIED(SUBCL)	
N	N	(N 15)

(70, 90)
CATEGORY

LABELED	CLASSIFIED(SUBCL)	
N	N	(N 19)

(90, 90)
CATEGORY

LABELED	CLASSIFIED(SUBCL)	
N	N	(N 16)

(170, 90)
CATEGORY

LABELED	CLASSIFIED(SUBCL)	
N	N	(N 03)

(70,100)
CATEGORY

LABELED	CLASSIFIED(SUBCL)	
N	N	(N 11)

(80,100)
CATEGORY

LABELED	CLASSIFIED(SUBCL)	
N	N	(N 14)

(150,100)
CATEGORY

LABELED	CLASSIFIED(SUBCL)	
N	S	(S 04)

(150,110)
CATEGORY

LABELED	CLASSIFIED(SUBCL)	
S	S	(S 06)

(20,110)
CATEGORY

LABELED	CLASSIFIED(SUBCL)	
N	N	(N 16)

(50,110)
CATEGORY

LABELED	CLASSIFIED(SUBCL)	
N	N	(N 09)

(150,110)
CATEGORY

LABELED	CLASSIFIED(SUBCL)	
N	N	(N 02)

20-87
196

***** DISPLAY COMPLETED *****

TIME FOR DISPLAY 0.137

PLEASE BE ADVISED OF THE CHANGE TO CLASSIFY AND DISPLAY PROCESSOR CARD IMAGES
MAPTAP FILE AND UNIT NUMBER NOW APPEAR AS ORDINARY CONTROL CARDS FIRST ONES AFTER PROCESSOR CARD

20-88

LYNDON B. JOHNSON SPACE CENTER
HOUSTON, TEXAS

PROCEDURE 1 CLUSTER RESULTS

$DISPLAY

```
DDTF      INPUT/UNIT=19,FILE=2
COMM      PROCEDURE 1 CLASSIFICATION RESULTS
*END
```

YOU HAVE SELECTED THE FOLLOWING OPTIONS:

PROCESS THE CLASSIFICATION RESULTS FROM PARTAP (B), UNIT 2 , FILE 2
APPLY NO THRESHOLDING
PRINT OUT DATA PERFORMANCE SUMMARIES FOR OUT DATA FROM FORTRAN UNIT 19 ,FILE NO. 2 ,TAPE (OR FILE) L
EXCLUDE PIXELS IN THE DESIGNATED AREAS FROM CLASSIFICATION SUMMARIES

B01/20-89

L.Y. [illegible] JOHNSON SPACE CENTER
HOUSTON, TEXAS

PROCEDURE 1 CLASSIFICATION RESULTS

AREA USED TO COMPUTE FIELD STATISTICS

FIELD	CLASS	SUBCLASS	VERTICES (SAMPLE,LINE)
1 SEGM	1 S		(2, 2) (196, 2) (196, 117) (2, 117)

20-90
199

[illegible] JOHNSON SPACE CENTER
[illegible], TEXAS

PROCEDURE 1 CLASSIFICATION RESULTS

ESTIMATED FIELDS

FIELD	ESTIMATED	VERTICES (SAMPLE,LINE)									
1	001	(73, 5)	(77, 2)	(103, 2)	(102, 9)	(88, 18)					
2	002	([illegible]	(95, 20)	(115, 20)	(99, 34)						
3	003	(127, 22)	(153, 12)	(162, 12)	(162, 21)	(140, 36)					
4	004	(142, 42)	(153, 36)	(160, 41)	(150, 52)						
5	005	(77, 101)	(121, 66)	(133, 110)	(129, 117)	(100, 117)					
6	006	(134, 41)	(160, 88)	(163, 96)	(140, 110)						
7	007	(150, 117)	(164, 104)	(183, 110)	(178, 117)						

DOT FILE INFORMATION :

NO. DOT CATEGORIES = 2
TOTAL NO. OF DOTS = 54
DOT CATEGORY NAMES :

S [illegible]

DOT RECORD :

DOT NO.	SAMPLE	LINE	TYPE	CATEGORY
1	60	20	S	1
2	70	20	S	1
3	160	20	S	1
4	30	30	S	1
5	190	30	S	1
6	170	40	S	1
7	30	50	S	1
8	70	50	S	1
9	90	50	S	1
10	160	50	S	1
11	50	60	S	1
12	150	60	S	1
13	20	70	S	1
14	140	70	S	1
15	190	70	S	1
16	90	80	S	1
17	150	80	S	1
18	150	80	S	1
19	130	90	S	1
20	180	90	S	1
21	150	110	S	1
22	70	110	S	1
23	110	110	S	1
24	20	20	S	2
25	40	20	S	2
26	70	30	S	2
27	170	30	S	2
28	10	40	S	2
29	70	40	S	2
30	80	40	S	2
31	20	50	S	2
32	30	50	S	2
33	60	60	S	2
34	80	60	S	2
35	130	60	S	2
36	140	60	S	2
37	30	70	S	2

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[illegible] OF TECHNOLOGY
[illegible] LAKE, [illegible]

38	90	[illegible]	1	1
39	120	70	1	1
40	60	80	1	1
41	70	60	1	1
42	120	40	1	1
43	170	40	2	1
44	20	90	2	1
45	40	90	2	2
46	70	[illegible]	1	2
47	80	[illegible]	1	2
48	170	40	2	2
49	70	100	2	2
50	40	100	2	2
51	180	100	2	2
52	20	110	2	2
53	50	110	5	2
54	140	110	2	2

THERE IS A 1-1 CORRESPONDENCE BETWEEN THE CATEGORY NAMES FROM UOTFILE --

S N

AND THE CATEGORY NAMES FROM MAPTAP --

S N

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HOUSTON, TEXAS

PROCEDURE 1 CLASSIFICATION RESULTS

DISPLAY OF CLASSIFIED FIELD.....SEQ#
CLASSIFICATION DATE.....
CLASSIFICATION CHANNELS... 1 2 3 4 5 6 7 8

MAP OF CATEGORY CLASSIFIED CLASSIFICATION RESULTS

CATEGORY NO.	CATEGORY NAME	CLASS NO.	CLASS NAME	SUBCLASS NO.	SUBCLASS NAME	SUBCLASS SYMBOL
1	S	1	S	1	S 01	1
				2	S 02	2
				3	S 03	3
				4	S 04	4
				5	S 05	5
				6	S 06	6
				7	S 07	7
				8	S 08	8
				9	S 09	9
				10	S 10	A
				11	S 11	B
2	N	2	N	12	N 01	C
				13	N 02	D
				14	N 03	E
				15	N 04	F
				16	N 05	G
				17	N 06	H
				18	N 07	I
				19	N 08	J
				20	N 09	K
				21	N 10	L
				22	N 11	M
				23	N 12	N
				24	N 13	O
				25	N 14	P
				26	N 15	Q
				27	N 16	R
				28	N 17	S
				29	N 18	T
				30	N 19	U
				31	N 28	V

** DESIGNATED FIELDS SYMBOL IS #

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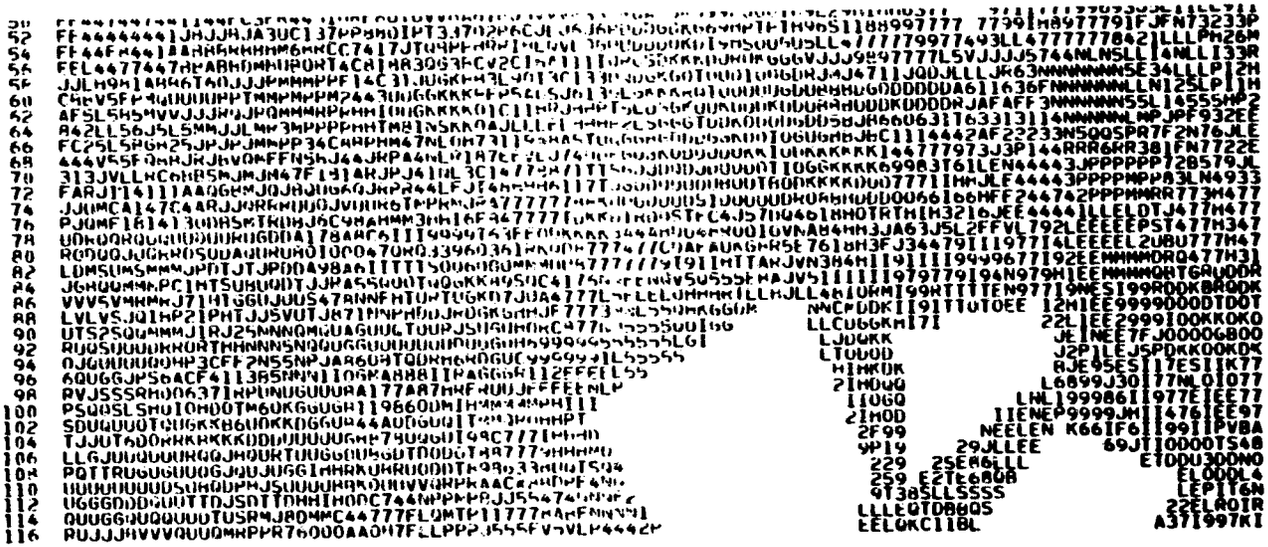

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PROCEDURE 1 CLASSIFICATION RESULTS

CLASSIFICATION SUMMARY FOR FIELD SEGM

TOTAL NUMBER OF SAMPLED POINTS 4961

SUBCLASS	PTS. BEFORE THRES.	PCT. OF TOTAL CLSF.FLD.	PTS. AFTER THRES.	PCT.OF TOTAL CLSF.FLD.	PCT.OF SUBCLASS	PTS. THRES.	PCT.OF TOTAL CLSF.FLD.	PCT. OF SUBCLASS THRES.
S 01	256	5.14	256	5.14	100.00	0	0.0	0.0
S 02	103	2.07	103	2.07	100.00	0	0.0	0.0
S 03	150	3.01	150	3.01	100.00	0	0.0	0.0
S 04	260	5.22	260	5.22	100.00	0	0.0	0.0
S 05	111	2.23	111	2.23	100.00	0	0.0	0.0
S 06	164	3.29	164	3.29	100.00	0	0.0	0.0
S 07	281	5.64	281	5.64	100.00	0	0.0	0.0
S 08	130	2.61	130	2.61	100.00	0	0.0	0.0
S 09	181	3.63	181	3.63	100.00	0	0.0	0.0
S 10	40	1.81	40	1.81	100.00	0	0.0	0.0
S 11	128	2.57	128	2.57	100.00	0	0.0	0.0
N 01	78	1.57	78	1.57	100.00	0	0.0	0.0
N 02	260	5.22	260	5.22	100.00	0	0.0	0.0
N 03	142	2.85	142	2.85	100.00	0	0.0	0.0
N 04	130	2.61	130	2.61	100.00	0	0.0	0.0
N 05	167	3.35	167	3.35	100.00	0	0.0	0.0
N 06	171	3.43	171	3.43	100.00	0	0.0	0.0
N 07	159	3.19	159	3.19	100.00	0	0.0	0.0
N 08	211	4.24	211	4.24	100.00	0	0.0	0.0
N 09	129	2.59	129	2.59	100.00	0	0.0	0.0
N 10	169	3.39	169	3.39	100.00	0	0.0	0.0
N 11	120	2.41	120	2.41	100.00	0	0.0	0.0
N 12	106	2.13	106	2.13	100.00	0	0.0	0.0
N 13	180	3.61	180	3.61	100.00	0	0.0	0.0
N 14	130	2.61	130	2.61	100.00	0	0.0	0.0
N 15	160	3.21	160	3.21	100.00	0	0.0	0.0
N 16	146	2.93	146	2.93	100.00	0	0.0	0.0
N 17	110	2.21	110	2.21	100.00	0	0.0	0.0
N 18	175	3.51	175	3.51	100.00	0	0.0	0.0
N 19	309	6.20	309	6.20	100.00	0	0.0	0.0
N 20	75	1.51	75	1.51	100.00	0	0.0	0.0

PTS. THRESHOLDED IN DISPLAY 0
PTS. THRESHOLDED IN CLASSIFY 0
TOTAL 0 PCT. = 0.0

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PROCEDURE 1 CLASSIFICATION RESULTS

CLASSIFICATION SUMMARY FOR FIELD SEGM

TOTAL NUMBER OF SAMPLED POINTS 4981

CLASS	PTS. BEFORE THRES.	PCT. OF TOTAL CLSF.FLD.	PTS. AFTER THRES.	PCT.OF TOTAL CLSF.FLD.	PCT.OF CLASS	PTS. THRES.	PCT.OF TOTAL CLSF.FLD.	PCT. OF CLASS THRES.
S	1854	37.22	1854	37.22	100.00	0	0.0	0.0
N	3127	62.78	3127	62.78	100.00	0	0.0	0.0

PTS. THRESHOLDED IN DISPLAY 0
PTS. THRESHOLDED IN CLASSIFY 0
TOTAL 0 PCT. = 0.0

20-96
205

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PROCEDURE 1 CLASSIFICATION RESULTS

CLASSIFICATION SUMMARY FOR FIELD SEGM

TOTAL NUMBER OF SAMPLED POINTS 4981

CATEGORY	PTS. BEFORE THRES.	PCT. OF TOTAL CLSF.FLD.	PTS. AFTER THRES.	PCT.OF TOTAL CLSF.FLD.	PCT.OF CATEGORY	PTS. THRES.	PCT.OF TOTAL CLSF.FLD.	PCT. OF CATEGORY THRES.
S	1854	37.22	1854	37.22	100.00	0	0.0	0.0
W	3127	62.78	3127	62.78	100.00	0	0.0	0.0

PTS. THRESHOLDED IN DISPLAY 0
PTS. THRESHOLDED IN CLASSIFY 0
TOTAL 0 PCT. = 0.0

DOT DATA PERFORMANCE SUMMARY

(SUMMARY OF ANALYST LABELED VERSUS CLASSIFIED CATEGORIES)

ANALYST LABELED DOT CATEGORY	TOTAL NUMBER ANALYST LABELED DOTS	PERCENT CORRECTLY CLASSIFIED	NUMBER THRESHOLDED	UNCORRECTED CATEGORY PROPORTION %	BIAS CORRECTED CATEGORY PROPORTION	DOT CLASSIFICATION SUMMARY (ALPHA) S	N
S	21	80.952	0	37.221	35.612	17 (73.913)	4 (12.903)
N	33	81.818	0	62.779	64.388	6 (26.087)	27 (87.097)

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DOT DATA PERFORMANCE SUMMARY

(SUMMARY OF INDIVIDUAL DOTS)
DOT ID = (SAMPLELINE)

(70, 10) CATEGORY		
LABELED	CLASSIFIED(SUBCL)	
N	N	(N 18)

(110, 10) CATEGORY		
LABELED	CLASSIFIED(SUBCL)	
N	S	(S 05)

(60, 20) CATEGORY		
LABELED	CLASSIFIED(SUBCL)	
S	S	(S 08)

(70, 20) CATEGORY		
LABELED	CLASSIFIED(SUBCL)	
S	S	(S 08)

(180, 20) CATEGORY		
LABELED	CLASSIFIED(SUBCL)	
S	S	(S 04)

(20, 20) CATEGORY		
LABELED	CLASSIFIED(SUBCL)	
*	*	(S 19)

(40, 20) CATEGORY		
LABELED	CLASSIFIED(SUBCL)	
N	S	(S 06)

(30, 30) CATEGORY		
LABELED	CLASSIFIED(SUBCL)	
S	N	(N 04)

(190, 30) CATEGORY		
LABELED	CLASSIFIED(SUBCL)	
S	S	(S 03)

(70, 30) CATEGORY		
LABELED	CLASSIFIED(SUBCL)	
N	*	(S 17)

(170, 30) CATEGORY		
LABELED	CLASSIFIED(SUBCL)	
N	N	(N 10)

(170, 40) CATEGORY		
LABELED	CLASSIFIED(SUBCL)	
S	S	(S 07)

(10, 40) CATEGORY		
LABELED	CLASSIFIED(SUBCL)	
N	S	(S 11)

(70, 40) CATEGORY		
LABELED	CLASSIFIED(SUBCL)	
N	N	(N 13)

(80, 40) CATEGORY		
LABELED	CLASSIFIED(SUBCL)	
N	N	(N 02)

(30, 50) CATEGORY		
LABELED	CLASSIFIED(SUBCL)	
S	N	(N 04)

(70, 50) CATEGORY		
LABELED	CLASSIFIED(SUBCL)	
S	S	(S 06)

(90, 50) CATEGORY		
LABELED	CLASSIFIED(SUBCL)	
S	S	(S 11)

(160, 50) CATEGORY		
LABELED	CLASSIFIED(SUBCL)	
S	S	(S 01)

(50, 60) CATEGORY		
LABELED	CLASSIFIED(SUBCL)	
S	S	(S 04)

20-99
108

(160, 60) CATEGORY

LABELED	CLASSIFIED(SUBCL)	
S	S	(S 06)

(20, [illegible]) CATEGORY

LABELED	CLASSIFIED(SUBCL)	
N	[illegible]	(N 19)

(30, 60) CATEGORY

LABELED	CLASSIFIED(SUBCL)	
N	N	(N 14)

(60, 60) CATEGORY

LABELED	CLASSIFIED(SUBCL)	
N	N	(N 05)

(80, 60) CATEGORY

LABELED	CLASSIFIED(SUBCL)	
N	N	(N 13)

(130, 60) CATEGORY

LABELED	CLASSIFIED(SUBCL)	
N	S	(S 11)

(140, 60) CATEGORY

LABELED	CLASSIFIED(SUBCL)	
N	N	(N 02)

(20, 70) CATEGORY

LABELED	CLASSIFIED(SUBCL)	
S	S	(S 06)

(140, 70) CATEGORY

LABELED	CLASSIFIED(SUBCL)	
S	S	(S 09)

(190, 70) CATEGORY

LABELED	CLASSIFIED(SUBCL)	
S	S	(S 07)

(30, 70) CATEGORY

LABELED	CLASSIFIED(SUBCL)	
N	N	(N 09)

(90, 70) CATEGORY

LABELED	CLASSIFIED(SUBCL)	
N	N	(N 10)

(120, 70) CATEGORY

LABELED	CLASSIFIED(SUBCL)	
N	N	(N 07)

(90, 40) CATEGORY

LABELED	CLASSIFIED(SUBCL)	
S	S	(S 07)

(150, 80) CATEGORY

LABELED	CLASSIFIED(SUBCL)	
S	N	(N 07)

(160, 80) CATEGORY

LABELED	CLASSIFIED(SUBCL)	
S	S	(S 07)

(50, 80) CATEGORY

LABELED	CLASSIFIED(SUBCL)	
N	N	(N 15)

(70, 50) CATEGORY

LABELED	CLASSIFIED(SUBCL)	
N	N	(N 13)

(12[illegible], 80) CATEGORY

LABELED	CLASSIFIED(SUBCL)	
N	S	(S 05)

(170, 80) CATEGORY

LABELED	CLASSIFIED(SUBCL)	
N	N	(N 03)

LY [illegible] to JOHNSON SPACE CENTER
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PROCEDURE 1 CLASSIFICATION RESULTS

$EXIT

10079 BATCH JOB STARTED 18.42.21 [illegible] 19.41.49 TOTAL CPU TIME USED 943.58 SECONDS (BATEND)

20-101
2 of 2

***** DISPLAY COMPLETED *****

TIME FOR DISPLAY 0.149

PLEASE BE ADVISED OF THE CHANGE TO CLASSIFY AND DISPLAY PROCESSOR CARD IMAGES
MAPTAP FILE AND UNIT NUMBERS NOW APPEAR AS ORDINARY CONTROL CARDS FIRST ONES AFTER PROCESSOR CARD

20-102
X11

(130, 90)
CATEGORY

LABELED	CLASSIFIED(SUBCL)	
S	N	(N 02)

(100, 90)
CATEGORY

LABELED	CLASSIFIED(SUBCL)	
S	S	(S 09)

(20, 90)
CATEGORY

LABELED	CLASSIFIED(SUBCL)	
N	N	(N 11)

(40, 90)
CATEGORY

LABELED	CLASSIFIED(SUBCL)	
N	N	(N 15)

(70, 90)
CATEGORY

LABELED	CLASSIFIED(SUBCL)	
N	N	(N 19)

(80, 90)
CATEGORY

LABELED	CLASSIFIED(SUBCL)	
N	S	(16)

(170, 90)
CATEGORY

LABELED	CLASSIFIED(SUBCL)	
N	N	(N 03)

(70,100)
CATEGORY

LABELED	CLASSIFIED(SUBCL)	
N	N	(N 11)

(80,100)
CATEGORY

LABELED	CLASSIFIED(SUBCL)	
N	N	(N 14)

(150,100)
CATEGORY

LABELED	CLASSIFIED(SUBCL)	
N	S	(S 02)

(150,110)
CATEGORY

LABELED	CLASSIFIED(SUBCL)	
S	S	(S 06)

(20,110)
CATEGORY

LABELED	CLASSIFIED(SUBCL)	
N	N	(N 17)

(50,110)
CATEGORY

LABELED	CLASSIFIED(SUBCL)	
N	N	(N 09)

(150,110)
CATEGORY

LABELED	CLASSIFIED(SUBCL)	
N	N	(N 02)

20=103
312

APPENDIX

PROCEDURE 1 FLOW

APPENDIX

PROCEDURE 1 FLOW

This section is intended to outline the sequence of executing the various processors to accomplish the task of classifying a LACIE segment. The capabilities described are those of first priority, and it is expected that other features will be added in the near future. The system is designed to provide Research, Test, and Evaluation (RT&E) Branch with a means of experimenting with a new technique for classifying Landsat data for LACIE.

The data are preprocessed by the Earth Resources Interactive Processing System (ERIPS). (ERIPS merges tapes received from Goddard Space Flight Center and creates a multitemporal/ multipass tape.) Using an ERIPS tape as input to the DOTDATA processor, a dot data file is output. The files contain both type 1 and type 2 dots. Type 1 dots are used both as starting vectors for the clustering processor (ISOCLS) and as labeling vectors for the labeling processor (LABEL). Type 2 dots are used as a bias correction factor in computing the classification results output by the DISPLAY processor.

After delineating DO/DU fields by card input, ISOCLS clusters the segment using the starting vectors from the dot data file to initialize the clustering process. Sun angle correction is provided. An unconditional cluster map and a set of "unlabeled" statistics are output.

The "unlabeled" statistics, cluster map, and dot data file are input to the LABEL processor. Using one of two procedures, k-nearest-neighbor or all-of-a-kind, the statistics are labeled. A conditional or mixed cluster map may be output and later displayed on the Passive Microwave Imaging System Data Analysis Station (PMIS DAS) or the Image-100.

Using the "labeled" statistics and allowing the user the capability of setting the intersubclass weights by category, the best k of n channels may be selected by the Feature Selection processor SELECT.

In CLASSIFY, each class in the "labeled" statistics may be assigned to a category by the analyst or by the system. The a-priori probability for each category may be computed using the cluster population from the statistics. Using the k best channels, the sum-of-density classifier assigns each pixel in the LACIE segment to a given subclass.

In DISPLAY, the bias correction dots are used in computing the bias correction for the classified area. Two performance tables relating to the bias correction dots are output. One table contains a category dot summary performance and the other an individual dot summary performance.

If the analyst is not satisfied with the classification results, he or she may relabel the dots and/or relabel the statistics (by a labeling procedure or by card input) and restart the process at any given point.