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IMAGE SELECTION SYSTEM

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<p>16. Abstract As part of a complete remote sensing data handling system, an Image Selection System (ISS) has been developed for the NASA-Ames Research Center Earth Resources Aircraft Project (ERAP). The ISS is an interactive, graphics oriented, computer retrieval system for aerial imagery and is in operational use at the ERAP Data Facility.</p> <p>The ISS design focuses on geographical location as the fundamental request parameter. Computerized records -- containing the center and corner coordinates, and 25 other descriptors for each frame of imagery -- are hierarchically structured by geographical location into the system data base for retrieval. The data base is interactively interrogated using commands issued through a retrieval station consisting of a graphics digitizer, a graphics CRT computer terminal, and a semi-automatic microfilm browse file viewer. With the appropriate map on the graphics digitizer, the operator enters the user's geographic area and graphically displays variations of coverage densities on the CRT terminal. To obtain "best coverage," the original coverage is selectively filtered with any Boolean combination of other non-locational image descriptors. Center points may be displayed on the CRT terminal and individual frames may be selected with the graphics cursor to obtain a display of precise frame coverage and to determine microfilm browse file or full format accession numbers. Any selected frame may be viewed on the microfilm viewer to confirm selection criteria.</p> <p>The system software features a full range of graphical displays from synoptic large area coverage of entire states to precise individual frame coverage over specified points. Other system features include: defining an analysis grid for restructuring the coverage files and displays, naming and saving any of the selectively filtered coverage sets, graphically overlaying coverage sets for visual correlations, listing selected coverage sets on either the CRT terminal or the high speed printer, and generating computer coverage plots.</p> <p>The report contains an analysis of user coverage requests and retrieval strategies followed by a complete system description. Data base structure, retrieval processors, command language, interactive display options, file structures, and the system's capability to manage sets of selected imagery are described. A detailed example of an area coverage request is graphically presented.</p>					
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PREFACE

The design and development of the Image Selection System (ISS) presented in this report has been performed by ESL Incorporated under subcontract to Lockheed Aircraft Corporation for the NASA Earth Resources Aircraft Project (ERAP) at Ames Research Center, under the supervision of Mr. Martin A. Knutson, ERAP Project Manager. This system is presently operational under the management of ESL Incorporated for NASA's U-2 high altitude remote sensing aircraft based at Ames Research Center, Moffett Field, California.

Mr. Donald Hurd was the ESL Project Manager for the design, development, and implementation of the ISS. In addition, the following ESL staff have made significant contributions to the developments of the ISS and this report: Mr. Larry Hubble, Mr. Ronald Mitooka, Mr. Michael Lovas, Mr. Paul Polk, Mr. Dave Blair, Mr. Gary Gnauck, Mr. Michael Ayer, Mr. Richard Yamamoto, and Mr. Richard Ivan (Deputy Manager, Earth Sciences Laboratory at ESL).

CONTENTS

Section		Page
1.	INTRODUCTION.	1-1
1.1	NASA-Ames ERAP Data Handling System	1-2
1.2	ERAP Image Retrieval Operational Guidelines.	1-2
1.2.1	Coverage Requirements	1-4
1.2.2	General ERAP Retrieval Procedures	1-5
1.2.3	Detailed ERAP Retrieval Procedures.	1-5
2.	SYSTEM DESCRIPTION.	2-1
2.1	ISS Retrieval Station	2-1
2.2	ISS Data Base	2-4
2.2.1	Data Base Contents.	2-4
2.2.2	Data Base Structure	2-6
2.3	ISS Basic Retrieval Processors.	2-8
3.	SYSTEM OPERATION.	3-1
3.1	DATA INITIALIZER.	3-1
3.1.1	The GO Command.	3-3
3.1.2	The FIX Command	3-4
3.1.3	The VERIFY Command.	3-6
3.1.4	The DISPLAY Command	3-7
3.1.5	The ? Command	3-8
3.2	DATA DISCRIMINATOR.	3-8
3.2.1	Command Format.	3-10
3.2.2	DISCRIMINATOR Processing Flow	3-15
4.	ISS SYSTEM DATA BASE FOR ERAP	4-1
4.1	System Data Base Structure.	4-1
4.1.1	Major Directory	4-3
4.1.2	Minor Directory	4-3
4.1.3	Physical Block of ERAP Data	4-3
4.2	System Data Base Creation	4-6

CONTENTS

-- Continued.

Section		Page
5.	ISS PROCESSOR IMPLEMENTATION.	5-1
5.1	INITIALIZER	5-1
5.1.1	Bookkeeping Information	5-1
5.1.2	Search Specifications	5-2
5.1.3	Secondary Data Base Formation	5-7
5.1.4	File Structure.	5-11
5.2	DISCRIMINATOR	5-12
5.2.1	The Simulated Command String.	5-13
5.2.2	Line Parsing.	5-16
5.2.3	Command Line Interpretation	5-21
APPENDIX A.	EXAMPLE OF AN AREA COVERAGE REQUEST	A-1
APPENDIX B.	COMMAND SYNTAX FOR THE DATA DISCRIMINATOR	B-1

ILLUSTRATIONS

Figure		Page
1-1	Ames-ERAP Data Handling System	1-3
2-1	ISS Retrieval Station Configuration.	2-2
2-2	ISS - Data Base Structure.	2-7
2-3	ISS - Major Retrieval Processing Stages.	2-9
3-1	Data Initializer Processing Flow	3-2
3-2	DATA DISCRIMINATOR Commands.	3-9
3-3	Data Discriminator - Logical File Structure. . .	3-16
4-1	System Data Base Structure	4-2
4-2	Physical Format of Major Directory	4-4
4-3	Physical Format of Minor Directory	4-5
4-4	Physical Format of Each Record of ERAP Data. . .	4-7
4-5	Creation of Image Selection System Data Base . .	4-8
5-1	Illustration of Analysis Grid Block Numbering Convention	5-7
5-2	Flowchart of Secondary Data Base Formation . . .	5-9
5-3	File Structure for DATA DISCRIMINATOR.	5-10
5-4	Command Line Buffer.	5-14
5-5	Free Format Command Line	5-15
5-6	Command Line--Left Justified and Packed.	5-17

ILLUSTRATIONS

-- Continued.

Figure		Page
5-7	Parsed Command Line.	5-19
5-8	Command Line Fields.	5-21
5-9	Command Line Processing.	5-22
5-10	DATA DISCRIMINATOR Command Flowchart	5-26

TABLES

Table		Page
2-1	Ames-ERAP ISS Data Base Descriptors	2-5
3-1	Valid Targets for GO TO nn Command	3-5
3-2	DATA DISCRIMINATOR Commands	3-9
3-3	Input Field Format	3-11
3-4	Command Field Format	3-13
3-5	DISCRIMINATOR File Processing	3-18
5-1	Internal Character Format	5-3
5-2	Precedences for Boolean Expressions	5-5
5-3	Polish Notation Codes	5-6
5-4	Command String Field Representation	5-13
5-5	Field and Subfield Delimiters	5-16
5-6	Parsing Pointers Array	5-18
5-7	Pointer States and Command Line Syntax	5-20
5-8	Command Letter to Command Number Correspondence	5-24

IMAGE SELECTION SYSTEM

1. INTRODUCTION.

A computer oriented aerial image Data Handling System to catalog and retrieve imagery has been developed for the NASA Earth Resources Aircraft Project (ERAP) at Ames Research Center, Moffett Field, California. The Ames-ERAP operates two U-2 high altitude remote sensing aircraft in support of NASA's overall Earth Observations Program and maintains a data bank consisting of archival storage of original and duplicate data, flight summary reports, data catalogs, photo indices, master coverage plots, a browse file of the imagery on 16 mm microfilm cassettes, and a computerized data base, indexing all ERAP imagery.

The U-2 aircraft employ a variety of sensor packages, primarily aerial cameras, collecting various types of imagery throughout the United States and parts of Canada. Since the first data flight on 31 August 1971, over 200,000 aerial photographs have been collected. This imagery is distributed to various users and Government agencies associated with the NASA Earth Observations Program and is made available to the general public through the USDI EROS Data Center.

1.1 NASA-Ames ERAP Data Handling System.

The Ames-ERAP Data Handling System consists of both manual and computer assisted procedures to process specific image information and control the handling and flow of imagery. The manual procedures involve the physical aspects of film handling such as flight film evaluation, film titling and editing, preparation of film for duplication, dissemination of reproduced film to appropriate users or agencies and initial flight documentation (Flight Summary Reports).

Figure 1-1 depicts the two major components of the Ames-ERAP image Data Handling System involving interactive computer procedures - the Data Entry System*, and the Image Selection System which is the topic of this report. These systems represent the most complex and critical aspects of the entire data handling process by performing the functions of entering individual frame descriptors into a computer data base for subsequent efficient retrieval of imagery by a wide variety of users. The initial testing of the Data Entry System began in June 1972 and it became operational in February 1973. The Image Selection System has been operational since December 1973.

1.2 ERAP Image Retrieval Operational Guidelines.

The operational guidelines for ERAP image retrieval discussed in this section have been verified by two years of

*Gnauck, G.E., Hurd, D.J., and Kroeck, R.M., "A Semi-Automated System for Plotting and Computer Cataloging of Remote Sensing Imagery," in *Management and Utilization of Remote Sensing Data*, The American Society of Photogrammetry Symposium Proceedings, 1973.

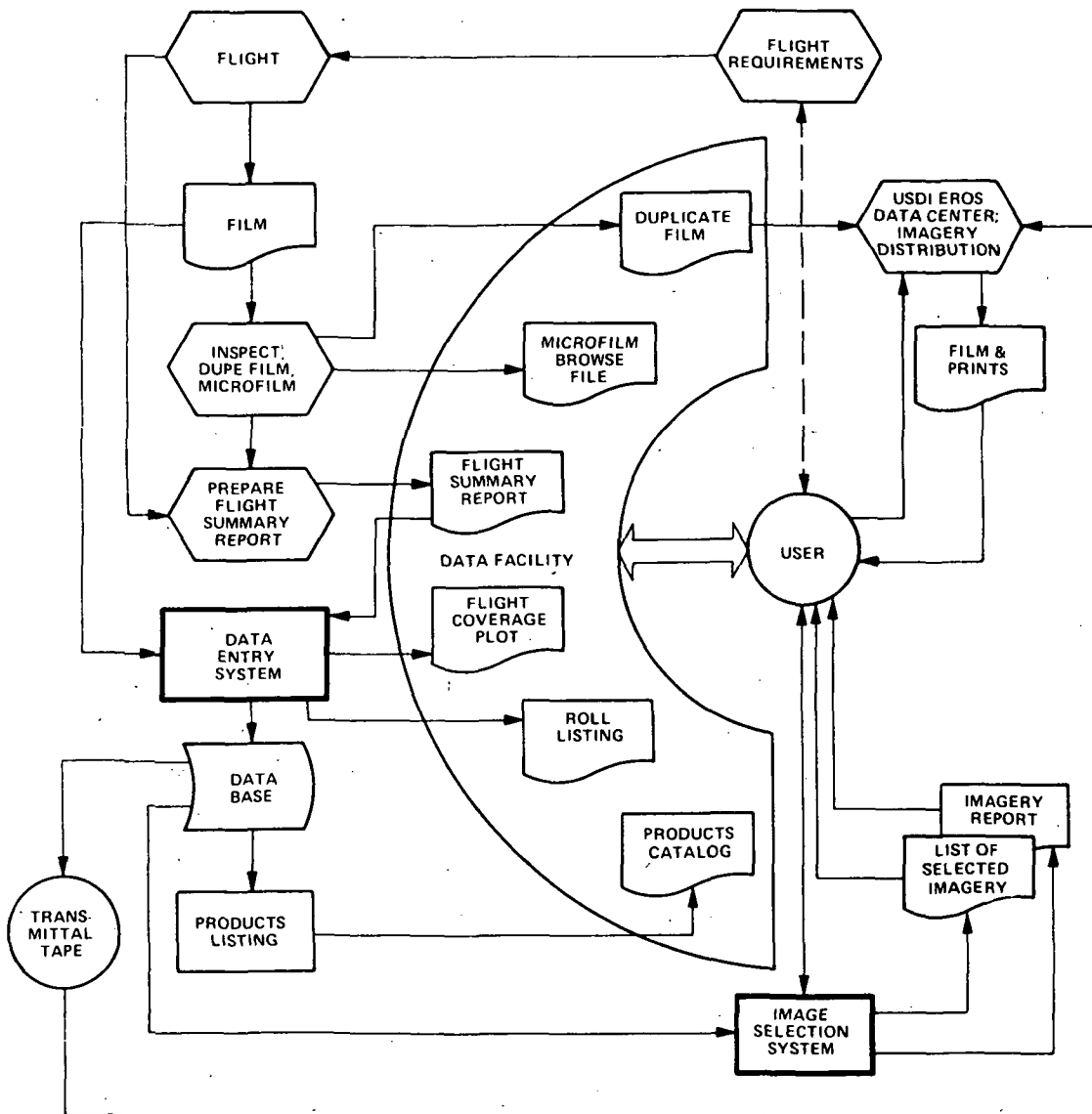


Figure 1-1. Ames-ERAP Data Handling System.

1.2 -- Continued.

operational experience in the ERAP Data Facility at NASA-Ames. During this period, over 2,500 users, representing local, state and Federal government agencies, universities, private industry, and the general public, have visited or contacted the Data Facility.

1.2.1 Coverage Requirements.

ERAP earth resources investigators are usually tasked with the analysis of specific geographical regions to determine relationships among resources parameters. These resource studies include land use, forest management, water conservation, crop disease detection, agricultural productivity, disaster assessment, and other related problems of vital concern to resource management programs. Remote sensing imagery is essential for the analysis of many of these study areas and frequently this imagery must be combined with ancillary or "ground truth" data accumulated for specific test sites. In addition, to be of utility in these studies, the remote sensing imagery must satisfy the data acquisition parameters specified by the investigator, for example, precise geographical locations, scales, cloud cover, sensor types and spectral bands.

Specific studies of phenomena, such as urban analysis or geological faults, are directly related to location. Other studies such as crop disease detection are dependent upon a specific season of the year. Even in the case of disease

1.2.1 -- Continued.

detection programs, the regions of most probable occurrence of the disease are specified. Thus, the primary concern of the investigator is to obtain coverage over a particular location which may be subsequently filtered with non-locational parameters to obtain "best coverage".

1.2.2 General ERAP Retrieval Procedures.

The ERAP data bank provides a means by which numerous investigators with various interests may acquire previously collected data and apply it to a variety of new problems, particularly problems requiring chronological coverage. The prospective user is informed of the general nature of the ERAP data bank through summary reports, synoptic coverage charts, sensor descriptions, and discussions with Data Facility personnel. From this information the investigator can determine the possibility that the data bank will contain remote sensing coverage pertinent to his requirements. If the general ranges of the ERAP data acquisition parameters overlap with the user's requirements, he will begin a systematic search of the data bank.

1.2.3 Detailed ERAP Retrieval Procedures.

ERAP data selection is most easily accomplished in an interactive mode. The user works with a trained Data Facility analyst at a retrieval station consisting of a browse file of ERAP data on microfilm (and/or access to full format imagery) and a graphics terminal to the computerized retrieval system.

1.2.3 -- Continued.

Because of the large number of frames of data, a computer retrieval system is essential to the data selection procedure. The graphics terminal provides the capability for dynamic displays of coverage plots vital to the user's understanding of available coverage. In addition to providing an index to the imagery, the computer retrieval system coordinates with other ERAP data documentation such as Flight Summary Reports (FSR).

Interactive image retrieval consists of probing the structured data base to determine the quantity and appropriateness of available imagery satisfying various combinations of requested acquisition parameters. The retrieval system displays the quantity of frames consistent with the search request and lists the parameters associated with sample frames, including the browse file and frame accession numbers for actual data examination. Feedback to the user on quantity is important because it directs the course of the selection strategy pursued by the user. By examining the amount of coverage under key parameters, the user can determine the degree to which his coverage requirements will be satisfied. The quantity of data is also an important item of information to the user with respect to the volume and cost of the data which he must analyze.

Once the user has determined that the data bank contains coverage pertinent to his analysis, his next step is to determine which specific rolls or frames meet his requirements.

1.2.3 -- Continued.

Precise execution of this step is essential in image retrieval. Appropriate data which are missed degrade the results of the user's analysis. On the other hand, data which are redundant or superfluous to his needs are a burden to the user and to the reproduction and dissemination facilities and increase the overall cost of the data. The user is interested in obtaining the "best coverage" subset from the ERAP archives.

The most effective selection strategy begins with the specification of image acquisition parameters crucial to the user's requirements. These are the data descriptors that must be met in order for the coverage to be useful to the investigator's analysis. For ERAP, this crucial descriptor is location. Sensor type is usually second, with date or cloud cover often third.

The quantity of data satisfying these stringent conditions are displayed to the user together with regional coverage densities over his areas of interest. Regional coverage densities are particularly important because of local variations in repetitive coverage over adjacent geographical regions. Retrieval criteria associated with regions of high coverage densities can be more stringent than for regions of sparse coverage where the user has limited choices. If the total number of frames over a portion of his study area is small, the typical investigator will want them all. Even if the frames have high cloud cover he will likely request all the frames as

1.2.3 -- Continued.

they represent the total image information available. At this point he will want to know the proper identification of the frames and where he can get copies. Also, the investigator will require computer printouts of all pertinent parameters concerning the requested imagery. Thus, the investigator needs to know the altitude, scale, sensor, spectral band, etc., for each frame of imagery. This is *essential information* for subsequent analysis and interpretation of the photographs, but much of it is only *marginal information* with respect to photo retrieval requirements.

However, if the density of coverage is high, the investigator will often want to successively refine his initial coverage set by specifying additional parameters consistent with his coverage requirements. By this technique of imposing the most restrictive conditions at each stage of the retrieval procedure, successively small subsets are formed in an orderly progression. When the quantity is within limits acceptable to the user, he usually examines the browse file or full format frames and requests a computer listing of all pertinent information for the selected frames. With this listing, he may order any frames he needs by the accession numbers contained in the listing. Note that in the case of high coverage densities, information on sensor type, scale, spectral band, etc., is not only required for subsequent analysis, but is essential to the retrieval function because these parameters are used to select what the user defines as "best coverage".

1.2.3 -- Continued.

The Image Selection System, described in detail in the remainder of this report, fully satisfies the operational guidelines for ERAP image retrieval. Five months of operating experience at the Ames ERAP Data Facility have shown that the ISS can rapidly and precisely retrieve ERAP imagery for a variety of users.

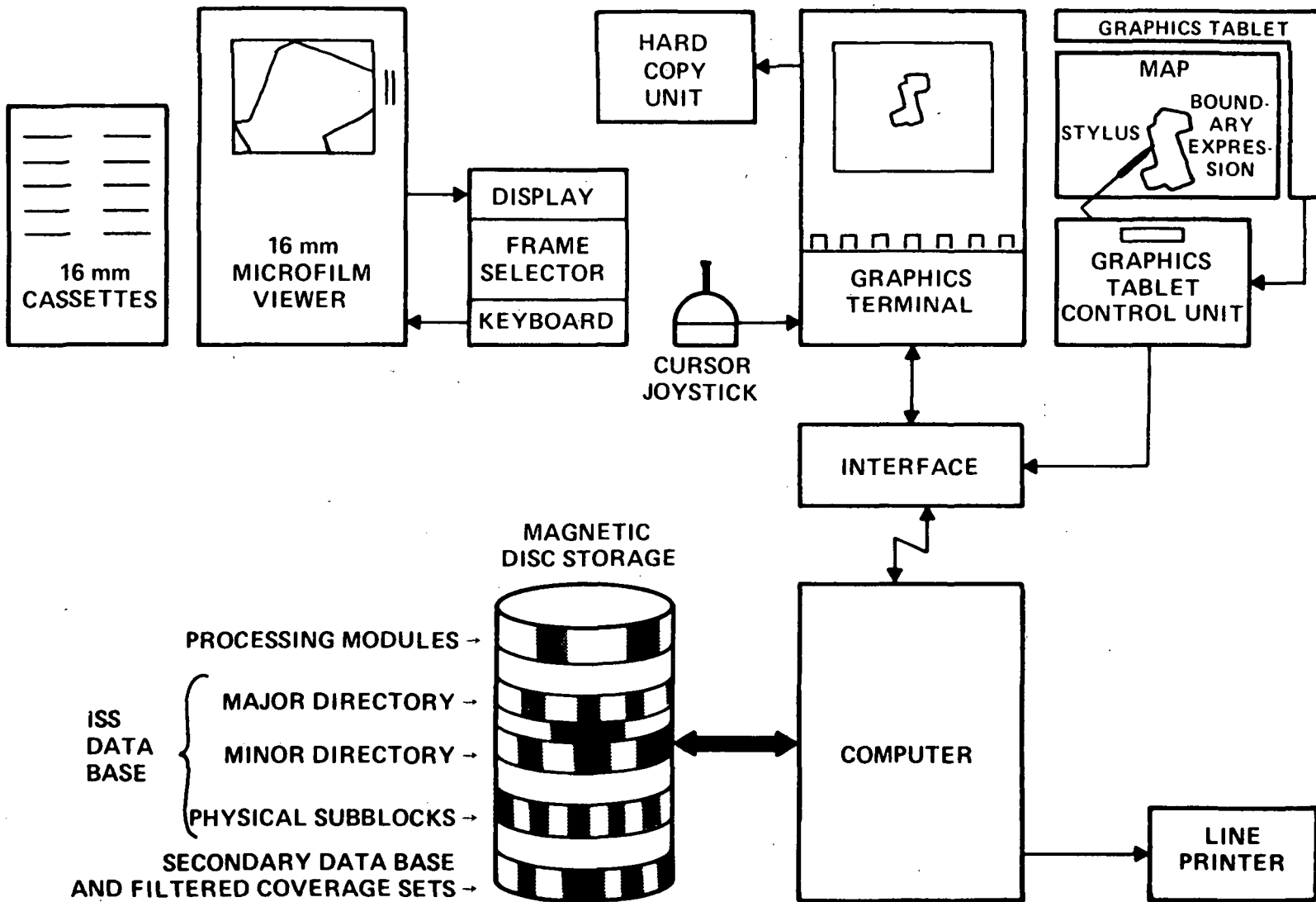
2. SYSTEM DESCRIPTION.

The ISS is an interactive computer retrieval system for ERAP aerial imagery. The system consists of a retrieval station, a computerized data base of descriptors for each frame of ERAP imagery and software processing routines.

2.1 ISS Retrieval Station.

The ISS retrieval station configuration is shown in Figure 2-1 and consists of the following hardware components:

- Tektronix 4002A CRT graphics terminal
- Tektronix hard copy unit
- Tektronix cursor joystick
- Graf-pen sonic digitizer
- Graf-pen ASCII interface unit
- Communication link with dedicated phone line and Prentice 202C modems (1200 baud)
- IBM 370/145 with 3330 magnetic disk storage units and line printer at ESL
- Kodak Microstar 16-mm microfilm viewer with IC5 frame selection control unit.



2-2

Figure 2-1. ISS Retrieval Station Configuration.

2.1 -- Continued.

Geographical areas of interest are input through the digitizer. The analyst traces the outline of the geographical area with the stylus. Raw data points are converted to ASCII code by the interface unit and transmitted over the communication link to the computer. The graphics terminal keyboard is used to enter search commands and selection parameters which are also input to the computer processors.

All displays are generated on the CRT screen of the graphics terminal. These displays include the outline of the original geographical area, system or user defined reference grids, quantitative information denoting coverage densities, dots ("Tek-points") or symbols representing the relative spatial locations of frame center points, and a variety of full frame coverage plots based on user specifications. The analyst may select individual frames with the cursor joystick and list key frame parameters on the screen in one of several formats. The analyst may also list selected coverage sets of ERAP data on either the CRT screen or the high speed line printer at the computer site. One of four listing formats ranging from a complete printing of all frame parameters to just the flight numbers is available depending upon which device is used, the CRT screen or the line printer.

Two important parameters the analyst usually displays are the full frame accession number and the browse file number for each selected frame. With the browse file number the analyst

2.1 -- Continued.

can interactively view the 16-mm browse file copy of the ERAP imagery on the Microstar viewer by selecting the proper cassette and keying in the browse file number on the IC5 control unit (up to 2000 frames/cassette). If a more detailed inspection is required, the frame accession number refers the analyst to the full format image in the archives.

2.2 ISS Data Base.

The ISS data base is a cross index and information file for the NASA-Ames high altitude aircraft data collected and maintained by ERAP. Physically, the data base is a hierarchically structured computer file describing the ERAP imagery.

2.2.1 Data Base Contents.

Each frame of ERAP data has a corresponding computerized record describing the acquisition parameters pertaining to that frame. These computerized records are generated through the ERAP semi-automatic Data Entry System. Each record in the ISS data base contains 25 parameter fields as shown in Table 2-1.

The data parameters have a dual role. In addition to providing acquisition and indexing information for each frame, any retrieval request may be stated as a general Boolean combination of the data parameters, using the abbreviations in Table 2-1. The syntax of these Boolean combinations is described in Appendix B.

Table 2-1. Ames-ERAP ISS Data Base Descriptors

Descriptor		Explanation	Typical Data	Significance
Name	Code			
<u>Flight Parameters</u>				
Flight No.	FN	Year, number and segment of flight	72125 1	125th flight, 1st segment, 1972
Flight Date	FD	Julian data flown	72208	Flown on July 26, 1972
Mission/Key	MK	Project for which flown	9	ERTS A underflight support
Platform	PL	Aircraft Identification	2	U-2 Earth Survey Aircraft No. 5
<u>Roll Parameters</u>				
Roll	RO	Roll accession number, unique	552	Roll no. 552 (unique)
Sensor	SI	Camera or other instrument	17	Wild RC-10, 6 in. f. 1.
Format	FO	Image size	3	9 x 9 in.
Film	FT	Film type	3	EK type 3443 Aerochrome IR
Filter	FI	Filter type or pack	4	Wratten 12, yellow
Spectral Band	SB	Low and high ends, nm	510,900	510 to 900 nm. bandpass
Entry Date	ED	Julian date of data entry	73170	Data entry run June 19, 1973
Stereo	ST	Stereo or mono coverage	2	Stereoscopic imagery
Map Ref	MR	Map type used in entry	2	Army Map Service 1:250,000 Transverse Mercator
<u>Frame Parameters</u>				
Frame No.	FR	Frame no., for ordering	0001	Frame 1
Browse File	BN	Microfilm browse file no.	1711662	Microfilm file 171, frame 1662
Time	TI	Time shot; hour, min, sec GMT	174431	17 hrs, 44 min, 31 sec GMT
Coordinates		Geographic location of frame center	81011	Center: 81011 = 45° 11' N
Center Lat.	CA	(tenths of minutes from South Pole	66643	66643 = 111° 43' W
Center Long.	CO	and Greenwich Meridian)	etc.	
Scale	SC	Imagery scale x 1000	128	Scale 1:128000
Attitude	AT	Vertical, low or high oblique	1	Vertical frame
Quality	QU	Subjective rating of image	2	Judged good quality
Cloud Cover	CC	Percent cloud cover, x 10%	1	Up to 10% cloud cover
Altitude	AL	Above sea level, x 1000 ft.	650	Altitude 65,000 ft.
Resolution	RE	Ground resolved distance	2	Nominal resolution of 10 to 30 ft.
Sequence	SE	Sequence in roll (starts at 1)	1	First frame this roll
Coord Enter	CE	Method used to enter coordinates	1	Plotted via spark-pen stylus

2.2.2 Data Base Structure.

The ISS data base is hierarchically structured by geographical location; both *logically* and *physically on magnetic disk storage*. The first level of the hierarchical structure consists of one degree grid blocks referred to as system blocks. Each frame of data is assigned to one, and only one, of these system blocks, depending on the latitude and longitude values of the center coordinates of the frame. When the number of frames in any one degree system block exceeds 200, the system dynamically subdivides the one-degree system block into four 30-minute system subblocks. As the number of frames in these subblocks exceeds 200, they are again dynamically subdivided to smaller subblocks. The smallest subblock is presently 7.5 minutes on a side and is congruent with the USGS 7.5 minute quadrangle sheets.

The logical structure of the system data base over the United States is presented in Figure 2-2. A major directory indexes the one-degree system blocks and a minor directory the system subblocks. Both of these directories are used to access the master data base consisting of physical blocks (groups) of frame records assigned to each system block and system subblock. The directories also contain summary statistics describing the quantities of frames in each system block and subblock, and together form a single data set with a partitioned organization. The system data base uses a direct access organization. Both data sets reside on an IBM 3330 disk capable of storing over one million image records.

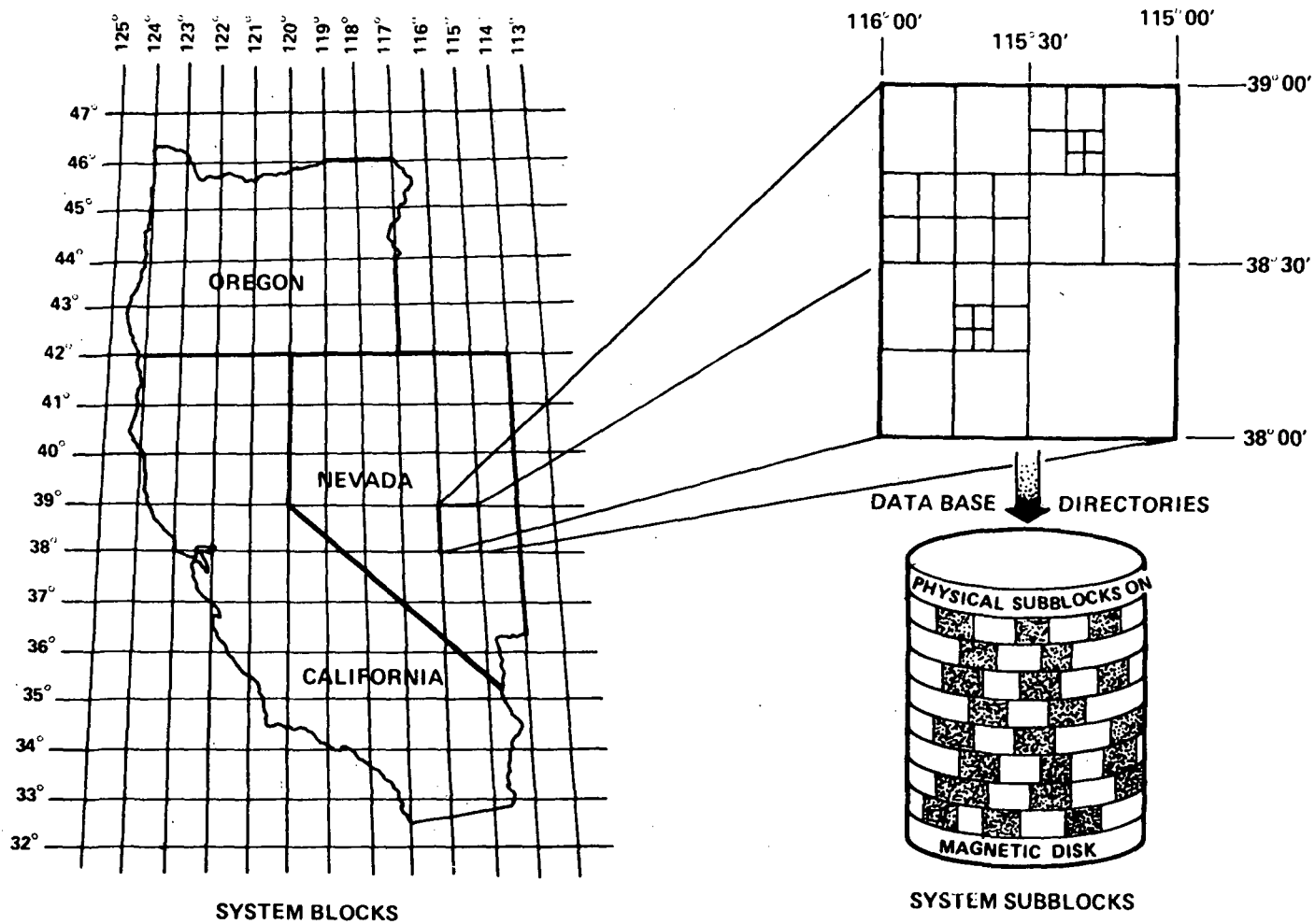


Figure 2-2. ISS - Data Base Structure

2.3 ISS Basic Retrieval Processors.

Data retrieval with the ISS is performed in two major stages using the DATA INITIALIZER processor and subsequently the DATA DISCRIMINATOR processor as shown in Figure 2-3. In the first stage, the analyst uses the DATA INITIALIZER to enter user identification information and initial request parameters. The objective of INITIALIZER processing is to prepare and verify the desired request parameters such as the geographical boundary and any requirements which the imagery must meet to satisfy a user's request (mandatory requirements), and to execute a search of the hierarchically structured ISS data base to create a unique "secondary data base" consisting of imagery within the specified boundary and meeting the mandatory requirements. The secondary data base and processing control is then passed to the DISCRIMINATOR for detailed, and often repetitive frame by frame processing using various search strategies and selection techniques.

The primary request parameter in the INITIALIZER is the geographical area of interest precisely described by a series of latitude-longitude coordinate pairs called a "boundary expression". Using a graphics terminal as shown in Figure 2-1, the analyst typically displays this boundary expression delineating the geographical area of interest. Optionally, the system blocks or subblocks covering the geographical area may also be displayed graphically. It is important to note at this point that only the system directories are accessed for these displays and that the total number of frames available in each system block or subblock

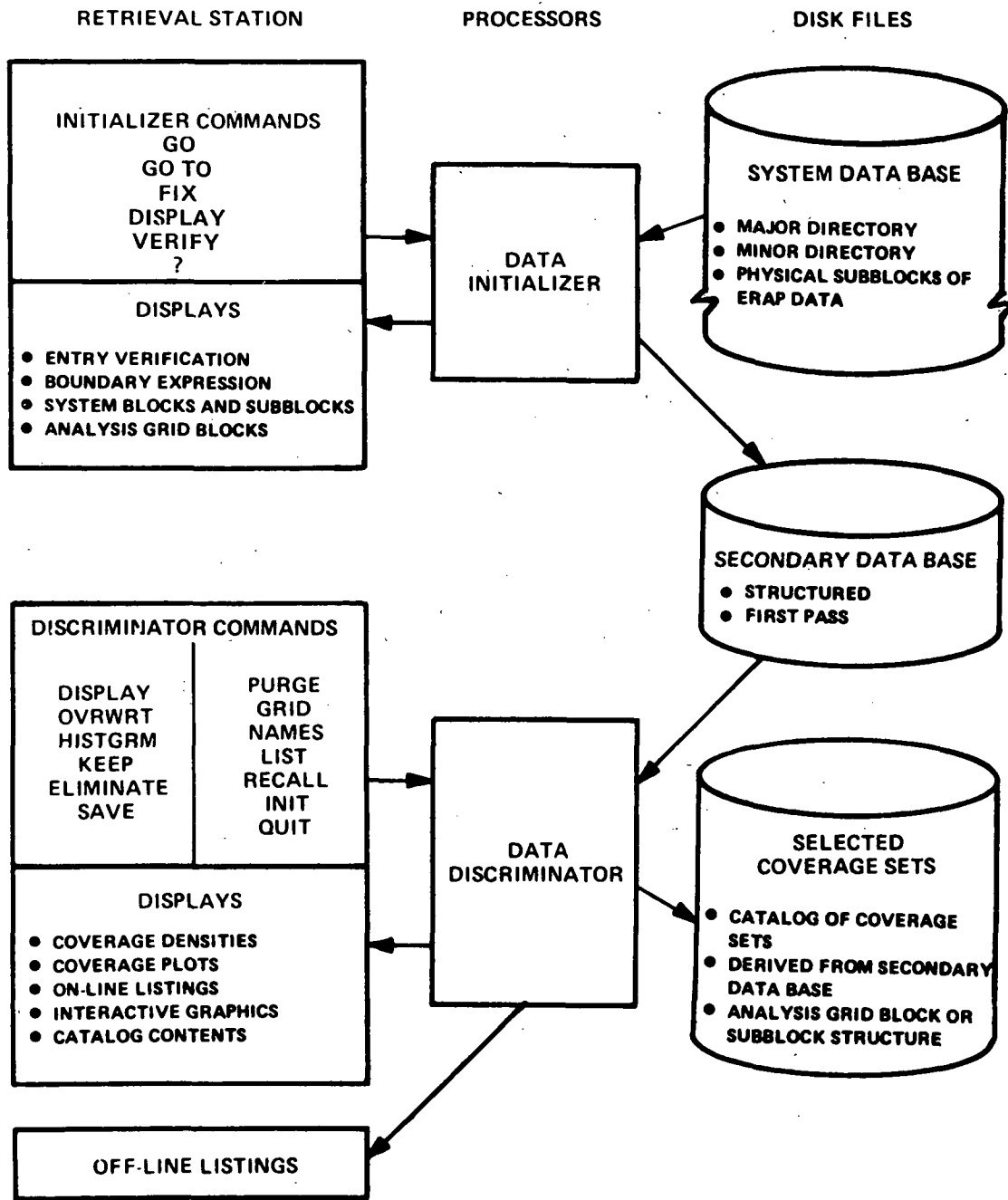


Figure 2-3. ISS - Major Retrieval Processing Stages

2.3 -- Continued.

is annotated on the display screen inside the corresponding block or subblock. Thus, the correlation of available ERAP data coverage over the requested geographical area is visual and serves to provide a synoptic view of available coverage densities. Based on these displays, the analyst sets limits on the ranges of other data acquisition parameters by specifying mandatory requirements in terms of Boolean combinations of ERAP data descriptors.

The secondary data base is then formed by examining every frame of data in each system subblock overlapping the geographical area. Each of these frames inside the user's boundary expression and satisfying the mandatory requirements is placed into the structured secondary data base. The structure of the secondary data base may be defaulted to the system subblocks or the analyst may specify his own analysis grid consisting of a rectangular array of up to 12×12 blocks. The analysis grid is used to precisely control display formats and to easily reference subregions of the geographical area of interest for selective processing in the DATA DISCRIMINATOR.

When the secondary data base is passed to the DISCRIMINATOR, the active data base has usually been narrowed from several hundred thousand frames to less than a few thousand, depending on the size of the user's boundary expression and the density of coverage. For point requests, the secondary data base is often smaller than 200 frames of ERAP data.

2.3 -- Continued.

In the DISCRIMINATOR the analyst may efficiently process the relatively small secondary data base in the following ways:

- Name and save any coverage sets (subsets of the secondary data base)
- Selectively filter any coverage sets with Boolean combinations of ERAP data descriptors
- Select any subregion of the geographical area by addressing specific analysis grid blocks (or system subblocks if no analysis grid is specified)
- Display any coverage set in one of ten graphical formats
- Graphically overlay coverage sets for visual correlations
- Select individual frames with the graphics cursor to view frame coverage and to obtain browse file accession numbers or other frame parameters
- Display all flight numbers in a selected coverage set
- Obtain coverage plots of any desired combination of coverage sets using the Tektronix graphics terminal and hard copy unit

- List selected coverage sets on either the graphics terminal or high speed line printer
- Display all the names in the coverage set catalog
- Purge any coverage set name from the catalog
- Restructure the secondary data base by specifying a new analysis grid (all existing coverage sets are purged from the catalog)
- Recall previous commands from the command history file
- Return to the INITIALIZER processor.

3. SYSTEM OPERATION.

Retrieval of ERAP data with the ISS is controlled through commands issued by the analyst to one of the two major processors, the DATA INITIALIZER and the DATA DISCRIMINATOR as was shown in Figure 2-3. This section presents the structure of the INITIALIZER and DISCRIMINATOR processors in terms of command language, processing flow, and logical file structure.

3.1 DATA INITIALIZER.

The command language of the DATA INITIALIZER processor is used to enter all necessary information to initiate an ERAP data search. There are six submodules within the INITIALIZER processor of the ISS. These are:

- a. LOGON - Program Parameters
- b. User Identification
- c. Boundary Entry
- d. Mandatory Requirements
- e. Analysis Grid Blocks
- f. Search.

They will typically be called in sequence during an image retrieval request, but can be accessed directly if required. Processing flow in the INITIALIZER is shown in Figure 3-1.

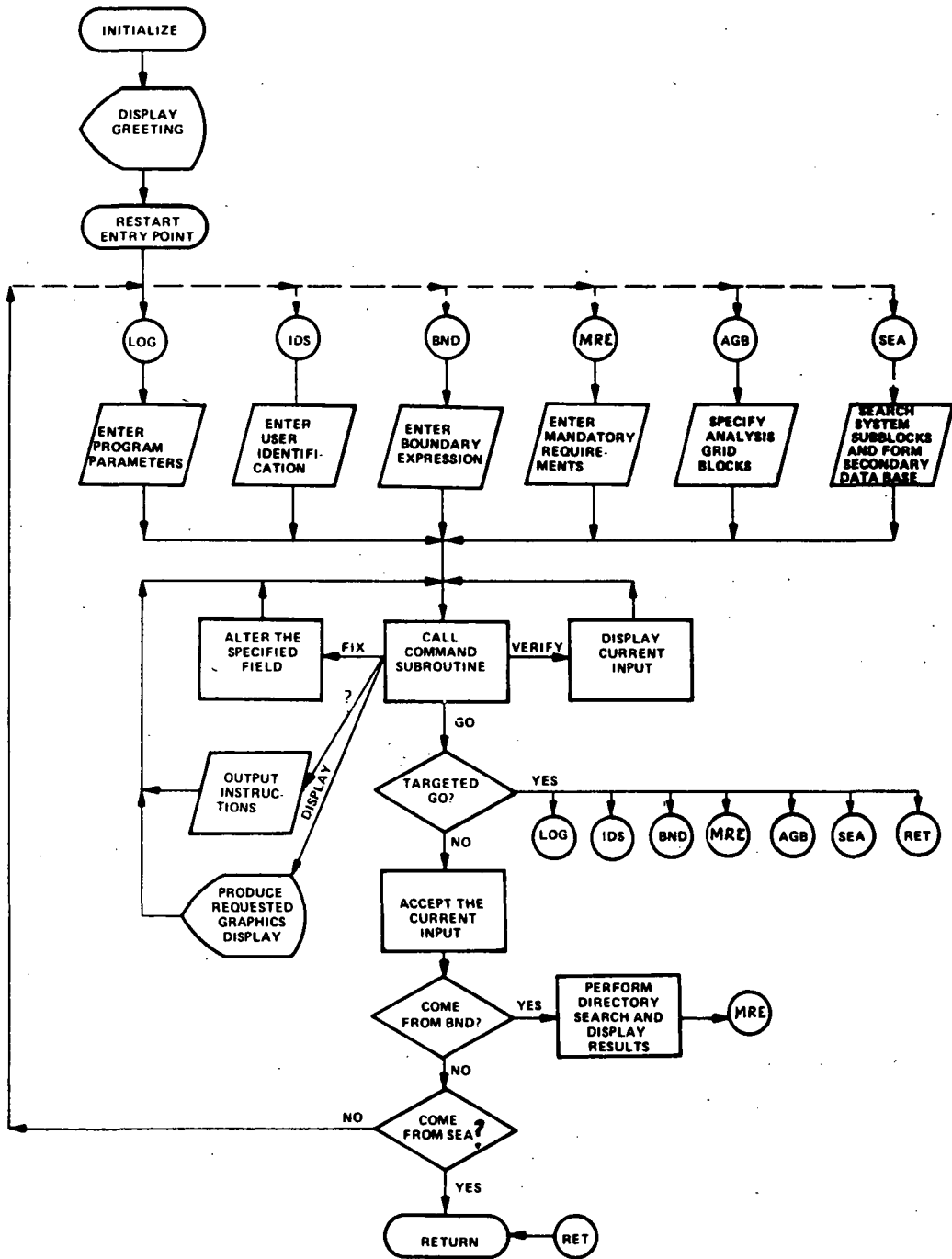


Figure 3-1. Data Initializer Processing Flow

3.1 -- Continued.

Operation within the DATA INITIALIZER is accomplished with the following six commands:

- a. GO
- b. GO TO
- c. FIX
- d. VERIFY
- e. DISPLAY
- f. ?

Each of these commands is described in the following sections. Note that commands and subsequent responses entered by the analyst appear in the permanent storage portion of the Tektronix screen. They can be edited by using an asterisk (*), which deletes the previous character, or the slash (/), which eliminates all input characters on that line.

3.1.1 The GO Command.

The GO command is used to sequentially step through submodules within the DATA INITIALIZER in the following predetermined order after LOGON:

- User Identification
- Boundary Entry
- Mandatory Requirements
- Analysis Grid Blocks
- Search.

3.1.1 -- Continued.

After completing the search process, the GO command will proceed to the DATA DISCRIMINATOR.

The GO TO nn form of the GO command permits the user to control the order of processing within the DATA INITIALIZER. Valid values for nn are listed in Table 3-1 and shown in Figure 3-1. A GO issued after a GO TO nn will proceed to the next process as indicated above.

An important distinction must be made between GO TO nn and GO TO Cnn. The former allows one to skip a DATA INITIALIZER command submodule while the latter permits the operator to review input parameters by using the VERIFY and DISPLAY commands described in Sections 3.1.3 and 3.1.4, or to change these parameters by using FIX or FIXC commands described in Section 3.1.2.

3.1.2 The FIX Command.

The FIX command is used to modify the input parameters required by DATA INITIALIZER submodules. There are two forms of the FIX command, FIX and FIXC. Only input data within the currently active submodule is affected.

FIX n is used to modify the nth input line. For example, FIX 2 in the BND submodule will allow the second vertex of the boundary expression to be modified. By convention, FIX 0 is used to reenter all input in the active submodule.

Table 3-1. Valid Targets for GO TO nn Command

Mnemonic	Branch Location	Comments
LOG IDN BND MRE GRI SEA RET	LOGON - program parameters entered USER identification Boundary entry section Mandatory requirements Analysis grid specification Search section Data discriminator	Allows the operator to proceed directly to the applicable INITIALIZER submodule and enter necessary information. All previous information in that submodule is purged.
CLOG CIND CBND CMRE CGRI CSEA	Logon command section Identification command section Boundary entry command section Mandatory requirements command section Analysis grid specification Search command section	Allows the operator to verify, display, or fix input parameters in each of the applicable INITIALIZER submodules. The "C" prefix inhibits automatic purging of the information in the referenced submodule.

3.1.2 -- Continued.

FIXC is used to change a string of characters. The format for this command is `FIXC∅; mm; nn;` this is the only command which requires a blank delimiter, `∅`, following the command. After the first semicolon, the string of characters to be changed is entered followed by another semicolon, the new string of characters, and finally, a third semicolon. Any other character may be used in place of the semicolon as a delimiter. The following examples illustrate the use of FIXC.

Assume the name WILL JONES was entered in the user identification submodule. To change WILL to BILL, the command

```
FIXC∅;W;B;
```

would be entered.

3.1.3 The VERIFY Command.

The VERIFY command is used to display input parameters. In the boundary entry and analysis grid submodules, this verification is a graphical display, while in the other submodules the display is a list of parameter values. There is no verify command in the search submodule as the search display is automatically output to the screen.

3.1.4 The DISPLAY Command.

The DISPLAY command is used to call a graphical display to the Tektronix screen. The format of the command is

DISPLAY n

where n is the display option number. Valid display options and the display each invokes are as follows:

<u>Display Option</u>	<u>Display</u>
1	Boundary expression
2	Boundary expression and system blocks
3	Boundary expression and system subblocks
4	Boundary expression and analysis grid blocks

These displays are available for graphical verification. For example, option 2 displays the quantity of data in each system block intersecting the geographical boundary and option 3 displays the quantities in each system subblock. Thus, a display using option 2 or option 3 will help the operator to assess the quantity and geographical distribution of data that is available for more detailed searching. Thus the analyst will use DISPLAY to help him develop an overall retrieval strategy, particularly the specification of mandatory requirements. (Examples of DISPLAY graphics output are presented in Appendix A.)

3.1.5 The ? Command.

While in the DATA INITIALIZER, entry of a ? after any prompt will give an explanation of the prompt, or if at the command level, will give an explanation of the active command.

3.2 DATA DISCRIMINATOR.

The command language of the DATA DISCRIMINATOR allows the retrieval operator to create and search through image data files using a number of different strategies to select the best available imagery for each particular request. The DISCRIMINATOR also allows the operator to interrogate and display any temporary or named files derived from the secondary data base, and to list out applicable frames.

While operating in the DISCRIMINATOR, all commands are entered from the scratch pad portion of the Tektronix screen. They can be edited with the spacing keys and other editing functions available on the Tektronix 4002A. Alternatively, an asterisk (*) will delete the previous character and a slash (/) will eliminate all characters on that line.

A list of commands available to the analyst when operating in the DATA DISCRIMINATOR processor of the ISS is presented in Table 3-2. This table also provides a brief description of the function of each command, necessary parameters, and parameter default values, if any. The syntax of the command

Table 3-2. DATA DISCRIMINATOR Commands

Command		Function	Parameter	Default for Parameters
Filter/Display	DISPLAY	Display data on graphics device - options 1 thru 10	<ul style="list-style-type: none"> o Option number for display format (OPT=n) o Boolean expression 	current working data set displayed if no name provided
	OVRWRT	Overwrite data on graphics device - options 1 thru 10	<ul style="list-style-type: none"> o Option number for format (OPT=n) o Boolean expression 	as above
	HSTGRM*	Histogram of data of specified parameter	<ul style="list-style-type: none"> o Parameter o Range 	
	KEEP ELIMINATE	Select data meeting specified criteria	<ul style="list-style-type: none"> o Boolean expression 	none
Data Management	SAVE	Enter data set as a user-named file	<ul style="list-style-type: none"> o File name o Comments 	must specify name
	PURGE	Delete a user-named file from directory	<ul style="list-style-type: none"> o File name or ALL 	none
	GRID	Redefine analysis grid structure	<ul style="list-style-type: none"> o No. of blocks across o No. of blocks down 	No. across = 1 No. down = 1
	NAMES	List the names of all user files	none	all names are listed
	LIST	List data set - options 1 thru 3	<ul style="list-style-type: none"> o Format number 	must specify option number
Utility	RECALL	List previous commands	<ul style="list-style-type: none"> o No. of commands to be listed 	1
	INIT	To initialize a new session	none	none
	QUIT	Stop	none	none
		*Not currently implemented.		

3.2 -- Continued.

language and general DISCRIMINATOR processing flow is discussed in the remainder of Section 3.2. The detailed syntax of the command language in the DISCRIMINATOR is shown in Appendix B.

3.2.1 Command Format.

The general command line format in the DISCRIMINATOR processor is:

<input field> - <command field>. <comments field>

Each command line is terminated with an end-of-transmission character.

3.2.1.1 Input Field.

The <input field> specifies one of the DISCRIMINATOR coverage set files in one of the formats listed in Table 3-3.

To be valid, a <file name> must meet the following restrictions:

- a. No more than eight characters in length
- b. The first character is alphabetic
- c. The remaining characters can be a mixture of either alphabetic or numeric characters
- d. No special characters are allowed.

Table 3-3. Input Field Format

<input field> Format	Comment
<file name>	Specifies one of the named files in the coverage set catalog (including the named secondary data base). If <file name> is null (i.e., omitted), then the current active file is assumed (see Section 3.2.2).
<file name> (<block numbers>)	Analysis grid block (or subblock) numbers separated by commas to select a geographical region of the specified coverage set file. If <block numbers> is null, the graphics cursor is used to select the blocks. As above, <file name> may be null.

3.2.1.1 -- Continued.

Some examples of valid file names are:

SAVE1	SAVE22	FILTER
CC90	QUAL100	WORKFILE
ROLL965	SECDB	FD72244

An example of a fully qualified command <input field> is

ROLL965 (25, 26, 27, 28) - <command field>

where the file being called is ROLL965, but limited to those frames falling within analysis grid blocks 25 thru 28.

3.2.1.2 Command Field.

The format of the <command field> varies slightly with each command name used as shown in Table 3-4.

The command line interpreter recognizes each command by the first alphabetic character of the command word. Thus, all other characters and blanks, with the exception of the end-of-transmission character, period, and the editing characters (* and /), are ignored up to the first left parenthesis in the <command field>. In general, blanks are ignored except within a Boolean expression where blanks are interpreted as delimiters.

Table 3-1. Valid Targets for GO TO nn Command

Mnemonic	Branch Location	Comments
LOG IDN BND MRE GRI SEA RET	LOGON - program parameters entered USER identification Boundary entry section Mandatory requirements Analysis grid specification Search section Data discriminator	Allows the operator to proceed directly to the applicable INITIALIZER submodule and enter necessary information. All previous information in that submodule is purged.
CLOG CIND CBND CMRE CGRI CSEA	Logon command section Identification command section Boundary entry command section Mandatory requirements command section Analysis grid specification Search command section	Allows the operator to verify, display, or fix input parameters in each of the applicable INITIALIZER submodules. The "C" prefix inhibits automatic purging of the information in the referenced submodule.

3.1.2 -- Continued.

FIXC is used to change a string of characters. The format for this command is `FIXC∅: mm: nn;` this is the only command which requires a blank delimiter, `∅`, following the command. After the first semicolon, the string of characters to be changed is entered followed by another semicolon, the new string of characters, and finally, a third semicolon. Any other character may be used in place of the semicolon as a delimiter. The following examples illustrate the use of FIXC.

Assume the name WILL JONES was entered in the user identification submodule. To change WILL to BILL, the command

```
FIXC∅;W;B;
```

would be entered.

3.1.3 The VERIFY Command.

The VERIFY command is used to display input parameters. In the boundary entry and analysis grid submodules, this verification is a graphical display, while in the other submodules the display is a list of parameter values. There is no verify command in the search submodule as the search display is automatically output to the screen.

3.1.4 The DISPLAY Command.

The DISPLAY command is used to call a graphical display to the Tektronix screen. The format of the command is

DISPLAY n

where n is the display option number. Valid display options and the display each invokes are as follows:

<u>Display Option</u>	<u>Display</u>
1	Boundary expression
2	Boundary expression and system blocks
3	Boundary expression and system subblocks
4	Boundary expression and analysis grid blocks

These displays are available for graphical verification. For example, option 2 displays the quantity of data in each system block intersecting the geographical boundary and option 3 displays the quantities in each system subblock. Thus, a display using option 2 or option 3 will help the operator to assess the quantity and geographical distribution of data that is available for more detailed searching. Thus the analyst will use DISPLAY to help him develop an overall retrieval strategy, particularly the specification of mandatory requirements. (Examples of DISPLAY graphics output are presented in Appendix A.)

3.1.5 The ? Command.

While in the DATA INITIALIZER, entry of a ? after any prompt will give an explanation of the prompt, or if at the command level, will give an explanation of the active command.

3.2 DATA DISCRIMINATOR.

The command language of the DATA DISCRIMINATOR allows the retrieval operator to create and search through image data files using a number of different strategies to select the best available imagery for each particular request. The DISCRIMINATOR also allows the operator to interrogate and display any temporary or named files derived from the secondary data base, and to list out applicable frames.

While operating in the DISCRIMINATOR, all commands are entered from the scratch pad portion of the Tektronix screen. They can be edited with the spacing keys and other editing functions available on the Tektronix 4002A. Alternatively, an asterisk (*) will delete the previous character and a slash (/) will eliminate all characters on that line.

A list of commands available to the analyst when operating in the DATA DISCRIMINATOR processor of the ISS is presented in Table 3-2. This table also provides a brief description of the function of each command, necessary parameters, and parameter default values, if any. The syntax of the command

Table 3-2. DATA DISCRIMINATOR Commands

Command		Function	Parameter	Default for Parameters
Filter/Display	DISPLAY	Display data on graphics device - options 1 thru 10	<ul style="list-style-type: none"> o Option number for display format (OPT=n) o Boolean expression 	current working data set displayed if no name provided
	OVRWRT	Overwrite data on graphics device - options 1 thru 10	<ul style="list-style-type: none"> o Option number for format (OPT=n) o Boolean expression 	as above
	HSTGRM*	Histogram of data of specified parameter	<ul style="list-style-type: none"> o Parameter o Range 	
	KEEP ELIMINATE	Select data meeting specified criteria	<ul style="list-style-type: none"> o Boolean expression 	none
Data Management	SAVE	Enter data set as a user-named file	<ul style="list-style-type: none"> o File name o Comments 	must specify name
	PURGE	Delete a user-named file from directory	<ul style="list-style-type: none"> o File name or ALL 	none
	GRID	Redefine analysis grid structure	<ul style="list-style-type: none"> o No. of blocks across o No. of blocks down 	No. across = 1 No. down = 1
	NAMES	List the names of all user files	none	all names are listed
	LIST	List data set - options 1 thru 3	<ul style="list-style-type: none"> o Format number 	must specify option number
Utility	RECALL	List previous commands	<ul style="list-style-type: none"> o No. of commands to be listed 	1
	INIT	To initialize a new session	none	none
	QUIT	Stop	none	none
		*Not currently implemented.		

3.2 -- Continued.

language and general DISCRIMINATOR processing flow is discussed in the remainder of Section 3.2. The detailed syntax of the command language in the DISCRIMINATOR is shown in Appendix B.

3.2.1 Command Format.

The general command line format in the DISCRIMINATOR processor is:

<input field> - <command field>. <comments field>

Each command line is terminated with an end-of-transmission character.

3.2.1.1 Input Field.

The <input field> specifies one of the DISCRIMINATOR coverage set files in one of the formats listed in Table 3-3.

To be valid, a <file name> must meet the following restrictions:

- a. No more than eight characters in length
- b. The first character is alphabetic
- c. The remaining characters can be a mixture of either alphabetic or numeric characters
- d. No special characters are allowed.

Table 3-3. Input Field Format

<input field> Format	Comment
<p data-bbox="145 431 357 459"><file name></p> <p data-bbox="145 721 698 749"><file name> (<block numbers>)</p>	<p data-bbox="798 431 1337 687">Specifies one of the named files in the coverage set catalog (including the named secondary data base). If <file name> is null (i.e., omitted), then the current active file is assumed (see Section 3.2.2).</p> <p data-bbox="798 721 1337 1044">Analysis grid block (or subblock) numbers separated by commas to select a geographical region of the specified coverage set file. If <block numbers> is null, the graphics cursor is used to select the blocks. As above, <file name> may be null.</p>

3.2.1.1 -- Continued.

Some examples of valid file names are:

SAVE1	SAVE22	FILTER
CC90	QUAL100	WORKFILE
ROLL965	SECDB	FD72244

An example of a fully qualified command <input field> is

ROLL965 (25, 26, 27, 28) - <command field>

where the file being called is ROLL965, but limited to those frames falling within analysis grid blocks 25 thru 28.

3.2.1.2 Command Field.

The format of the <command field> varies slightly with each command name used as shown in Table 3-4.

The command line interpreter recognizes each command by the first alphabetic character of the command word. Thus, all other characters and blanks, with the exception of the end-of-transmission character, period, and the editing characters (* and /), are ignored up to the first left parenthesis in the <command field>. In general, blanks are ignored except within a Boolean expression where blanks are interpreted as delimiters.

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SECTION 4 MISSING

PART OF SECTION 5

5-1

5-2

Table 5-1. Internal Character Format

Character	Internal Code	Character	Internal Code
Space	1	-	33
A	2	/	34
B	3	S	35
C	4	T	36
D	5	U	37
E	6	V	38
F	7	W	39
G	8	X	40
H	9	Y	41
I	10	Z	42
¢	11	:	43
•	12	,	44
<	13	%	45
(	14	_	46
+	15	>	47
|	16	?	48
&	17	0	49
J	18	1	50
K	19	2	51
L	20	3	52
M	21	4	53
N	22	5	54
O	23	6	55
P	24	7	56
Q	25	8	57
R	26	9	58
!	27	:	59
\$	28	#	60
*	29	@	61
)	30	'	62
;	31	=	63
~	32	"	64

5.1.2.1 -- Continued.

- a. The center point and length of one side of a square are entered from the keyboard (Point Square).
- b. Each coordinate of the closed polygon is defined point by point on a registered map base by spark pen (Spark Pen).
- c. Each coordinate is entered from the keyboard (Keyboard).
- d. The top left and bottom right coordinates of a rectangle defining the desired boundary are entered either from the keyboard or by spark pen (Rectangle).

In addition to the boundary, the analyst can also identify special points of interest (landmarks). These landmarks will be indicated with a triangle on any displays produced. The boundary expression along with the associated landmarks, if any, are stored as a sequential list of coordinates. All coordinates in the ISS are stored as a relative distance from the base point of 180 degrees west longitude and 90 degrees south latitude.

5.1.2.2 Mandatory Requirements.

The "mandatory requirements" are initial criteria on particular descriptor fields of the data records which *must* be satisfied in order for imagery to be acceptable for a particular request. The analyst can specify mandatory requirements on any descriptor field in the form of a Boolean expression. The syntax of Boolean expression will be parsed and converted to Polish notation, using a standard single precedence scheme as shown in Table 5-2, for filtering data during the secondary data base formation. The Polish notation is stored as a sequence of codes which is terminated by an end-of-line operator (see Table 5-3).

Table 5-2 Precedences for Boolean Expressions

Operator	Meaning	Precedence
'	NOT	2
&	AND	3
+	OR	4
(and)	grouping	6
.	end-of-line	7

Table 5-3. Polish Notation Codes.

Code	Meaning
Positive non-zero integer	Indicates the descriptor field in the record. Associated with this entry is an inclusive range (all relational operators are converted internally to inclusive ranges) that the analyst requested.
-2	Perform logical NOT operation on the previous item in the Polish string. Result replaces operator and the operand.
-3	Perform logical AND operation on the previous two items. Result replaces operator and both operands.
-4	Same as -3, except a logical OR operation.
-7	End of expression. The only item left will be the final result of the Boolean expression.

5.1.2.3 Analysis Grid Blocks.

"Analysis grid blocks" are an analyst-defined grid structure which allows him to systematically analyze large secondary data bases or to select an appropriate scaling for his displays. The numbering system for the analysis grid blocks (system subblocks also) is illustrated in Figure 5-1 where the maximum number of blocks is 144. At the command level in the data discriminator, each of these blocks may be considered singly, in arbitrary groups of up to 30, or in total.

7	8	9
4	5	6
1	2	3

Figure 5-1. Illustration of Analysis Grid Block Numbering Convention.

5.1.3 Secondary Data Base Formation.

Once all search specifications have been completed, the system data base must be searched in an orderly and efficient manner. An individual picture in the system data base will be placed in the secondary data base if it meets the following criteria:

5.1.3 -- Continued.

- a. The mandatory requirements are satisfied,
- b. The center point of the picture lies within or on the boundary,
- c. The center point of the picture lies within the analysis grid structure, if one was specified.

Figure 5-2 shows a flowchart of the search strategy which is built around two key algorithms. Given a coordinate and a boundary expression, the "winding number" algorithm determines whether the coordinate lies inside, outside or on the boundary. Considerable search time is saved by using the "single" algorithm which determines whether a complete system block or subblock is inside, outside or overlapping the boundary.

To minimize the waiting time for the analyst, a display is constructed as the search progresses. This display consists of blocks (the analyst chooses whether he wants analysis grid blocks or system subblocks) overlaid with the boundary expression. The number of pictures that satisfy the criteria listed above is printed in each block.

Once the secondary data base has been created, it must be made available to the DATA DISCRIMINATOR. This is accomplished by setting up the following entries in the file structure for the DATA DISCRIMINATOR (see Figure 5-3):

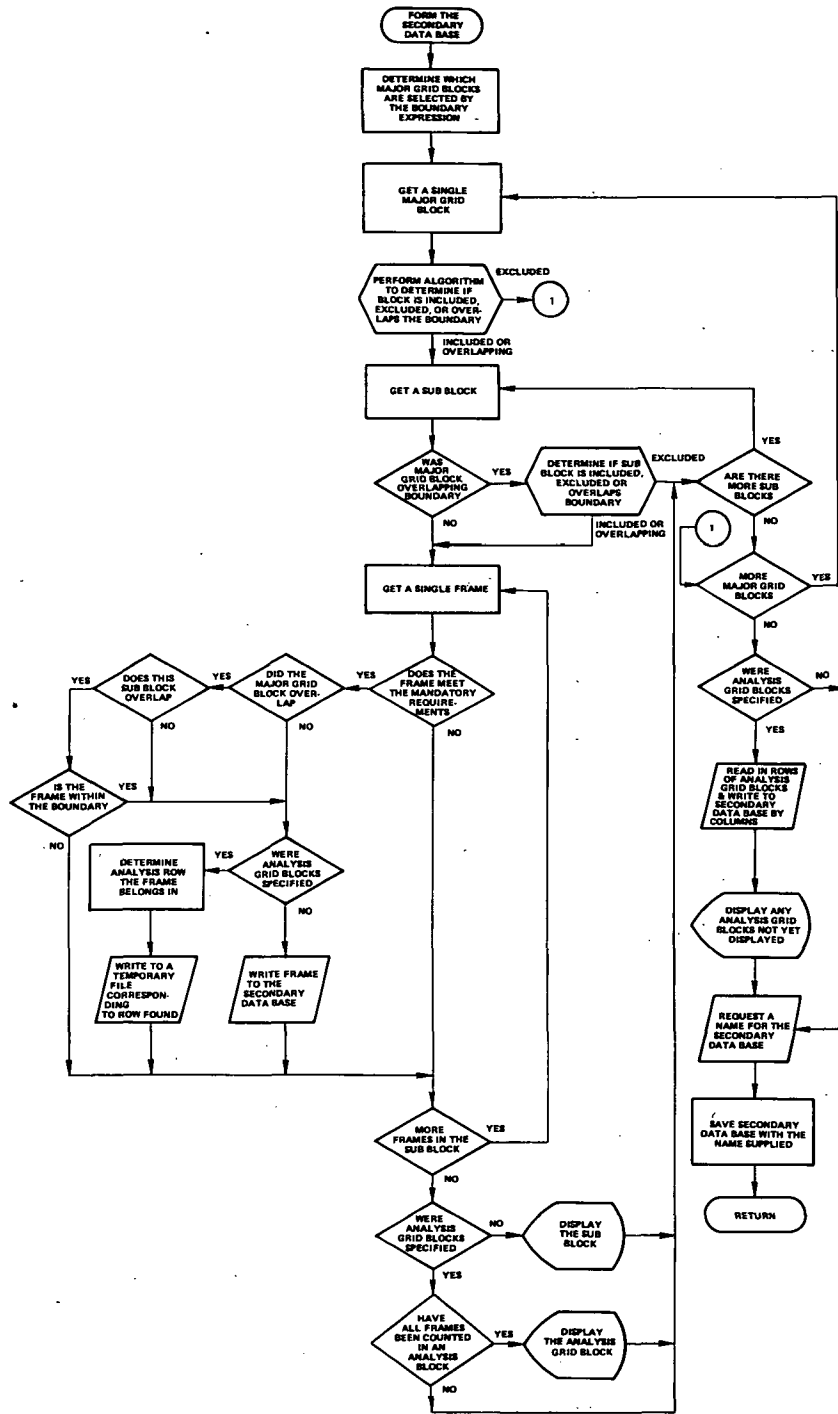
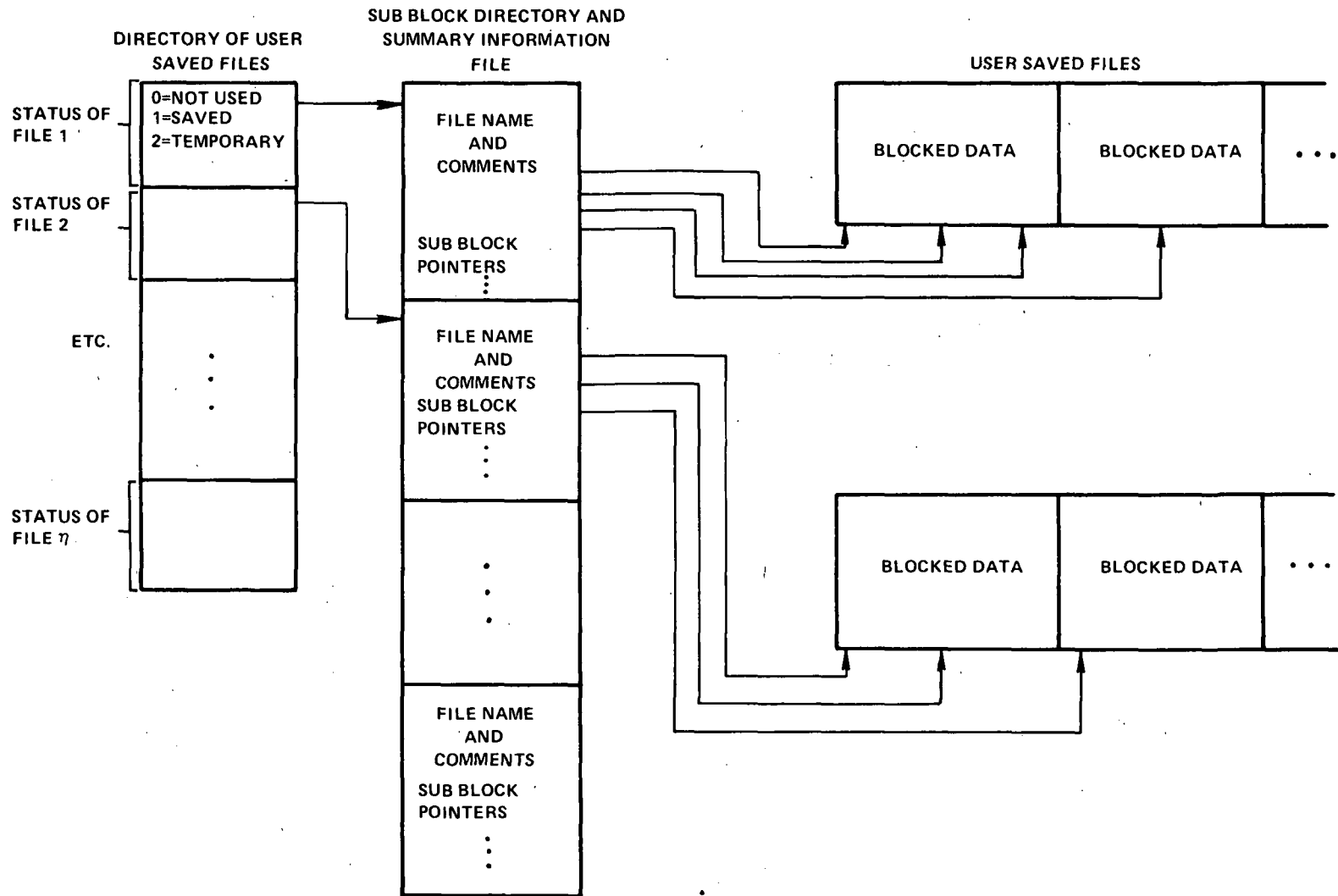


Figure 5-2. Flowchart of Secondary Data Base Formation.



5-10

Figure 5-3. File Structure for DATA DISCRIMINATOR.

5.1.3 -- Continued.

- a. The status of File 1 is set to user-saved file (code of 1).
- b. The name supplied by the analyst is placed in the directory for the secondary data base. The subblock pointers and summary information are set up (see Figure 5-3) and the directory is written into the first record of the directory file.

5.1.4 File Structure.

The file structure for the DATA DISCRIMINATOR is described in Figure 5-3. In addition, each of the basic three entities in the file structure will be discussed briefly in this section.

The directory of user-saved files consists of a vector having one entry for each file. The possible values are:

- a. Entry is not used: code of 0.
- b. User-saved file: code of 1.
- c. Temporary working file: code of 2.

The position of an entry within the vector indicates which record of the directory file is to be used and also where the actual data begins, i.e. - the first entry corresponds to File 1, the second to File 2, etc. The first entry will always correspond to the secondary data base.

5.1.4 -- Continued.

One record in the directory file contains the file name, comments, and all of the subblock pointers for a user-saved file; therefore, it requires only one input operation to obtain all of this information. In some cases, the summary information is all that is required, eliminating the need to look at any actual data records.

Finally, all data records are blocked at 20 records per block, drastically reducing the number of input/output operations necessary to examine the data on a frame by frame basis.

5.2 DISCRIMINATOR.

The DATA DISCRIMINATOR has been previously described both in terms of the format of the command line and of the individual functions which operate on the data records. This section describes the operation of the command line processor of the ISS. In order to accomplish this on a general level and to preserve the relationship of characters within the command string, the discussion will be directed to "pseudo-fields" or character representations for the actual fields recognized by the processor. The successive processing steps of the command will be described employing this simulated command string.

5.2.1 The Simulated Command String.

The general command line format described in Section 3.2.1 is:

<input field> - <command field> • <comments field>

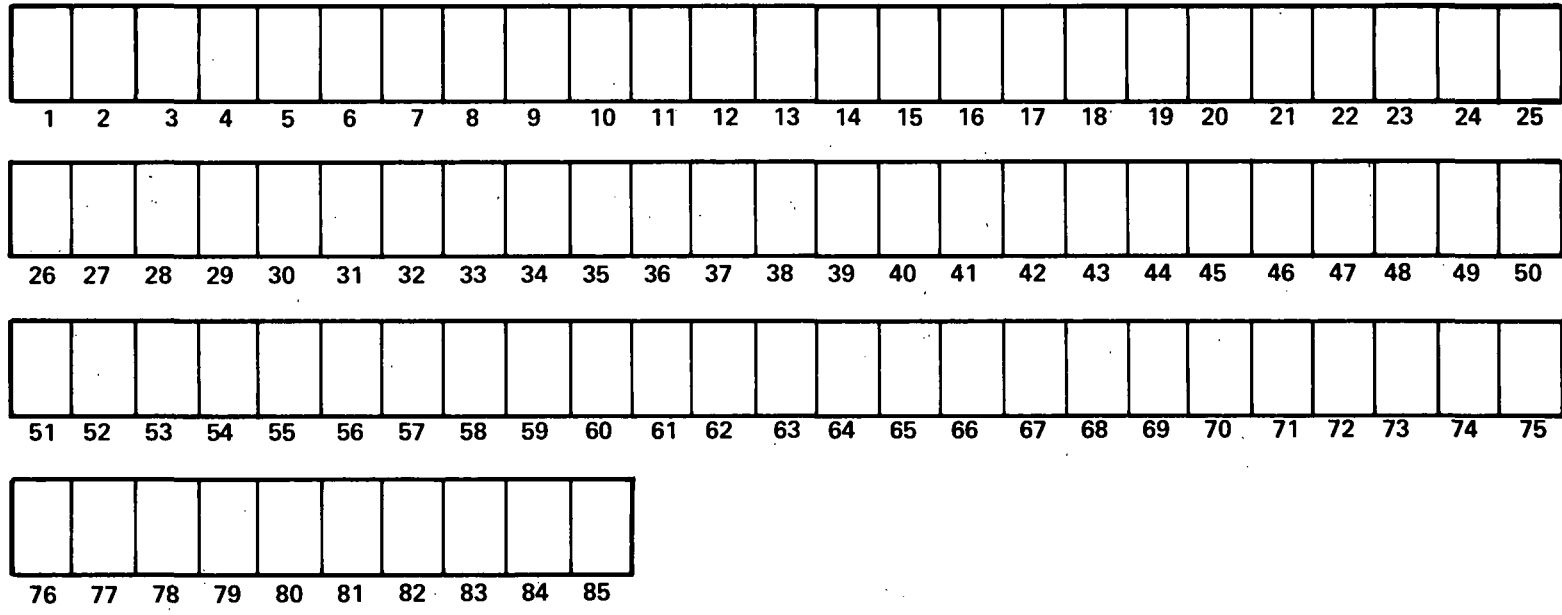
where both the <input field> and <command field> formats were analyzed in Tables 3-3 and 3-4 respectively. The correspondence of the pseudo-field to the actual field is presented in Table 5-4.

Table 5-4. Command String Field Representation

PSEUDO-FIELD	REPRESENTATION OF
INPUT (BLOCKS)	<input field>
COMMAND (PARAMETERS)	<command field>
COMMENTS	<comments>

Rather than generate specific examples of all command line possibilities these characters strings will represent the various possibilities. For example, the phrase COMMAND (PARAMETERS) can represent any of the DISCRIMINATOR commands listed in Table 3-2.

Figure 5-4 represents an in-core buffer area used to store the command line for inter-routine communication purposes. Figure 5-5 represents the exaggerated "freely" formatted command



5-14

Figure 5-4. Command Line Buffer.

			I	N	P	U	T		(	B	L	O	C		K	S	)			-	C	O	M	M
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

A			N		D		(		P	A	R	A	M	E	T	E	R	S)	.				
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

	C	O	M	M	E	N	T	S																
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

5-15

Figure 5-5. Free Format Command Line.

5.2.1 -- Continued.

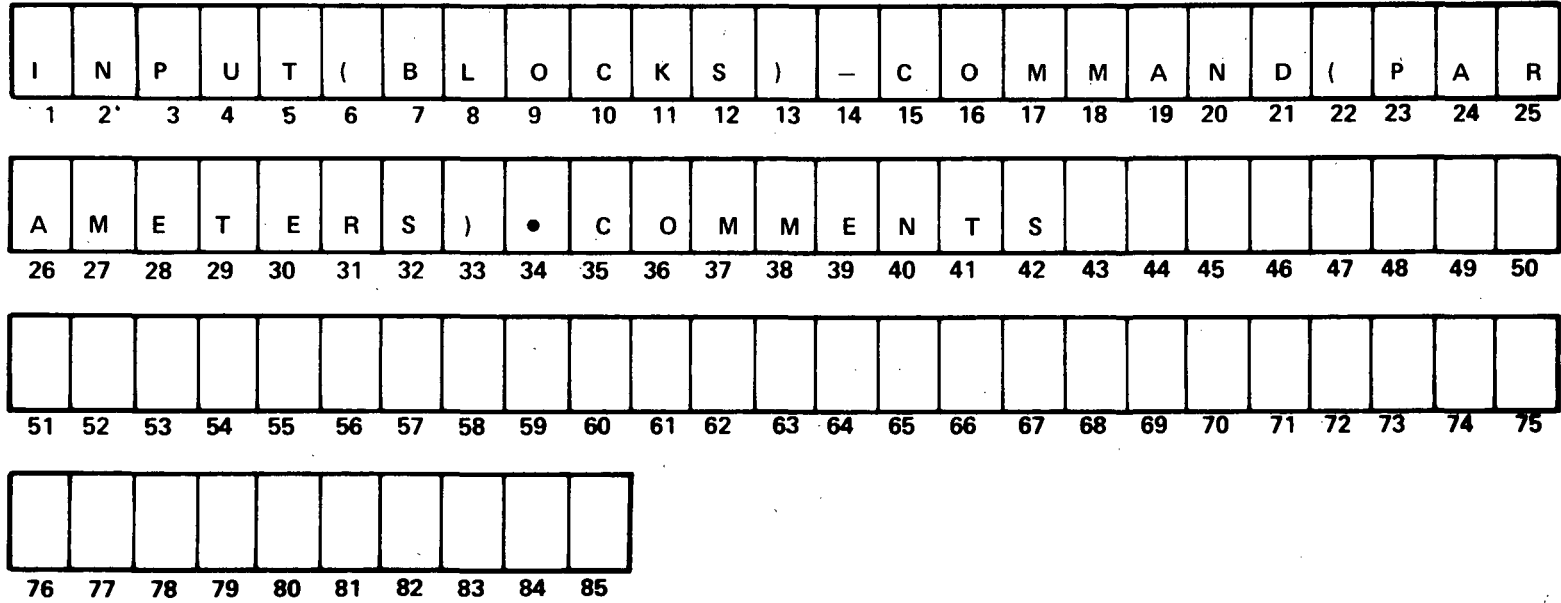
line upon which further discussions will be based. The command line processor ignores imbedded blanks within the command line. In fact, it first left justifies and packs the command line and then scans the command line for any illegal characters. Any illegal characters will cause an error message to be printed and a prompt for a new command. A successful pass through the phase will result in the processed buffer area depicted in Figure 5-6.

5.2.2 Line Parsing.

There are four delimiters recognized by the command processor which separate fields and subfields within a command line.

Table 5-5. Field and Subfield Delimiters

Symbol	Code	Meaning
-	33	separates the characters of the <input field> from the <command field>
(	14	opens either the block subfield in the <input field> or the parameter subfield in the <command field>
)	30	closes the above subfield
.	12	separates the <command field> from the <comments field>



5-17

Figure 5-6. Command Line--Left Justified and Packed.

5.2.2 -- Continued.

Under the assumptions of a left justified command line and of a command line free of any illegal characters, a scan of the command line will produce a parsed line which only needs to be interpreted. An array of four pointers is used to record the results of the parsing. Each pointer is used to define the particular extents of the field as listed in Table 5-6 and depicted in Figure 5-7.

Table 5-6. Parsing Pointers Array

Pointer	Value*
1	position of the hyphen
2	position of the opening parenthesis of the <command field> parameters
3	position of the closing parenthesis of the <command field> parameters
4	position of the period

*initial value = 0 for all

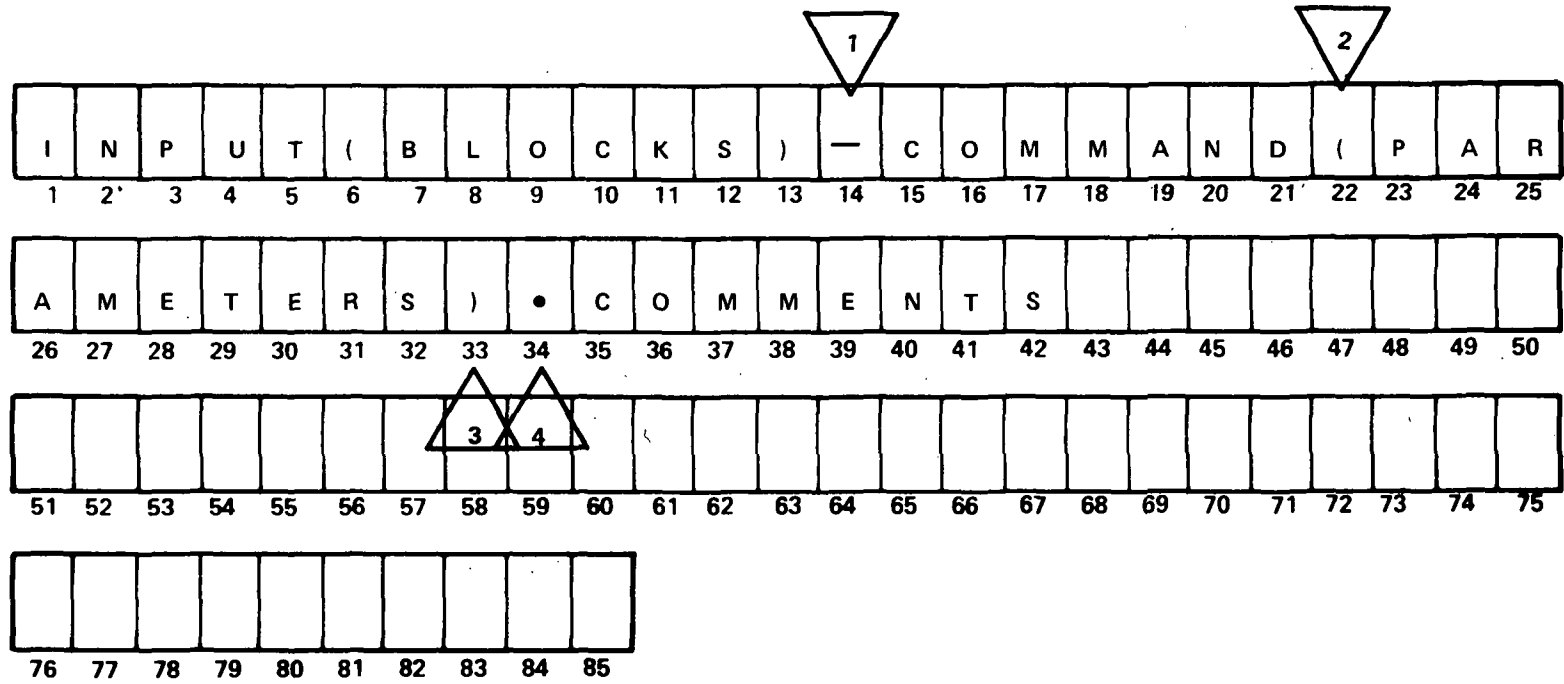


Figure 5-7. Parsed Command Line.

5.2.2 -- Continued.

In Figure 5-7, the values of points are: No. 1 = 14, No. 2 = 22, No. 3 = 34, and No. 4 = 34. All further processing can then concentrate on each of the fields. There are also certain conclusions concerning the syntax of the command line which can be deduced from the values of the pointers. Table 5-7 summarizes these deductions.

Table 5-7. Pointer States and Command Line Syntax

Pointer State	Deduction
No. 1 = 1	null <input field>
No. 2 = 0 No. 3 = 0	no <command field> parameter
No. 1 = 0	syntax error condition
No. 4 = 0	syntax error condition
No. 1 ≠ 0 No. 2 ≠ 0 No. 3 ≠ 0 No. 4 ≠ 0	the relationship must be No. 1 < No. 2 < No. 3 < No. 4

5.2.2 -- Continued.

By examination of the various pointer values, invoking of the various interpreters translating each character string can be controlled, and error conditions can be detected without any further processing.

After a command line has been successfully parsed, the command line processor of the data DISCRIMINATOR no longer operates on the character-by-character basis but rather on the field basis. This new processing level is reflected in Figure 5-8.

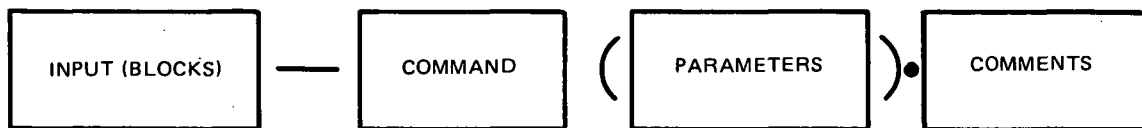
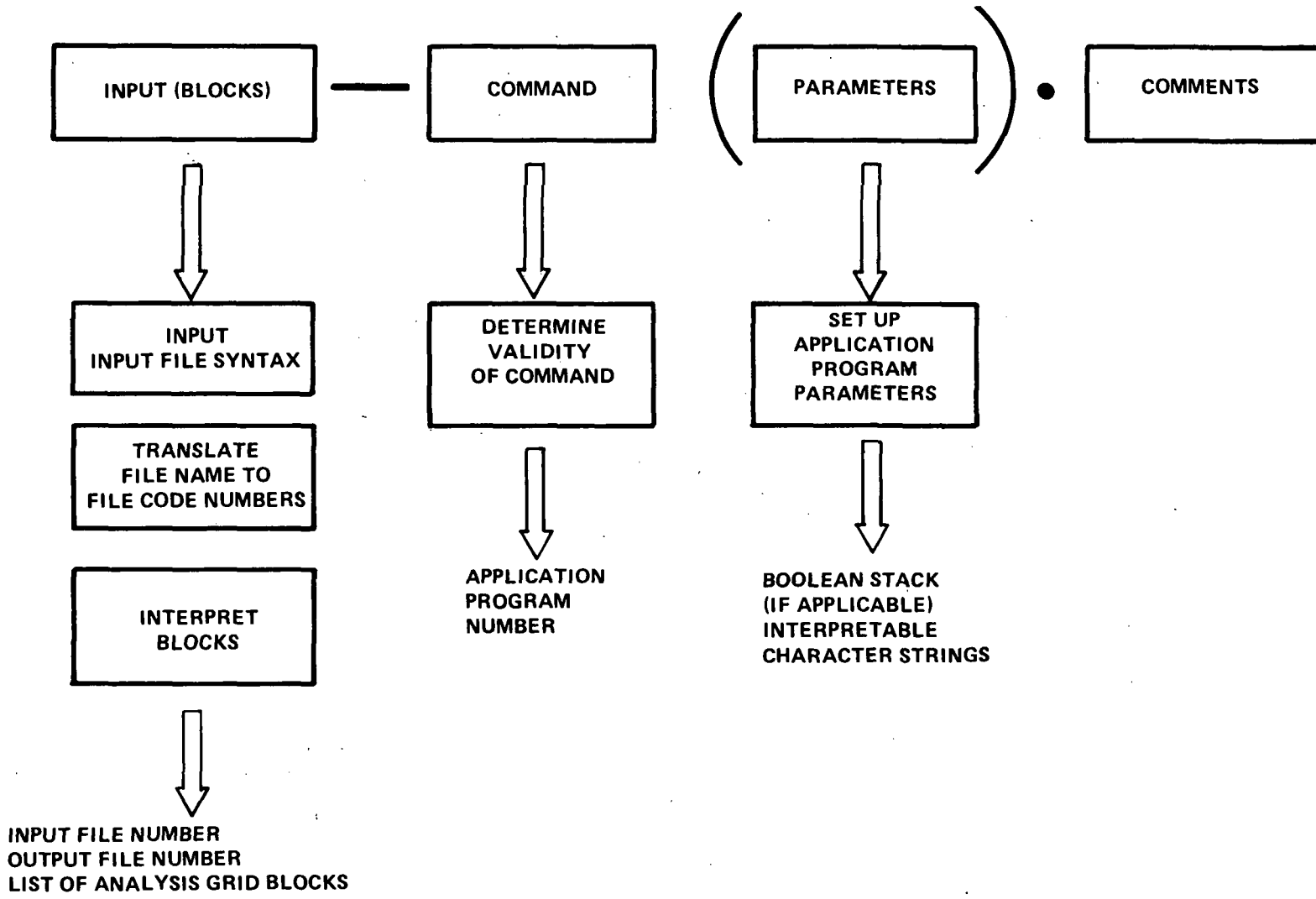


Figure 5-8. Command Line Fields.

Although COMMAND (PARAMETERS) define the <command field>, the PARAMETERS subfield is processed separately because of the command dependent forms it can assume as shown in Table 3-4.

5.2.3 Command Line Interpretation.

Figure 5-9 summarizes the processing which occurs for each field. Initially, the input file name is checked for any violations of syntax. These restrictions are:



5-22

Figure 5-9. Command Line Processing.

5.2.3 -- Continued.

- No more than eight characters
- The first character is alphabetic
- The remaining characters can be a mixture of either alphabetic or numeric characters
- No special characters are allowed

If an error is detected, the analyst is informed of the error condition and the system returns a prompt for a new command line. When no error is encountered, the character string which defines the input file name is used to search the directory of user-saved data files which has been discussed previously (a null field is a valid input file name). The result of that search is the disk address of the file. Where an output file number is required, the current temporary file is assigned. If block numbers have been specified, each number delimited by commas is translated and entered into a stack together with a count of the number of blocks. The result of <input field> processing is:

- Input file number
- Output file number (command dependent)
- List and count of block numbers (optional)

The processing on the command name portion of the <command field> is straightforward. All the initial characters

5.2.3 -- Continued.

of the commands are unique; therefore, a command is identified by its initial character. A search is made in the command number table for the matching letter. A match defines a particular application program to be called; no match is an error condition and returns the user to the system prompt. Table 5-8 presents the command letter to command number correspondence.

Table 5-8. Command Letter to Command Number Correspondence

Command No.	Command
1	P URGE
2	S AVE
3	G RID
4	R ECALL
5	I NIT
6	N AMES
7	Q UIT
8	D ISPLAY
9	O VERWRITE
10	E LIMINATE
11	H ISTOGRAM*
12	L IST
13	K EEP
*not implemented	

5.2.3 -- Continued.

With the exception of those commands which utilize option numbers and Boolean expressions, all parameter processing occurs within each application program. Options are a labeled parameter which is interpreted and placed in a communication area. Boolean expressions are translated into Polish notation and stacked. In commands which do not require parameters, the pointers are checked to verify that no parameters were entered. Figure 5-10 represents the total flow of the DISCRIMINATOR.

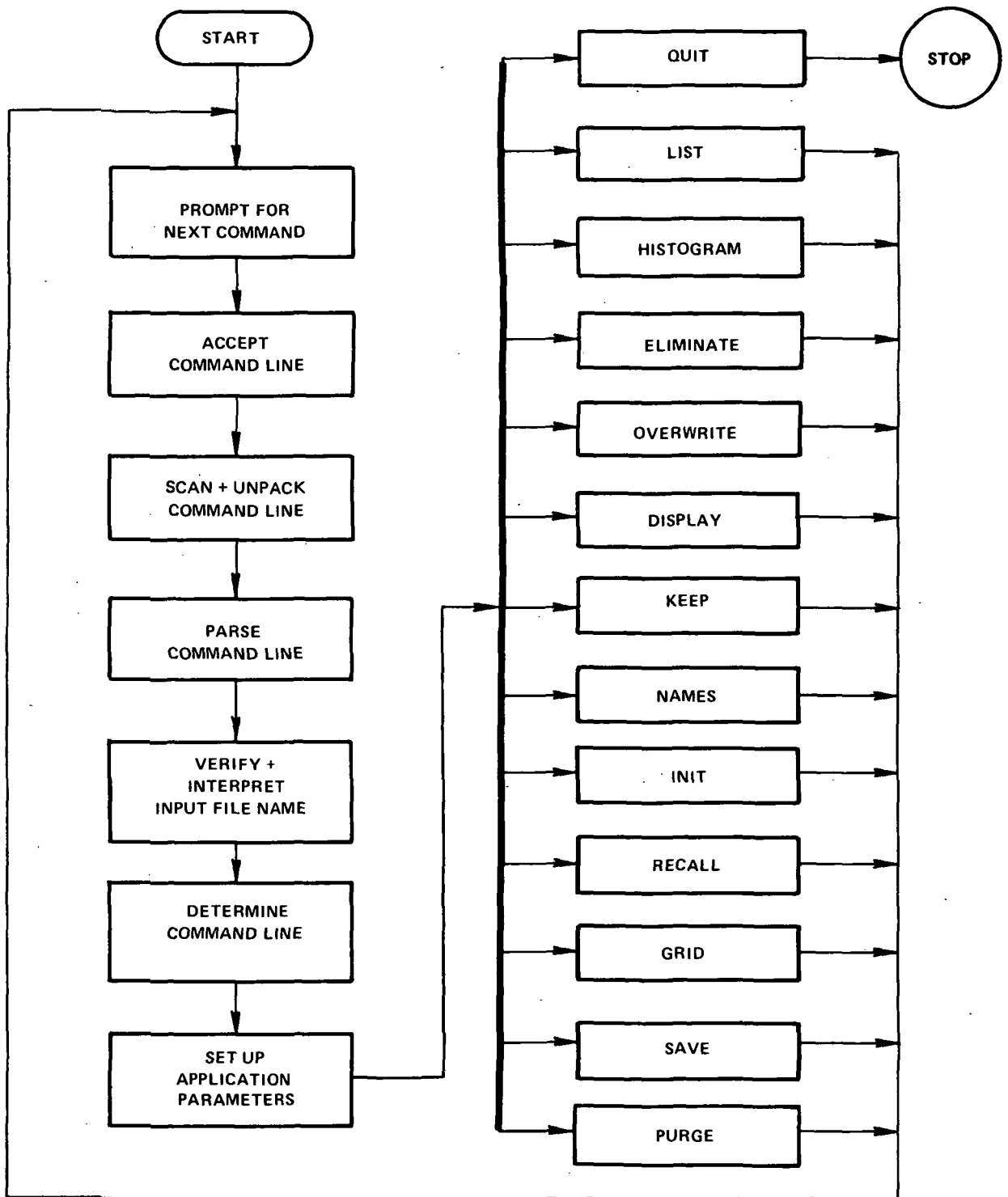


Figure 5-10. DATA DISCRIMINATOR Command Flowchart.

APPENDIX A. EXAMPLE OF AN AREA COVERAGE REQUEST.

In this Appendix, a typical area coverage request processed by the ISS is documented by a set of annotated photographs of the Tektronix screen. The request was for composite coverage of Yosemite National Park consisting of excellent quality data with little or no cloud cover. Color infrared aerial photographs in the 9" x 9" format were preferred. Figures A-1 through A-14 describe the required steps to satisfy this area request and to display the selected coverage.

A CR after the prompt (?) requests the system default value.

"GO" requests the next processing module in normal sequence.

```
WELCOME TO THE NASA AMES IMAGE SELECTION SYSTEM

RESTART? N
ENTER PROGRAM PARAMETERS:
TEK TERMINAL? DEFAULT = YES
LONG MESSAGES? DEFAULT = NO
AUTO-HARDCOPY? DEFAULT = NO
AUTO-DISPLAYS? DEFAULT = NO
ANALYST: RE EKSTRAND

COMMAND: GO

SECTION TO ENTER USER
IDENTIFICATION
NAME: JOHN MUIR
ORG: NAT'L PARK SERVICE
STREET: YOSEMITE N.P.
CITY, STATE: YOSEMITE, CA
ZIP:

COMMAND: GO

CODE:
```

Display Description:

After initializing the ISS, program control parameters are entered following the prompt (?) character. The analyst enters his name and the mailing address of the user.

Figure A-1. Initial LOGON and User Identification.

Boundary entry method code is selected and the map registration to the graphics digitizer is entered.

```
CODE: 2
ENTER MAP ORIGIN
DD MM DDD MM
37 00 119 00
DISTANCE BETWEEN POINTS IN MINUTES
75
```

```
ENTER BOUNDARY EXPRESSION
---DEFAULT TO EXIT---
38 11 .119 36
38 06 .119 27
38 07 .119 25
38 01 .119 18
37 58 .119 19
37 54 .119 12
37 47 .119 12
37 40 .119 18
37 32 .119 26
37 32 .119 34
37 30 .119 34
37 30 .119 39
37 38 .119 41
37 38 .119 43
37 39 .119 43
37 40 .119 45
37 42 .119 45
37 44 .119 51
37 49 .119 52
37 50 .119 49
37 53 .119 49
```

A-3

Display Description:

The geographic boundary is specified here by using the graphics digitizer to input selected points from a map source. The registration of the map and the display of coordinate values of the digitized points are shown.

Figure A-2. Geographical Boundary Entry.

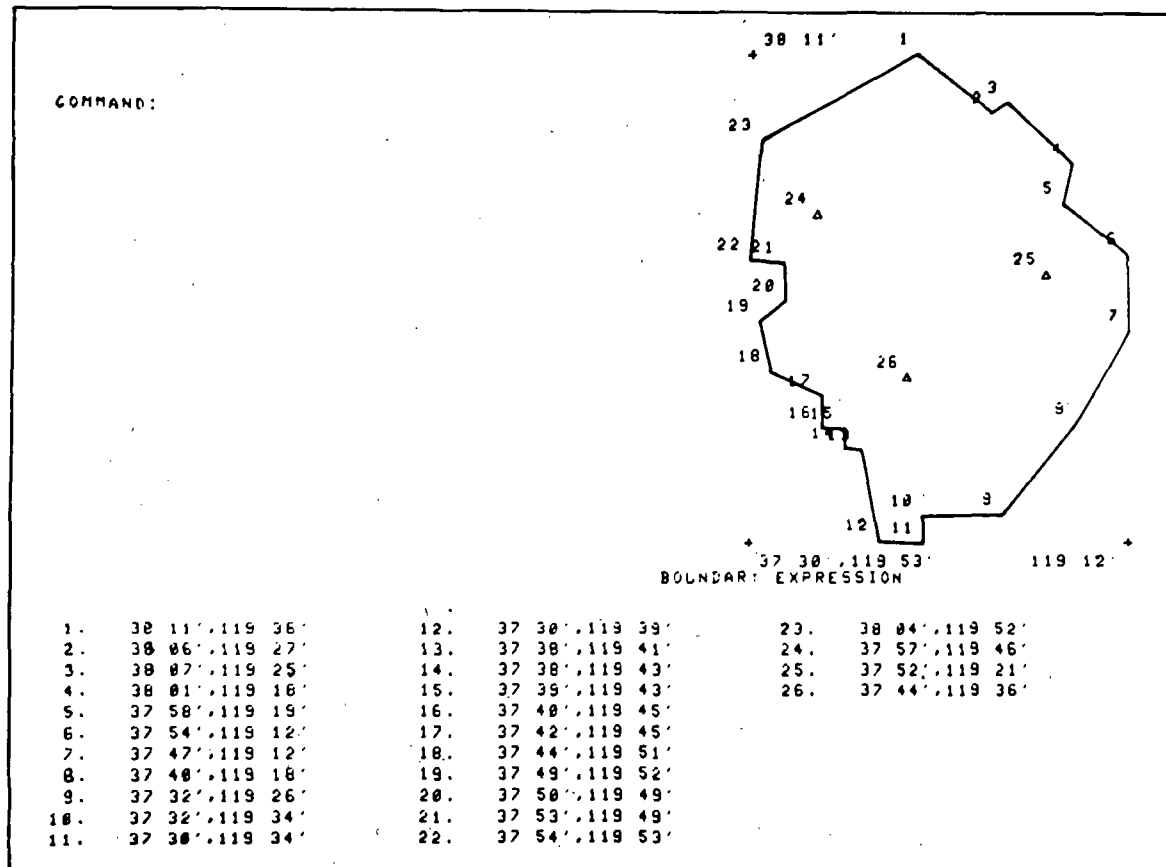
Verification of
the geographical
boundary is
requested.

```
37 54'.119 53'  
38 04'.119 52'  
  
DEFAULTED  
LANDMARKS? 07 MAXIMUM  
MAP(M) OR KEYBOARD(K)  
M  
ENTER LANDMARKS  
---DEFAULT TO EXIT---  
37 57'.119 46'  
37 52'.119 21'  
37 44'.119 36'  
  
DEFAULTED  
COMMAND: VERIFY
```

Display Description:

In this display, the last vertices are input, and the digitizer is then used to input three identifying landmarks.

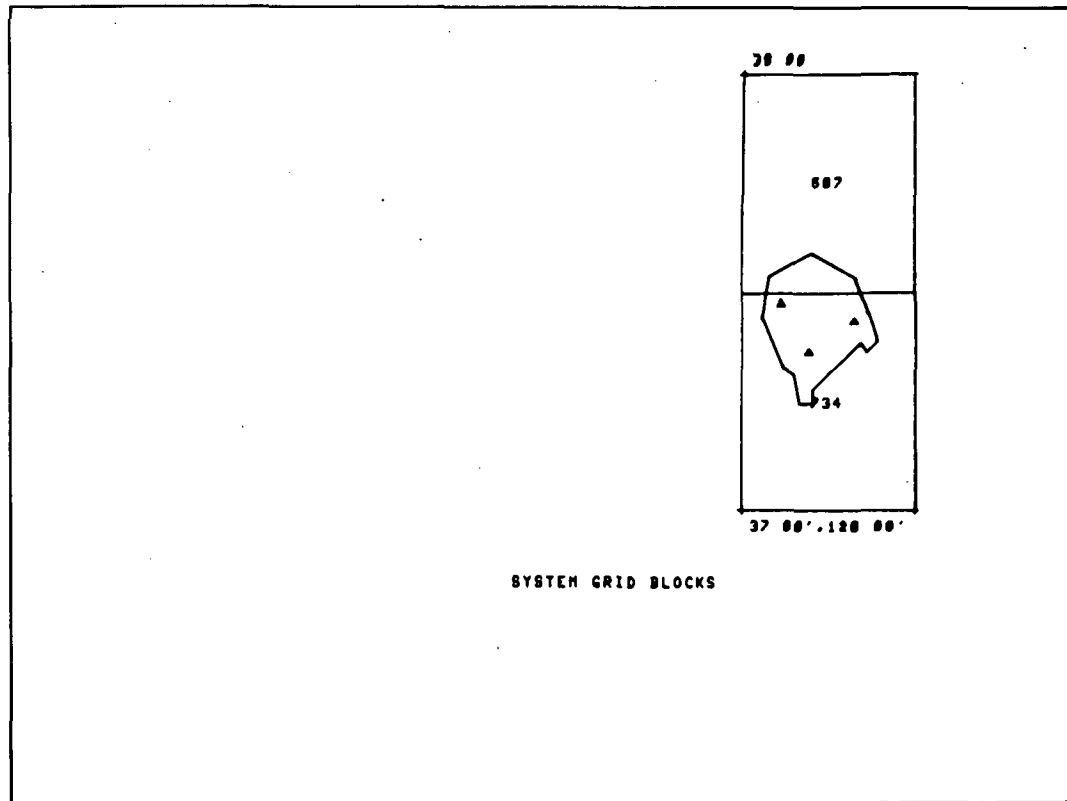
Figure A-3. Specification of Landmarks.



Display Description:

A graphical verification of the boundary expression and landmarks is presented here. Points 24, 25, and 26 are the landmarks, and are denoted by triangles. The displayed geographical outline is the Yosemite National Park boundary. The landmarks are: 24--Hetch Hetchy Reservoir, 25--Tuolumne Meadows, and 26--Yosemite Valley.

Figure A-4. Boundary Expression Verification.



Display Description:

Display of boundary expression and associated system grid blocks. The numbers inside the blocks give the number of images in that particular block.

Figure A-5. System Grid Blocks.

A CR ends entry
of mandatory
requirements.

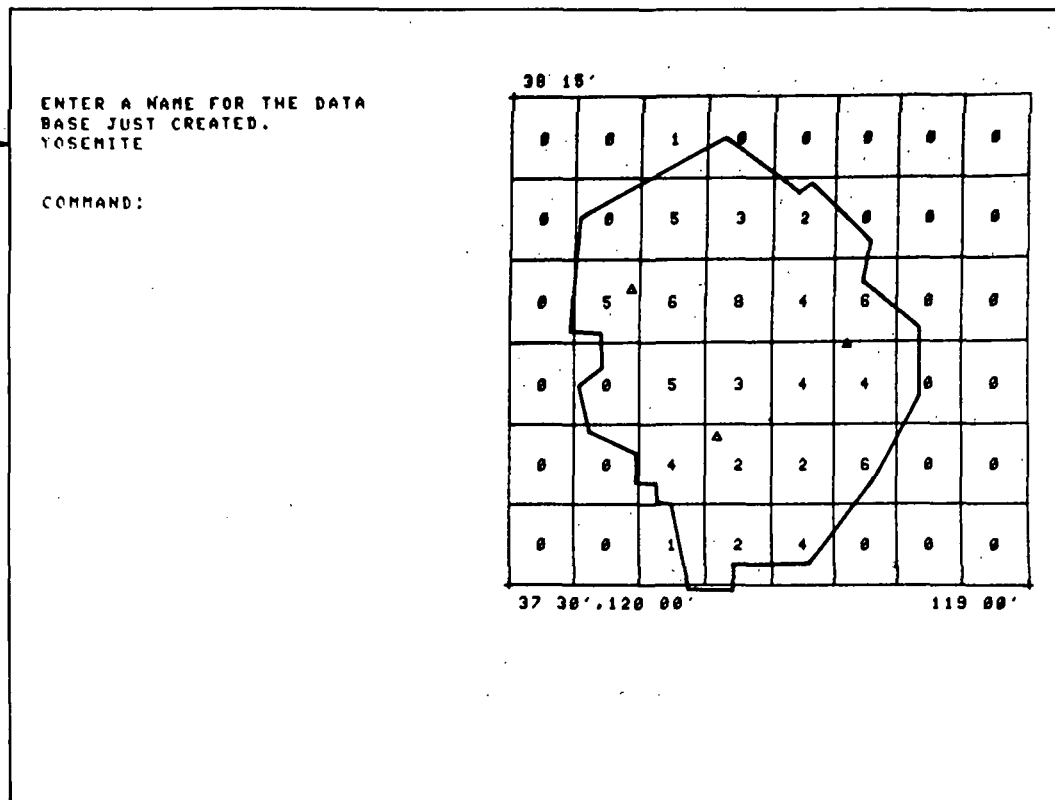
```
COMMAND: GO  
MANDATORY REQUIREMENTS  
TO BE ENTERED  
  
LIMIT:  
CC=1  
LIMIT:  
QU=1  
LIMIT:  
  
COMMAND: GO  
ANALYSIS GRID BLOCKS? Y  
MAP(M) OR KEYBOARD(K)? K  
TL BR CORNERS  
38 15 120 00  
37 38 119 00  
NUMBER OF X AND Y BLOCKS  
8X6
```

Display Discription:

Specification of mandatory requirements and analysis grid structure. Acceptable data must have less than 10% cloud cover and be of excellent quality. An 8 by 6 analysis grid structure is superimposed on the boundary for user display control and referencing convenience.

Figure A-7. Specification of Mandatory Requirements and Analysis Grid.

The search has been completed and the selected set (secondary data base) has been named.



Display Description:

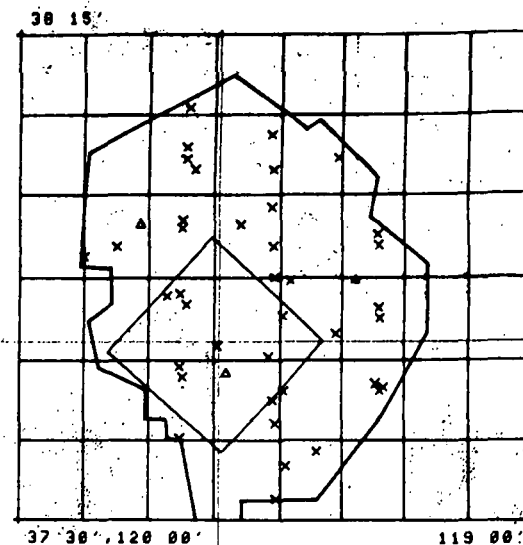
A secondary data base, named Yosemite, has been created from those frames inside the boundary and meeting the mandatory requirements. The numbers in the boxes indicates the number of selected frames in each grid block.

Figure A-8. Distribution of Selected Imagery.

Information on the frame selected with the crossbars is displayed:

- AN=9628035 is roll 962 and Frame 8035,
- BN=1751079 is cassette 175 and frame 1079,
- FN=73020A is flight 20, section A, in 1973,
- CC=0 is cloud cover of 0%,
- QU=1 is quality rating of excellent,
- FO=3 is 9" x 9" frame format,
- FD=73051 is Julian day 51 in 1973,
- SI=16 is sensor ID #16, RC-10 metric camera with 6" focal length lens,
- SC=123 is scale of 1:123,000,
- SB=4 is spectral band of 510nm-900nm,
- FT=3 is film type 2443 or 3443, color IR

```
-DISPLAY(OP=6)(FO=3&FT=3).
AN=9628035 ,BN=1751079
FN=73020A,CC=0 ,QU=1,FO=3,
FD=73051,SI=16,SC=123,SB=4
FT=3
```

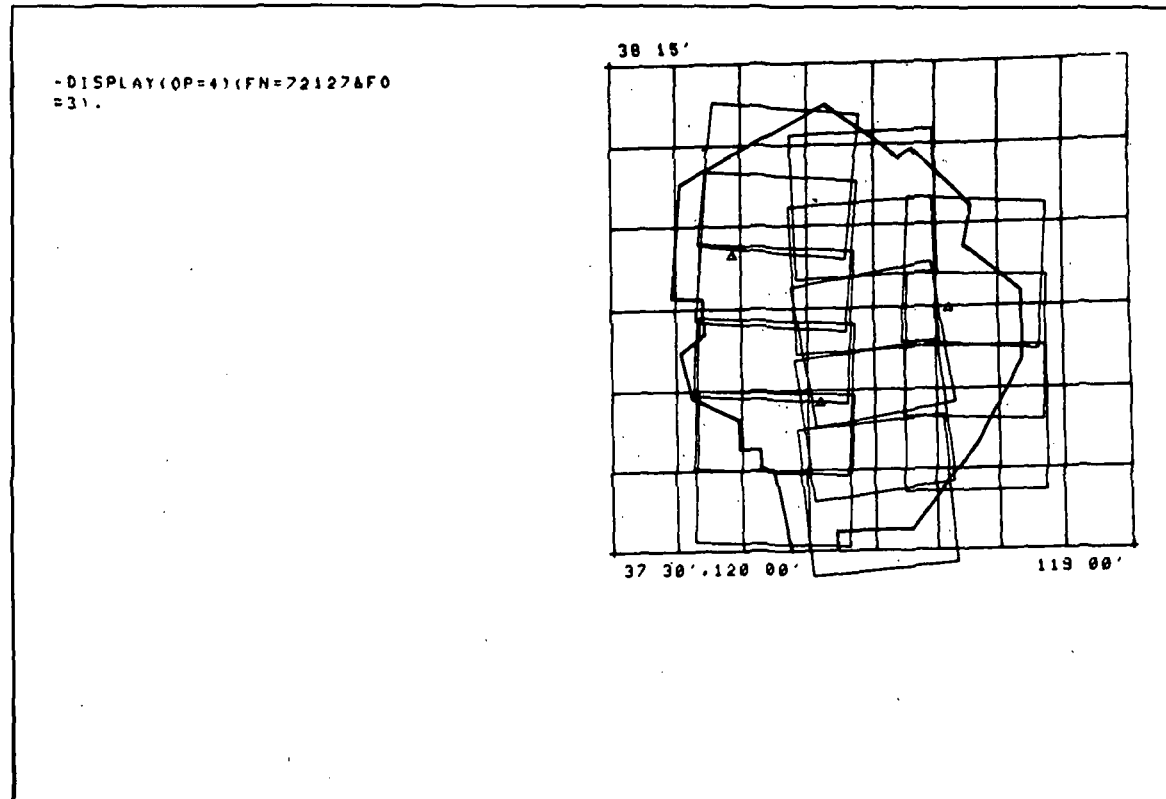


Display Description:

Display option 6 allowing crosshairs interrogation of the data file is requested. The Boolean expression after the display command limits the data displayed to that of format 3 and film type 3. The skewed rectangle inside the boundary is the outline of a frame selected by the crosshairs. The X's are the frame center points.

Figure A-10.

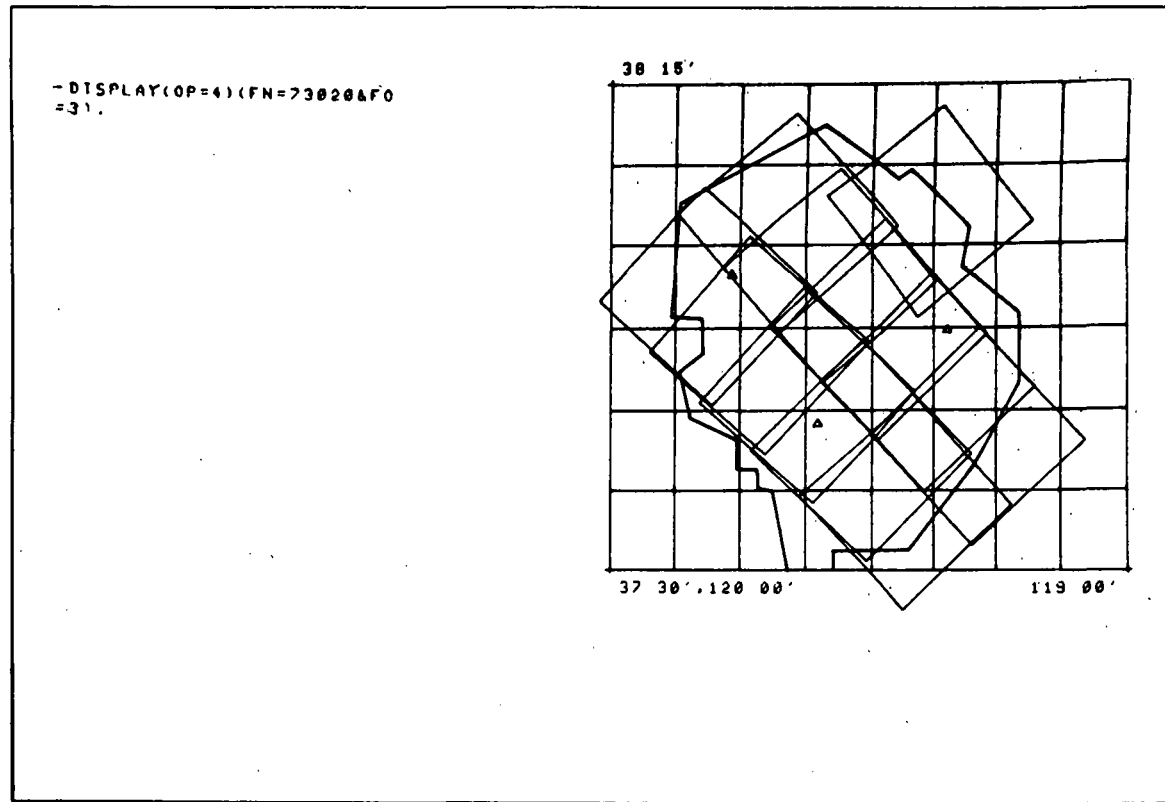
Interactive Graphics Frame Selection.



Display Description:

Display of frame coverage for format 3 (9" x 9") imagery on flight 72127. Other images in the data file not meeting these requirements are not displayed.

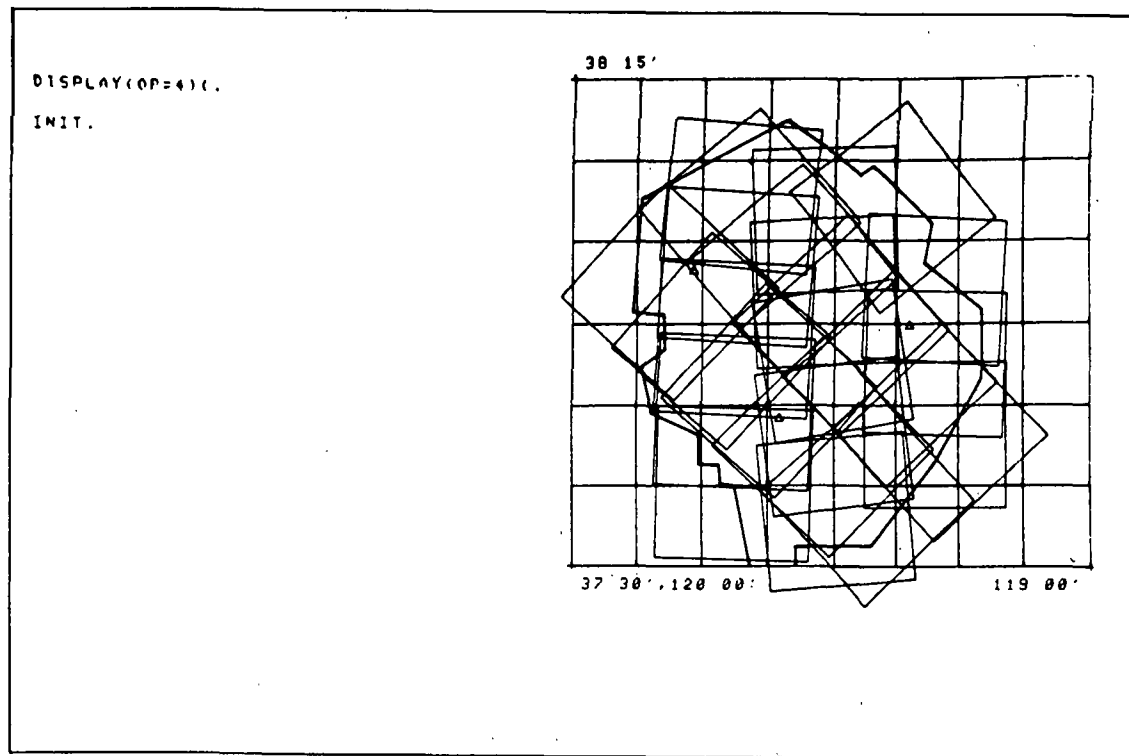
Figure A-11. Coverage Plot for One Flight.



Display Description:

Display of frame coverage for format 3 imagery on flight 73020. Note how this display differs from figure A-11 as a result of changing the flight number.

Figure A-12. Coverage Plot for a Second Flight.



Display Description:

Display of all frame coverage for this file. This display gives all the coverage shown in figures A-11 and A-12, and in addition, gives the coverage of those flights not requested previously. Note that the specification of a Boolean expression on the previous displays did not alter the data file.

Figure A-13.

Composite Coverage Plot.

IMAGE SELECTION SYSTEM----OUTPUT OF SELECTED FRAMES														
AN	FN	DATE	BN	CEN	LA	CEN	LOW	CC	QU	SI	FO	FT	AT	SC
9628037	73020	A 73051	1751001	37	36'	.119	26'	0	1	16	3	3	1	125
5651936	72127	A 72209	1720017	37	35'	.119	29'	0	1	17	3	3	1	120
5651943	72127	A 72209	1720024	37	38'	.119	41'	0	1	17	3	3	1	123
5651944	72127	A 72209	1720025	37	44'	.119	41'	0	1	17	3	3	1	123
9628036	73020	A 73051	1751000	37	41'	.119	31'	0	1	16	3	3	1	127
5651935	72127	A 72209	1720016	37	42'	.119	30'	0	1	17	3	3	1	117
9628012	73020	A 73051	1751056	37	42'	.119	18'	0	1	16	3	3	1	125
5651925	72127	A 72209	1720006	37	42'	.119	18'	0	1	17	3	3	1	118
5628034	73020	A 73051	1751078	37	51'	.119	43'	0	1	16	3	3	1	123
5651945	72127	A 72209	1720026	37	51'	.119	41'	0	1	17	3	3	1	122
9628035	73020	A 73051	1751079	37	46'	.119	37'	0	1	16	3	3	1	123
9628013	73020	A 73051	1751057	37	47'	.119	23'	0	1	16	3	3	1	125
9628014	73020	A 73051	1751058	37	52'	.119	29'	0	1	16	3	3	1	125
5651934	72127	A 72209	1720015	37	49'	.119	30'	0	1	17	3	3	1	115
5651926	72127	A 72209	1720007	37	49'	.119	18'	0	1	17	3	3	1	116
9628033	73020	A 73051	1751077	37	55'	.119	49'	0	1	16	3	3	1	123
5651946	72127	A 72209	1720027	37	58'	.119	41'	0	1	17	3	3	1	119
9628015	73020	A 73051	1751059	37	57'	.119	35'	0	1	16	3	3	1	121
5651933	72127	A 72209	1720014	37	55'	.119	31'	0	1	17	3	3	1	117
5651927	72127	A 72209	1720008	37	55'	.119	18'	0	1	17	3	3	1	114
9628016	73020	A 73051	1751060	38	02'	.119	40'	0	1	16	3	3	1	125
5651947	72127	A 72209	1720028	38	04'	.119	41'	0	1	17	3	3	1	116
5651932	72127	A 72209	1720013	38	02'	.119	31'	0	1	17	3	3	1	116
9627997	73020	A 73051	1751041	38	03'	.119	23'	0	1	16	3	3	1	121

Display Description:

On-line listing of format 3 (9 x 9) data for flight numbers 72127 and 73020. Similar listing can be produced for the off-line printer. The requestor may view selected frames on the microfilm viewer using the browse file number (BN). To review or order full format coverage, the accession number (AN) is used.

Figure A-14. On-Line Listing of Key Image Parameters.

APPENDIX B. COMMAND SYNTAX FOR THE DATA DISCRIMINATOR.

The syntax of the command language for the DATA DISCRIMINATOR is presented in this Appendix in standard Backus Normal Form (BNF).

```
<data discriminator command> ::= <command> <line terminator>
<command> ::= <filter/display command> | <data management command> |
              <utility command> | <command> . <comments>
<filter/display command> ::= <input field> - <FD function>
<input field> ::= <input file> <grid block list>
<input file> ::= <file name> | <temp file>
<temp file> ::= ε
<grid block list> ::= ε | (<number list>)
<number list> ::= ε | <integer> | <number list> , <integer>
<FD function> ::= <display> | <filter>
<display> ::= <display letter> (<boolean expression> , <option number>) |
              <display letter> (<option number>)
<display letter> ::= D | O
<option number> ::= OP = <integer>
<filter> ::= <filter letter> (<boolean expression>)
<filter letter> ::= K | E
<boolean expression> ::= <term> | <boolean expression> + <term>
<term> ::= <factor> | <term> & <factor>
<factor> ::= <item> | (<boolean expression>) | <factor> '
<item> ::= <parm> <relop> <integer> | <parm> (<integer> , <integer>)
<parm> ::= FN | FD | ED | BN | CA | CO | NO | MK | PL | SI | FO | FT | FI | SB |
          CF | ST | MR | SC | AT | QU | CC | AL | RE | SE | CE | TI | RO | FR |
<relop> ::= < | > | = | >= | <=
```

APPENDIX B. -- Continued.

```
<data management command> ::= -N|-P(<file to purge>)|  
                               <input field> - <DM function>  
<file to purge> ::= ALL|<file name>  
<DM function> ::= S(<file name>,<comments>)|G(<integer>,<integer>)|  
                  L(<option number>)  
<utility command> ::= -R(<integer>)|-I|-Q
```



POSTMASTER: If Undeliverable (Section 158
Postal Manual) Do Not Return

"The aeronautical and space activities of the United States shall be conducted so as to contribute . . . to the expansion of human knowledge of phenomena in the atmosphere and space. The Administration shall provide for the widest practicable and appropriate dissemination of information concerning its activities and the results thereof."

—NATIONAL AERONAUTICS AND SPACE ACT OF 1958

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