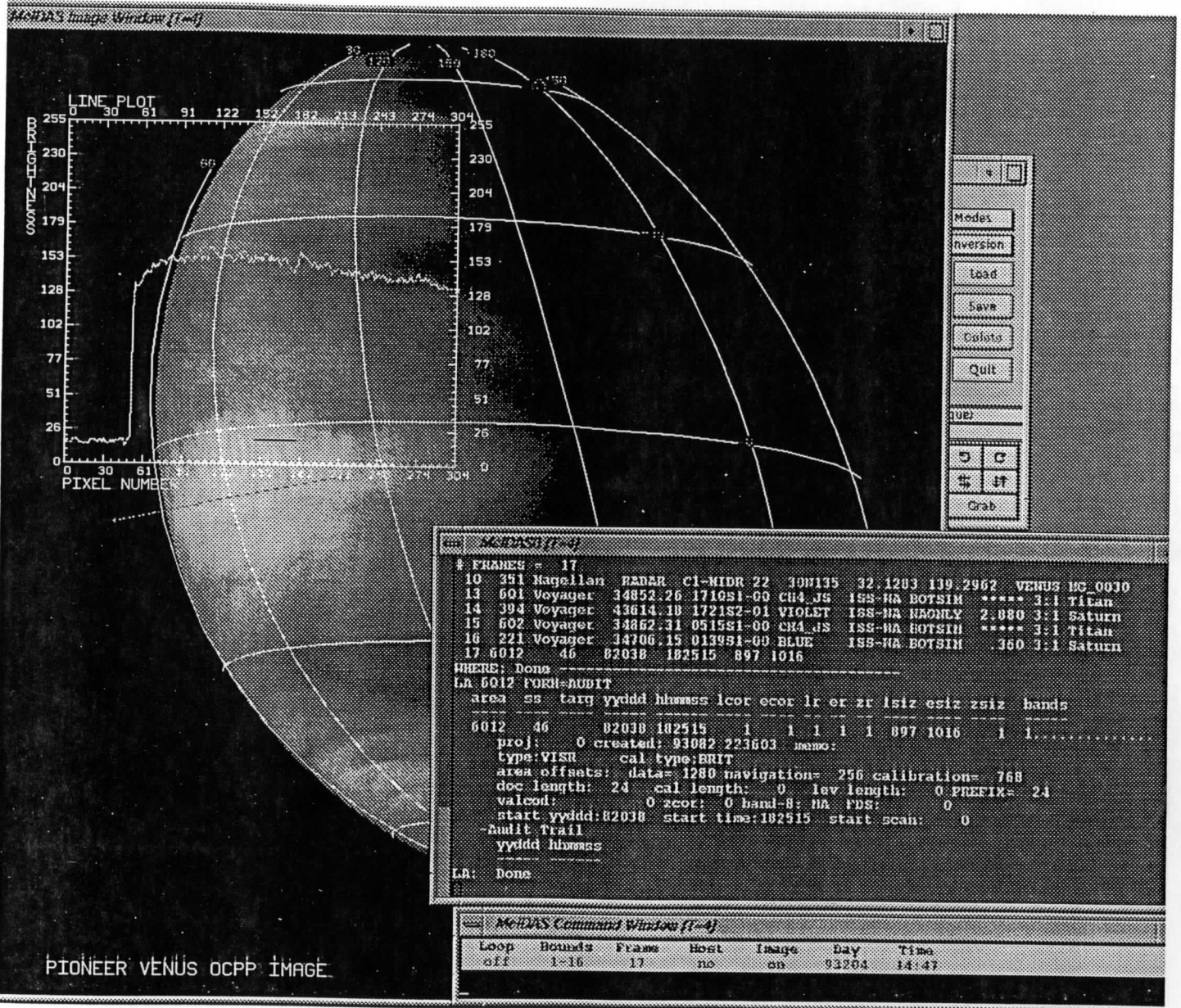


MCIDAS-EXPLORER

A PLANETARY ANALYSIS AND DISPLAY SYSTEM FOR MCIDAS-X



Space Science & Engineering Center
 University of Wisconsin-Madison

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Developed under support from the Applied Information Systems Research Program, NASA

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1.0 INTRODUCTION

This document describes **McIDAS-eXplorer**, a set of planetary analysis tools designed for the McIDAS environment. McIDAS is Man Computer Interactive Data Access System developed by the Space Science & Engineering Center (SSEC) of the University of Wisconsin-Madison (Suomi et al., 1983). Somewhat earlier, in late 1960's a similar facility was being born at the Jet Propulsion Laboratory (JPL) called Video Information Communication and Retrieval (VICAR) for analysis of the data being returned from the space probes such as the Mariner 6 mission to Mars (Castleman, 1979; Seidman, 1977). McIDAS originated as a tool for providing interactive access to the earth weather satellite data during the 1970's when there was a dearth of adequate hardware and software tools. While specific hardware elements are a key part of McIDAS, it is primarily the suite of software tools that has made it particularly useful in national and international operational weather facilities for integrating vastly different data weather sources and providing a coherent access to the user. Many of these capabilities are also applicable to the analysis of the planetary data returned by NASA's solar system missions of the past (Viking, Voyager, Magellan), current such as Galileo and Mars Observer and future such as Cassini or the Pluto Fast Flyby. However, because of the different nature of the data and target objects, many adaptations or modifications are necessary. PDADS constitutes these adaptations and includes other specific tools for analysis of the planetary data.

Describing McIDAS is analogous to the story of the five visually impaired persons describing an elephant by feeling. McIDAS is different things to different specialists. But there are a few key features that distinguish McIDAS and McIDAS-eXplorer that will become more apparent after a brief consideration of the differences in the data and applications as described below.

1.1 Data are data... or are they?

While it may appear that the remote sensing data such as images returned from LANDSAT or SPOT satellites and data from weather satellites have much in common, and hence the same analysis tools (e.g. many of the Geographic Information Systems packages) can suffice, the differences between the two are apparent in the way these data are utilized as well as in their content. These differences can be illustrated by the presence of clouds in the satellite data-- for geographic remote sensing applications the presence of clouds is a hindrance to the analysis of the underlying surface data, yet the presence of the same clouds in weather applications is used for determining the atmospheric flow and radiation budget or storm development. Further, the information for geographic applications is concentrated in the spatial and spectral domain whereas for meteorological applications the information is contained primarily in the time domain and in spatial and spectral domain for climate applications. The spatial resolution of the data as well as coverage is also a distinguishing factor. For geographic and geologic applications highest achievable spatial resolution is desirable whereas for weather and climate applications *global* and *temporal* coverage is more important than high spatial resolution.

Planetary data in general differ from both the geographic satellite remote sensing data and the terrestrial weather satellite data in several key aspects. First of all while some data is analyzed in near real time for mission sequencing and public affairs reasons, much of the scientific analysis is carried out later. The data is usually acquired over a limited period of time and is often unique. Thus while we have global weather satellite data for nearly two decades, we have less than two days worth of images of Venus from Galileo and for several weeks each year from the Pioneer Venus Orbiter. At the other extreme we have the radar investigation of the surface of Venus from Magellan at a resolution of 120 meters providing mapping of a planet that is unmatched even by the data available about our own planet due to difficulties of mapping the ocean bottom.

1.2 What is McIDAS?

Very briefly, McIDAS provides a multiprocessing software and hardware environment for multiframe display and analysis of and interactive access to any multi-dimensional data. Data is rendered onto the two-dimensional display device of the user workstation on as many frames as the hardware capabilities allow. A user interface allows as many analysis tasks as practical (limited by the workstation resources) and animation.

Currently three different flavors of McIDAS are supported by SSEC. They are McIDAS-MVS that runs under on mainframe computers capable of running the MVS operating system (i.e. IBM or compatibles), McIDAS-OS2 for IBM compatible personal computers capable of running the OS/2 operating system, and IBM-X for UNIX workstations that support the X-windows environment. The MVS environment also typically includes satellite data ingestors for earth satellite data and a variety of inputs through other communication networks to ingest other types of data such as weather forecast model outputs, conventional surface and upper air station data, surface radar data, lightning data etc. These ingestion capabilities are of course not required for analysis of planetary data. The other hardware element of McIDAS-MVS and McIDAS-OS2 versions is a SSEC designed workstation called the "Wide Word Workstation" (WWW). This workstation is controlled by an IBM PS/2 personal computer and is capable of storing displaying up to 1500 image/graphic frames in its video memory allowing animation at video refresh rates. The interface to this workstation does not yet exist for the RISC-6000 series computers although it is technically possible.

For reasons of technology and price vs. performance, the UNIX workstations from different vendors such as Silicon Graphics, IBM (RISC-6000 series), Sun Microsystems and Hewlett Packard, McIDAS software has been ported to the X-Window environment which is supported by these workstations. At the moment all of the new planetary code has been developed for the McIDAS-X environment, however, it can be easily ported to the OS2 environment.

Finally, a general observation about McIDAS is in order. By comparison with many of the commercial applications, particularly in the McIntosh and Windows 3.1 domains, the user interface used by McIDAS may seem dated. The primary reason why the interface has not yet changed is that McIDAS is used at many operational meteorological facilities throughout the world as well as colleges and universities in the US. The hardware environment McIDAS is used under ranges from IBM compatible personal computers based on Intel 80386 (or later processors), UNIX workstations and mainframe computers running MVS operating system (with SSEC designed and built workstations). The existence of a diverse user community implies user support and performance across platforms. As the port to the X-environment matures the interface will be eventually modernized as more and more users move to the X-Windows environment.

1.3 What is McIDAS-eXplorer?

McIDAS-eXplorer is a software enhancement package for McIDAS (currently only for the X-version). This is intended to provide support for analysis of planetary data acquired by NASA's numerous solar system missions. As the missions to different planets have different instrument systems, the planetary data spans a large range in terms of data quantity, type and global coverage. It is neither possible nor desirable to provide support for all types of data. The strength of McIDAS is in its ability to interact with satellite data for geophysical applications such as multispectral imagery, surface network data and atmospheric soundings. To that extent the enhancements described here provide support for planetary image data from missions such as Mariners, Vikings, Pioneer, Voyagers and Magellan as well as from Hubble

Space Telescope. In addition, other planetary data such as Magellan altimetry data, Pioneer and Mariner 9 Mars occultation profiles, Voyager IRIS can also be accessed and processed.

The tools developed to ingest the different data into McIDAS and specific planetary applications are described herein. Thus the user also needs access to the McIDAS-X User handbook to be able to utilize the standard McIDAS capabilities.

In the past the different missions usually provided the data in the form of Experiment Data Record (EDR) tapes. Supplementary navigation data required to analyze these data were provided as Supplementary Experiment Data Record (SEDR) tapes. The process of using these data for analysis required custom software for each mission and each instrument. Fortunately the situation is much improved now with the advent of the CD-ROMS. Much of the planetary data is now being made available through the Planetary Data System on CD-ROMS which allows at least some commonality to accessing these data. However, the SEDR data such as trajectory, pointing etc. are not yet available for all the CD-ROMS although limited data are available as SPICE kernels.

There are many capable software products available which unfortunately can be used only with specific data, particularly terrestrial data. With many successful missions to the solar system targets we now have an immense amount data collected at numerous objects that are as diverse as the airless moon or Mercury to rings of Neptune as well as comets and asteroids. The only thing common about these objects is that they have vastly different physical properties besides the fact that the opportunities to collect data on these targets from space probes are limited. One of the goals of has been to provide a unified approach to the analysis of the target dependent data by accounting for the differences in their physical characteristics such as size, shape, etc. To this end, the Navigation Ancillary Information Facility's (NAIF, at JPL) approach of assigning a unique identification tag to each object (and spacecraft for that matter) is adopted within McIDAS-eXplorer with some enhancements.

Although McIDAS-eXplorer is general enough to be utilized for most types of data, its strength is in analysis of multispectral images or data that can be visualized as a two dimensional image. McIDAS-eXplorer also has tools for analysis of atmospheric data such as temperature profiles which although are one-dimensional individually, are typically available globally for planets such as Mars, Venus. The Infrared Radiometer Interferometer Spectrometer (IRIS) instrument on Voyager 1 and 2 provides spectra for the giant planets from which temperature profiles have been derived.

Object Identification

The (NAIF) software developed at JPL uses an identification number for each solar system object for ephemeris purposes. This same number is used within McIDAS-eXplorer but with a small modification. This identification process serves another purpose besides naming the object in the image-- it is used to retrieve the object's physical constants (radii, length of day etc.). In most cases the planetary data refers to a single target object such as a planet or its satellite or ring system. Occasionally however there can be multiple objects in a single frame such as the images of a planet and its ring system or a satellite in the same frame. In such cases the decision on which NAIF identification number to use within McIDAS-eXplorer is made on the basis of which single object is being analyzed in that frame.

Another complication arises in investigating images of bodies with extended atmospheres such as Venus or Titan. The visible or infrared images of these planets do not "see" the surface but only the cloud-top level, which is about 65-70 km above the surface for Venus and nearly 300 km for Titan. Thus the effective radius for such objects needs to be different

for the purpose of not only image navigation (the process of relating the image co-ordinates to the planet's co-ordinates and vice-versa), but also for measuring distances etc. For this reason McIDAS-eXplorer distinguishes between the solid surface and the cloud level. Further, this level can be different at different imaging wavelengths such as for Saturn, therefore allowance is made for having as many as 9 separate radii for different levels for objects with atmospheres. The NAIF identification code for an object is entered as a four-digit number rather than as a three digit number. with the rightmost digit denoting the level for which the radius is defined. Thus, for Venus, the NAIFID value of 299 is modified to 2990 for the solid surface, and 2991 for the cloud level at the first wavelength, 2992 at the second wavelength etc. The mnemonic identification is also suitably modified as appropriate, for example, to Venus_sfc or Venus_atm.

Object specific physical constants are required for analysis are obtained through a single subroutine BODCON. This subroutine contains the most-recent published values of the triaxial radii and the length of the day for solar system objects. If any of the data need to be updated, then this subroutine needs to be recompiled after the required changes, and all of the planetary code needs to be relinked as well. This is done as a matter of precaution to ensure that the fundamental constants are not changed inadvertently (as is possible if the constants were loaded from a data file-- there is no simple accountability if the file gets modified).

1.4 McIDAS-eXplorer Workstations

The foremost requirement for McIDAS-eXplorer is to have convenient access to the current and future planetary datasets. Data from missions such as Voyager (giant planets), Viking (Mars), Galileo (Earth and Venus) and Magellan (SAR imagery of Venus and surface altimetry, reflectivity, emissivity) data are available on CD-ROM's through the Planetary Data System. The workstations required to use McIDAS-eXplorer are the ones that can run McIDAS-X with the exception that a CD-ROM reader needs to be available either locally or over a Local Area Network (LAN). A typical configuration is a UNIX based workstation (SUN, SGI, IBM/RISC-6000, HP) with 32 mb or more memory, 1 Gb or larger capacity disk, and a DAT or an Exabyte tape drive in addition to the CD-ROM reader. A color display, preferably with 24-bit display capability is desired but 8-bit display support is adequate for many applications. Similarly, a CD changer such as the Pioneer DRM-604X can also be useful to provide access to as many as 6 CD's simultaneously (not synchronously of course), but not necessary, and of course can be expanded through the SCSI interface to handle as many as 48 CD's on-line, up to 8 of the minichangers (daisy-chained to the SCSI port) simultaneously.

1.5 McIDAS-X User Environment

McIDAS-eXplorer is a set of specific commands or applications programs that can be run under McIDAS-X and familiarity with McIDAS-X workstation environment is useful. McIDAS-X capabilities, installation notes can be found in the Users Guide available from SSEC. For novice users a brief introduction to the McIDAS concepts is given here.

Starting and ending a McIDAS session

At the console login, enter the user ID and the password to log onto the workstation. The user ID and the password are created by the system administrator. At the system prompt type McIDAS to start a McIDAS session. To close a McIDAS session, i.e. to log off, press CTRL-ALT Backspace keys on the keyboard by pressing and holding down the CTRL and ALT keys simultaneously and then pressing the Backspace key. Follow with CTRL-D key sequence to finish the log off procedure.

If the X-server is not running, start it with xinit. To start McIDAS, simply enter at the prompt:

```
mcidas
```

from your home directory. This initiates execution of the mcidas profile file which sets the display environment flags such as # of bits displayed, number of frames created at start-up, size of the display frames etc. The contents of the profile are described in the McIDAS-X User's Guide. Note that it is when starting a McIDAS session that the frame size and the number of gray levels displayed gets set (leave it at 128 unless the workstation has more than a single 8-bit display plane).

Note that the frame size defined here is the McIDAS display frame size. The X-window within which this display appears is initially set to this size and should normally not be changed. Once the McIDAS session has started, expanding or shrinking the display window (or the "image" window for McIDAS) has no real effect on the amount of data displayed by McIDAS in that window. Thus the frame size should be set to the largest size of the image that needs to be seen at the full resolution since by integer sub-sampling larger images can be seen in a small display frame.

McIDAS-X creates several "windows" when a session is started, typically, four. One of these is a "command" window which also includes a status line (Figure 1) and is the primary user interface to McIDAS. There are two text windows ("1" and "2") which are made active by clicking in the particular window or from the numeric-keypad by pressing "1" or "2" key. These two text windows contain output from McIDAS commands. The fourth window is the image display which is sized according to the frame size specified in the start-up procedure.

McIDAS Display

Since the prime motive behind McIDAS is the analysis of data acquired in the temporal domain, animation is a key feature, and thus McIDAS uses multiframe display capability. The image data are displayed on a "frame" which can contain either image or graphic data. The frames can be any size as desired and each one can be of a different size. If the frame size is larger than the screen size then the screen provides a scrollable window into the displayed frame and can be moved with the mouse. Frames can also be dynamically added to a session (as allowed by available system memory), but at the moment they cannot be unloaded to free up memory without exiting a McIDAS session. On UNIX workstations the number of frames to configure and their sizes are specified by the user (in the profile) as constrained primarily by the amount of random access memory (RAM) available in the workstation.

The user controllable frame size is useful to optimize the number of display frames for the specific data being analyzed in that session. Even if animation may not be a desire, a large number of frames are still immensely useful in streamlining an analysis session by eliminating the need to erase and re-draw graphics as well as by keeping them around for reference. The planetary image data available on PDS CD-ROMs range in size from 800 x 800 for Voyager and Galileo to 1024 x 1024 or larger for Magellan products, a considerable difference in frame size and memory requirements.

The display frame contains much more information than just the visible image in McIDAS environment. For each frame that contains an image, McIDAS keeps track of the image source, its calibration, and, most important, the navigation. Overlay graphics can be drawn which can also be dynamically saved in separate graphics files for re-display later.

This is particularly useful in the X-environment wherein "peelable" graphics are not yet possible or implemented on most workstations. Thus, if any changes are required in the graphic frame, the entire contents have to be erased and re-displayed.

McIDASese - Not quite a language but a syntax of its own

At its core, McIDAS and McIDAS-eXplorer are command driven and not menu-driven. A certain familiarity with the command syntax is thus necessary. In future versions the emphasis on command language is hoped to be minimized through the use of windowed choices. Until then the grammar needs to be understood.

Typically a process can be performed with a command entered in the command window from the workstation key-board. A command may or may not have any arguments, have positional parameters or keywords or both. The positional parameters are generally restricted to certain "obvious" situations (but that is peculiar to the programmer!) while keywords are used to specify other specific inputs. Such keywords are used by typing the keyword exactly (ALWAYS in upper case) followed by a comma or the equality sign ("=") followed by the value. A keyword may accept as few as one or as many as 32 values entered consecutively on the command line. The McIDAS-eXplorer commands are expected to check the specified keywords for validity, if any are misspelled or extraneous to the command, an error message is printed out and the process is not executed. The keywords come in two varieties- global and command specific. The "global" keywords are generally recognized system-wide, and share some commonality in use. Examples are DAY= and TIME= or DEVice=. Generally the global keywords require only the first three characters, but command specific keywords may check the entire keyword.

Caution: In McIDAS-X the commands name can be entered in lower case (although not recommended) but all keywords **must** be entered in UPPER CASE!

The positional parameter is most often used to indicate to an applications program the *area#* containing an image of interest. Often it is desired to modify one image by some process and retain the original as well. The syntax most often used (and almost invariably in McIDASese) is to specify in input *area#* first and the output *area#* second. For example a command with a syntax given as:

```
REMAP from_area to_area and entered as  
REMAP 101 102
```

will remap the image contained in the file specified by the positional parameter *from_area* (*area#* 101 in this example) and write the output in the file specified by the second positional parameter *to_area* (*area#* 102) using the navigation transforms defined for the two areas. The actual file names for the two areas are AREA0101 and AREA0102, but the user seldom needs to worry about the exact names except for system administration purposes.

A simpler example of the positional parameter is when only a single parameter is required, such as in the LA command to list the directory for a given area (so one can find out what the contents are!):

```
LA 101
```

which produces a single line of output in the text window like:

If this is not sufficient, one can make use of the keywords for this command to produce additional output by keying in:

LA 101 FORM=AUDIT

which queries the area to produce the audit trail for the image contained in the Area 101 and the output may look like:

```

area ss yyddd hhmss lcor ecor lr er zr lsiz esiz z bands
-----
101 48 89214 83159 1 1 1 1 1 800 800 1 1.....
proj: 0 created: 93048 191147 memo: ---CDROM DECOMPRESS---
type:VISR cal type:BRIT
area offsets: data= 9040 navigation= 256 calibration= 2816
doc length: 36 cal length: 0 lev length: 0 PREFIX= 36
valcod: 0 zcor: 1 band-8: NA reel#:*****
-Audit Trail
yyddd hhmss
-----
PICNO= 0338N2-023 TARGET= NEPTUNE
FDS= 10706.02 CAMERA= NARROW ANGLE SPACECRAFT= VOYAGER
SHUTTER TIME= 89214 83159 NAONLY
FILTER= GREEN (5) EXP= 15.3600SEC. GAIN= LOW
LINES= 800 ELEMENTS= 800 SCAN= 5:1 EDIT=

VCDROM: Internal Parameters and Defaults:
SOURCE = /cdrom/neptune/c1070xxx/c1070602.img
FDS-START = 1070600
FDS-END = 1070700
TARGET = neptune
CAMERA =
FILTER =
SEARCH_INDEX= 0
OUTPUT_AREA = 101
93048 191155 VCDROM FDS= 10706.00 10707.00 AREA= 101 TARGET= NEPTUNE
93119 175624 RF 101
93119 175657 FILL0 101
93119 175727 RF 101
93119 175813 SEDRIN 101

```

Some commands which require no arguments at all. One example is **EXIT** which shuts down an active McIDAS session and closes all active McIDAS windows. Then there are some single-letter commands which can be alternately entered using the ALT-key simultaneously with another key. These commands do not require a [CR] if entered using the ALT key, and generally control the display state. Examples are the 'A' and 'B' key commands which respectively advance or back-up the display to the next frame in the sequence.

McIDAS also makes use of user defined string tables to facilitate simpler input to application programs as well as argument passing between different application programs. These string tables are created by a simple string editor and stored in the user profile and can be

saved and deleted. Multiple versions can be stored under different names for different applications and can be shared with other users. Besides the single command execution or action of application tools, McIDAS applications can be executed in a sequence for repetitive tasks in one of two distinct ways. One of them is as a macro command that is precompiled. A McIDAS macro program accepts as input standard FORTRAN statements with some exceptions and can call other McIDAS applications. Once compiled, the application executes the sequence described within the macro.

The second way of simplifying repetitive tasks is to use the REPEAT command, which executes a command string a given number of times with any number of numeric arguments. For example:

```
TE "MAPIT !1 !2 MERGE=YES; DF !2 1
```

```
REPEAT MAPIT 100 TO 200 BY 1 300
```

will map images contained in areas 100 to 200 and map into a given projection and merge the output into a single output area (# 300) and display the result after the addition of each image on frame 2. This sequence is useful for making mosaics from Magellan framelets or tiles.

Hardcopy Text or Image output

There are several ways of obtaining hardcopy text and image (gray-scale or color) output from McIDAS-X. The simplest means of obtaining a print copy of the McIDAS command output is to use the redirect capability offered by the DEV keyword. The output can be directed either directly to the workstation printer, or to a file, simply by appending any command by **DEV = P**, or **DEV = F filename** respectively. The text file can then be printed from the X-window by any of the methods. Note that this file is an LW file (which really means that it lacks the carriage-return LineFeed sequence) and must be converted to a DOS or a text file by using **DOSTOLW** command and then sent to the printer. One possible is to use *enscript*:

(In the McIDAS Command Window):

```
DOSTOLW filename text_file  
OS "enscript -2rG filename
```

which will print the file as facing pages in the landscape format.

If a complete log of the McIDAS worksession is desired, user key-ins and the McIDAS output can be also be copied to a log file using the **TFILE** command to open and close the log files at appropriate times as desired:

```
TFILE OPEN filename
```

```
TFILE CLOSE
```

The file can then be printed as before from the X-window using the operating system commands.

A third means is to use a screen capture device to print out the screen display which may or may not include gray-scale or color images using such as a TOYO printer which is connected to the display device of the workstation.

Finally, the image displayed on a McIDAS frame can be printed by saving it as a .GIF format file using the **SVGIF** command. The .GIF file can then be saved as a PostScript file using the **XV** utility from a X-Window session, either as a color image or as a black and white image. The PostScript file containing the image can then be sent to the system laser printer to get either a black and white gray-tone image, or to a color printer such as the Tektronix to obtain a color print:

```
lpr -Pr gb filename
```

The .GIF file can also be exported to other systems such as high resolution cameras or image editing programs to add annotation, change color balance etc.

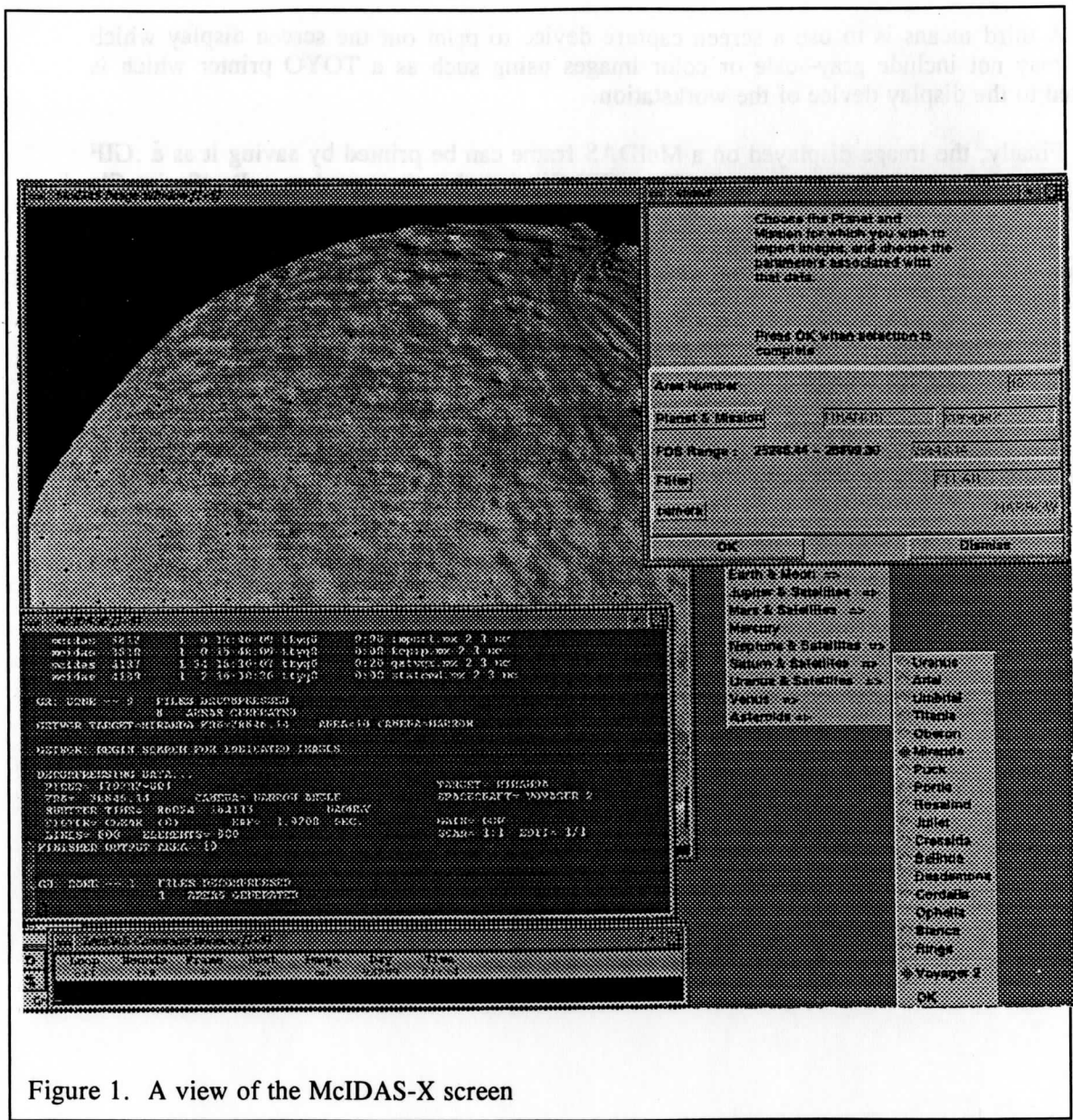


Figure 1. A view of the McIDAS-X screen

Frequently an X-window is also required for direct interface to the operating system, although most commands can also be sent to the operating system from the McIDAS command window through the OS command followed by a string (i.e. preceded by the double quote symbol, ") containing the operating system command syntax. Exceptions are commands that require authentication, as the "su" command.

OS "pwd (queries the system for the current directory).

The output is directed to the current McIDAS text window:

```
/u1/mcidas/data
```

McIDAS-eXplorer adheres to the general McIDAS-X conventions for the file system. Thus the data ingested normally resides in the /mcidas/data directory and the source is in

/mcidas/src directory, etc. Specific formats for storing and accessing the data are specified under McIDAS-X such as image data (two or three dimensional), gridded data (two dimensional gridded data sets e.g. output of numerical models) which is usually much more granular than the image data, and other single dimension data types such as time series, etc. The exact implementation of the different formats are dependent on the native operating system, but McIDAS-X provides a transparent and a common interface between the applications software and the native operating system. For both the gridded and the image data sets a directory service is provided to query the contents of the file. Other utilities allow contents of the areas and grids to be viewed appropriately. McIDAS-eXplorer uses certain extensions for planetary applications which are compatible with McIDAS-X.

System Status

As McIDAS-X is a multiprocessing environment, several one application programs can be executed simultaneously. The respective output can be directed to separate text windows or files. Some of the applications, such as multispectral classification of large images require significant processing time even on fastest workstations. It is useful in such instances to determine the active applications. A command (SHFT-?) provides a current snapshot of the processing load at any instance, and an abort mechanism also exists to abort a user process from within McIDAS-X.

Scheduler

McIDAS-X has a scheduler capability to execute a sequence of commands at a predetermined time in the future. Although this is most useful in real-time environments for acquisition of data, the facility is useful to schedule processing resources intensive tasks at times when the workstation may be otherwise idle or less stressed.

Batch processing of commands

A facility to execute commands from a file allows systematic, repetitive processing of data effortlessly. Any McIDAS command can be entered in a text file just as it would be entered from the key-board. The commands in the file can be executed using the scheduler capability or started from the key-board with the **RUN file_name** command. The file can be created using any text editor available on the workstation and should normally be in the /mcidas/data sub-directory.

Programmable Function Keys

Often used commands can be invoked quicker with the capability of programmable function keys. The 12 function keys available on most workstations are named KEYF1 through KEYF12 and can be programmed using the **TE** command with a specific command, e.g.:

```
TE KEYF1 WHERE FRAME 1 4  
KEYF1 = WHERE FRAME 1 4
```

Anytime the function key F1 is pressed, the programmed command is executed. It is also possible to assign multiple commands to a single key by separating them by a semi-colon:

TE KEYF10 "?;WHERE AREA 100 110;LISTDDB 10;OS "ls /cdrom

Pressing the F10 key will initiate the sequential execution of the four commands assigned to that key and will first provide the McIDAS processor status, list contents of areas 100 through 110, list the Data Description Block (DDB) for area 10 and send a command to the native operating system to list the directory of the /cdrom directory.

Environment Table

An environment table capability enables keyword parameters to be passed to commands that use that keyword. The environment table basically consists of keywords used by McIDAS commands which can be assigned values using the TE command. A McIDAS command will 'read' this table to scan if any of the keywords used in that command exist in the table and use the value assigned if the keyword exists in the table. If the keyword is also entered via the key-board as part of the command, then that value takes precedence over the environment table value.

TE DAY "79006

If the LA command is then entered from the keyboard with a certain range of area numbers to list, then only the ones that contain images acquired on day 6 of 1979 will be listed as DAY is a valid keyword for LA.

The environment table can be listed with the TL command and saved/restored in/from a named file with the TU command. Thus a user can create multiple environment tables for different types for data analysis and use any that is appropriate. Only one environment table is active at any time.

2.0 IMPORTING DATA into McIDAS-eXplorer

Most of the planetary data analysis takes place from "archived" data as opposed to "real time" data which is more typical with earth meteorological satellite environments. The most common format now for the archived planetary data is the CD-ROM. Appendix I contains a list of the data available through PDS in this format. One notable exception is the HST WF/PC data which is available only on 9-track or Exabyte tapes.

There is another format of data input/output from Digital Audio Tape (DAT) cartridges available from within McIDAS-X. If a DAT drive is available on the system, then McIDAS areas can be saved as individual files on these cartridges and restored later. This is a fairly attractive method for short/long term archiving of processed data as these cartridges can hold up-to 8 Gbytes (compressed) of data. Thus as the McIDAS work-space gets full, the image areas can be stored and restored as desired.

McIDAS-X stores image data in files called "areas" all of which have names of the form "AREAxxxx" where xxxx is a four-digit number. Each "area" contains one single image which can be multibanded. As many as 9999 areas can be accessed by McIDAS from the "/u1/mcidas/data" sub-directory. This sub-directory can be thought of as workspace for McIDAS-X, and needs to be large enough to accept the data to be accessed as well as for any output created, and typically this is the largest directory.

2.1 Reading data from PDS CD-ROM's

Most versions of UNIX require that a CD-volume be mounted before it is recognized by the system, and McIDAS-X is no exception. Here is how to mount and unmount the CD's:

changed

(physically remove the CD-ROM in the drive if there is any) and insert a new CD into the CD-ROM reader, and then click with the left mouse button in the active text window to finish the mount process. The CD-drive light should go on to read the directory which indicates that the command has taken effect

At this point the data from the particular CD inserted into the reader is accessible from within McIDAS-eXplorer though specific commands.

2.2 McIDAS-eXplorer Commands

A variety of tools are available to manipulate the data within McIDAS-eXplorer. For solar system image data these include geometric and radiometric calibration, filters of various types, navigation and cartographic projections, image enhancement, multispectral classification, time series analysis, area and distance measurements, cross-sections etc. Map outlines and gazetteer files provide ability to visually identify the geographic features. General purpose utility applications provide housekeeping functions and for data migration.

Two dimensional irregularly spaced data can be objectively analyzed onto grids and gridded data themselves can be graphically displayed via contour plots and cross-section plots as well as rendered into images. A basic spread sheet capability for grids allows arithmetic operations on the gridded data to compute other derived quantities.

Spectral data can be displayed, averaged and staged for further processing as desired for temperature retrievals or other analysis such as horizontal fields at specific vertical levels or vertical cross-sections. Multispectral data such as from the Galileo NIMS instrument which

have very many spectral bands compared to most imaging instruments would normally be handled as multibanded images, but some small modifications would be required in some of the applications, e.g. those that list the contents of an area and also indicate which bands are present.

McIDAS-eXplorer Tools

When fully developed, McIDAS-eXplorer will have tools to import, process and analyze planetary images from PDS CD-ROM volumes. Currently Voyager images of the giant planets and their satellites and ring systems, Magellan SAR images of Venus surface, Pioneer Venus Orbiter Cloud Photopolarimeter images of Venus clouds can be calibrated (shading and geometry) and navigated. Support for other data products such as Galileo SSI images and hopefully Mars Observer will be added in the near future. Once these data are imported within McIDAS-eXplorer, they can be gridded, map projected, animated, brightness normalized and filtered. Three color composites and multispectral classification of up to six bands are possible. Calibrated and navigated image data can be used for areal, cloud motion and other measurements using general tools.

Although many of these commands are quite general in that they can be used for data from any solar system object or spacecraft mission, some of them are very specific to a particular mission and data. For example, there are a set of specific commands that are limited to data from Voyager 1 and 2 missions to perform tasks related to the analysis of the images which have very specific properties requiring specific processing. Similarly the Magellan SAR and topography data have a set of commands that are not useful to any other data. Such mission specific commands are to be described in Section 3.

The McIDAS-eXplorer commands available currently are described in Section 4 in detail. All the core McIDAS-X commands are still available of course and are documented separately at this time. An alphabetic summary of what these commands do is given below. (*Future versions will have this list organized by functions*).

- ASTAT** - Measure image statistics from a displayed image e.g. histograms, outlines, etc.
- BOTSIM** - Navigate simultaneous Wide-Angle/Narrow-Angle Voyager Image pair with one of them navigated.
- CALCMA** - Calculates Transform Matrix for Planetary Navigation for framing camera image navigation. Currently it is set up for Voyager images only.
- CHANGECD** - Unload/load or load/unload CD-ROM in the CD-ROM drive from within McIDAS. **The disk of course has to be manually removed and replaced!**
- COMBIN** - Make a multiband area from several single band area. May also be used to reduce 2-byte data to 1-byte data using the calibration constants in the area directory. Useful for multispectral classification, remapping of multi-filter images such as Voyager or Viking.
- CONFIT** - Fit a general conic to a set of points stored in a limb points file created using the key-in **LIMBPT**. Primarily useful for planet center determination if the pointing data is accessible. Constrained fits are also used if the planet orientation and size are known.

- DSTNCE** - Measure distances on any navigated solar system image either between a pair of points or along a trajectory to determine the cumulative distance and segment lengths.
- EDGES** - Determine the location of the bright limb of a planetary image using the maximum local brightness gradient method and write the locations in a file (LIMBxxxx, where xxxx is the four digit area number. Usually a first step in image navigation (see **IMGCTR** and **PLANAV**).
- ELLIPS** - Draw signature ellipses from a USCLAS spectral classification to see the spectral class distribution.
- EXPDOC** - List the User guide and command help documentation in an X-Window that can be scanned using vi editor commands.
- FILLO** - Fill in the alternate line data compression gaps in Voyager 2 images of Uranus and Neptune by interpolation across lines for each missing element.
- FINDALT** - Determine on which PDS CD-ROM volume Magellan Altimeter data from a particular orbit can be found. *As yet there is no command to determine the orbit number corresponding to a given Venus location.*
- FINDFF** - Locate Magellan MIDR framelets containing a given geographic feature or a latitude-longitude region
- FINDVGR** - Search the CD-ROM index file(s) for a Voyager image to determine which CD-ROM & sub-directory it resides on. The index is in /mcidas/data/ sub-directory.
- FILLO** - Interpolate zeroes in scan lines due to data compression in Voyager Uranus/Neptune images which are compressed using the alternate side compression scheme, by interpolation across lines.
- GEOM** - Remove the geometric distortion in a Voyager image for which the reseau locations have been measured (RF command) and write a new area .
- GETALT** - Read Magellan Radar Altimeter CD-ROM (ARCDR's) Altimetry Data Files (ADF's) and plot the data (along the orbit track) on a displayed Magellan SAR image.
- GETCPP** - Import Pioneer Venus Orbiter Cloud Photopolarimeter (OCP) images from NSSDC tape archive files into McIDAS areas.
- GETFITS** - Import an image stored in a FITS format file into a McIDAS area. Useful for importing earth-based telescopic images of solar system targets.
- GETMGN** - Import a Magellan Mosaic Image Data Record (MIDR) image from CD-ROM into a McIDAS area.
- GETVGR** - Import compressed Voyager 1 or 2 images from CD-ROM and write a McIDAS area containing that image.

- GETVO** - Import Viking Orbiter 1 & 2 Mars images from CD-ROM into McIDAS areas.
- HSTTOMC** - Import Hubble Space Telescope WF/PC image from a FITS format tape-file into a McIDAS area.
- HSTKNIT** - Combine the 4 panels (800 x 800) of a HST WF/PC image into a single one (1600 x 1600) using specified co-ordinates.
- IMGCTR** - Determine the center of a planetary image for which limb points have been written to a file (LIMBxxxx, where xxxx is the area #) using the EDGES command (or any other process if the file conforms to the format) by using a general conic fit. The image center, the two axes, the orientation of the ellipse and the eccentricity of the ellipse are returned. These values can be used in the PLANAV key-in to attach navigation to an image (e.g. ground based for which SPICE kernels may not be available) if applicable.
- IMGTS** - compile or display a file containing a time series of data from digital areas
- INSDDB** - Attach to a McIDAS area without the extended Data Directory Block (DDB) and create a new area with the mandatory part of the DDB filled. Used with "old" areas or those imported from the mainframe.
- LIMBPTS** - Locate the planet's bright limb interactively using directional derivatives from displayed image and store the points in a file. Primarily useful for planet center determination (CONFIT) for the purpose of image navigation. (**Renamed PLAEDGI**)
- LIMPRO** - Plot radial scans of data from a planetary images from the planet center to the planet limb. (*Not yet released..7/31/93*)
- LISCOM** - Lists contents of PLAN navigation common from navigation blocks. Useful for debugging navigation programs.
- LISTAUD** - List audit trail for a McIDAS area.
- LISTDDB** - List the various Data Description Blocks (DDB) such as planetary SPICE navigation block, etc. for an area.
- LOCATE** - Plot as an overlay graphic on a navigated image display the co-ordinates of points from a text file.
- LP** - Line-plot of Image Data at Cursor Location or between any two points on a displayed image.
- MCLIMB** - Simulate view from orbit of a planet from a nadir looking instrument and plot instrument IFOV's.
- MDCLAS** - Spectrally classify a multi-band image
 - MDM CLASSIFICATION USING .SIG STATISTICS ---

- MINFIT** - Determine Minnaert scattering Coefficients (I_0 and β) for a navigated planetary image ($I = I_0 \mu \mu^{\beta}$) by both least squares and minimum absolute deviation methods.
- NAVCHG** - Poke parameters manually into the PLAN navigation block. Mostly used for debugging navigation code.
- PHYSCON** - Program to obtain the Physical constants of an object. Either the NAIF ID (preferred) or its name (capitalized) can be entered. Radii and length-of-day are currently listed.
- PLAEDG** - Determine a limited number of limb points for a planetary image for the purpose of navigation.
- PLANAV** - Create a general perspective view navigation codicil for a given area for any object.
- PLAREV** - Flip the longitude convention for the navigation created using PLANAV. *This is required for earth views because of the McIDAS longitude system convention which is opposite to the general planetary longitude convention.*
- POLEN** - Refine the C-matrix for a Voyager image by using a known star which can be located in the image. Will also optionally determine the pole position for Neptune.
- REDISP** - Re-display a displayed frame from the original given area at the cursor co-ordinates on the same or another frame using an integer blow-up or blow-down factor. Similar to BU on the McIDAS-MVS system.
- RESEAU** - Lists and/or plots reseau data for Voyager spacecraft
- RESREM** - Remove the reseau marks in Voyager images by interpolation of brightness from their immediate neighborhood.
- RF** - Determine the locations of the reseaus in a Voyager image which may or may not be displayed
- SEDRIN** - Reformat SEDR data into navigation block for raw image
- SEDRRD** - Load Voyager SEDR tape file records into LW file
- SHADE9** - Remove the photometric distortion in a Voyager image if the appropriate dark noise frame and the shading file for the specific camera/filter combination is available in /mcidas/data sub-directory and write the output in a new area.
- SPICEIN** - Reformat SPICE data into navigation block for planetary image)
- STRIPX** - Strip or fuse an area into or from the DDB and image data component files (DIRCxxxx and IMAGxxxx, where xxxx is the original 4-digit area number. Currently used for data compression experiments.

- TGET** - Restore one or more McIDAS area files from tape to disk (i.e. in /mcidas/data sub-directory) from a DAT or an Exabyte cartridge written using TPUT.
- TILES** - Displays the framelets or tiles that make up a Magellan browse image created from C1-MIDR's as a grid pattern and numbers the tiles. Normally started by MCDROM during retrieval of browse and full resolution images. Will scale the displayed image to the frame size by integer sampling appropriately.
- TLST** - Lists areas on a tape written by TPUT. SCSI tape drives only (either DAT or EXABYTE). Use TGET to restore data from tape to disk in the /u1/mcidas/data sub-directory.
- TPUT** - Save one or more McIDAS area files from disk to tape (i.e. in /mcidas/data sub-directory).
- TRIM** - Trim the spline-sized rectangular edges at the limb of a remapped planetary image. (*Renamed PCROP I*)
- USCLAS** - Spectrally classify a multi-banded image using unsupervised multispectral classification. Currently assumes 1-byte per spectral band data. 2-byte data can be used after using COMBIN to use the calibration to convert to 1-byte data.
- VENUSF** - LISTS & PLOTS Planetary Feature names on displayed images.
- WHERE** - List frame and area contents in the text screen using data specific information.

2.3 McIDAS-eXplorer Files

A number of data files are required by some of the commands that form McIDAS-eXplorer in addition to those files required by the core McIDAS. These files exist in /mcidas/data sub-directory. McIDAS generally uses standard prefixes (always UPPER CASE!) for its standard data files. The convention is as follows:

Digital images AREAxxxx

Gridded data files GRIDxxxx

Random ordered data MDxxxxxx

In addition, McIDAS-eXplorer uses similar convention for the files used in some solar system applications programs. They are:

LIMBxxxx	Image edge points
xxxx.ET	Enhancement tables created by USCLAS
xxxx.LOG	A log file of the USCLAS multispectral classification program

There are many data files associated with specific missions and instruments that are useful in more efficient operation of McIDAS-eXplorer commands. These are also in /mcidas/data sub-directory. Their names and brief description are given below.

<i>file_name</i>	<i>Remarks</i>
acumdir.tab	Magellan Mission cumulative directory for the ARCDR data (PDS CD-ROM Volumes MG2001 through MG2015). This is the version from MG2015 volume.
attspin.pvo	Pioneer Venus Orbiter Spin axis pointing log. Needed for navigation of OCPP images.
etopo5	NGDC global topography and bathymetry file with 10 minute resolution (ibmints).
gazetter.tab	Gazetteer table for Mars from the USGS Digital Image Map CD-ROM Volumes.
geo.tab	An ASCII file containing the names of the geographic features on Venus. This file is found on all PDS Magellan CD-ROM volumes through MG0080.
jupitertapes	A catalog of Voyager 1 and 2 Jupiter EDR tape cartridges. Each cartridge contains 240 images (10 1600-bpi original EDR tapes).
mcumdir.tab	Magellan Mission cumulative directory for the MIDR data (PDS CD-ROM Volumes MG0001 through MG0080). This is the version from MG0080 CD.

- neptapes A catalog of Voyager 2 Neptune EDR tape cartridges. Each cartridge contains 240 images (10 1600-bpi original EDR tapes).
- orbele.pvo Pioneer Venus Orbiter orbital elements file (text).
- pck00003.tpc The NAIF kernel file containing the planetary physical constants and other data used by NAIF software. Other NAIF data files are also copied into this directory.
- pvocpp.img Catalog of Pioneer Venus Orbiter Cloud Photopolarimeter images (text).
- RESEAU This is a binary file containing nominal reseau locations for Voyager 1 and 2 NA and WA cameras. The structure of this file is described elsewhere. Used by **RF** and **RESEAU** commands.
- uranustapes A catalog of Voyager 2 Uranus EDR tape cartridges. Each cartridge contains 240 images (10 1600-bpi original EDR tapes).
- vgr1n0 through vgr1n7 Voyager 1 narrow angle shading files for filters 1 - 7.
- vgr1w0 through vgr1w7 Voyager 1 narrow angle shading files for filters 1 - 7.
- vgr2n0 through vgr2n7 Voyager 2 narrow angle shading files for filters 1 - 7.
- vgr2w0 through vgr2w7 Voyager 2 narrow angle shading files for filters 1 - 7.

(This list is incomplete)

2.4 Planetary Data supported under McIDAS-eXplorer

The following data are planned to be fully supported for analysis in terms of navigation and data calibration. In addition to the following, earth based telescopic images of solar system targets can also be readily imported and analyzed using McIDAS-eXplorer if the data are available in a standard format such as FITS or TIFF.

Earth

Data from all US civilian meteorological satellites as well as METEOSAT and GMS (European and Japanese geosynchronous satellites).

Venus

Magellan Mosaicked Image Data (C- and F-MIDR's) on PDS CDs MIDRCD.01 - MIDRCD.80 and Altitude and Radiometry Data CDs on Volumes ARCDRCD.001 through ARCDRCD.015 and Composite Global topography and Radiometry Data, GxDR

Pioneer Venus Orbiter Cloud Photopolarimeter (OCPP) images

Pioneer Venus OCPP Polarimetry Maps from NSSDC archive tapes

Galileo SSI data.

Mars

Mapped Image Data Model (USGS): MDIMS volume 1-6

Viking Orbiter Images: PDS Volumes VO_1001 through VO_1006.

Jupiter and Satellites

Voyager 1 and 2 images on EDR tapes and PDS CD-ROM Volumes 6-8. Hubble Space Telescope images of Jupiter.

Saturn and Satellites

Voyager 1 and 2 images on EDR tapes and PDS CD-ROM Volumes 4-5. Hubble Space Telescope images of Saturn

Uranus and Satellites

Voyager 2 images on EDR tapes and PDS CD-ROM Volumes 1-3.

Neptune, Rings and Satellites

Voyager 2 images on EDR tapes and PDS CD-ROM Volumes 9-12.

2.5 McIDAS-eXplorer Data Structures

Although the CD's offer a convenient means of archival of image data, the speed of access is less than desirable. For this reason and for reasons of compatibility with the McIDAS environment as well as efficiency, the image data is imported into the McIDAS environment as files. At the same time a Data Description Block is created that provides a roadmap to the navigation, calibration information for the image data. While there is some commonality between various formats, mission and science instrumentation differences result in mission specific variations. These are accommodated by classifying the DDB's into specific models such as one for framing cameras, one for spin scan imagery, one for nadir pointing scanning instruments etc. The Magellan SAR and altimetry data are exceptions in that the image products are available only as mapped products (various compressions achieved through sampling) while the latter is mostly available along orbit tracks.

3. VOYAGER DATA ON GIANT PLANETS AND THEIR SATELLITES

The two Voyager spacecraft carrying seven experiments each (an imaging system consisting of a wide and a narrow angle camera (ISS), an infrared Radiometer Interferometer and Spectrometer (IRIS), a Plasma Wave Spectrometer (PWS), a Magnetometer were launched in 1978 August and 78 respectively. Voyager 1 observed the Jovian system in 1979 and the Saturn system in 1980. Voyager 2 also observed the Jovian and Saturn systems in 1979 and 1981 and then travelled further into the outer solar system to encounter the Uranus system in 1986 and finally the Neptune system in 1989. The data from the ISS and the IRIS experiments collected in these six encounters can be analyzed with McIDAS-eXplorer tools.

The tools for IRIS data analysis are limited to the display of individual spectra, location of the data based on pointing refined by simultaneous imaging observations (IRIS and ISS fields of view are bore-sighted), and averaging. These spectra are useful for a variety of applications that are too specialized to be of much general use, but the required tools can be imported or developed within McIDAS-eXplorer environment. Examples of such applications include temperature retrievals and trace gas abundance determinations for atmospheres of Jupiter, Saturn and Titan.

3.1 VOYAGER IMAGES

The imaging system on each of the two spacecraft was nearly identical- each carried a wide and a narrow angle vidicon camera. Each camera was equipped with a filter wheel with eight filters. The filters on the two spacecraft were nearly the same with the exception of a methane band filter on the Voyager 2 wide angle camera that replaced the blue filter on the Voyager 1 filter wheel. The faceplate of each of the cameras was etched with a pattern of 202 reseaux marks that were nominally 3 x 3 pixels wide. Their positions were measured to a ± 0.001 mm accuracy on the ground. The details of the imaging system and the calibration of the data can be found in the report by Benesh and Jepson (1978). The camera characteristics are summarized in Table 1 for completeness.

Table 1

Voyager Imaging System Characteristics

Spacecraft Camera	VGR 1 Narrow Angle	VGR 1 Wide Angle	VGR 2 Narrow Angle	VGR 2 Wide Angle
Focal Length,mm	1502.38 \pm 1.37	200.47 \pm 0.39	1503.49 \pm 0.39	200.77 \pm 0.23
Frame Size	800 x 800	800 x 800	800 x 800	800 x 800
FOV*	0.44989x0.44989	3.34888x3.34986	0.45022x0.45022	3.36174x3.36745*
Pixel Size** (μ rad)	9.12	68.34	9.11	68.23
Filters	6	5	6	5
	Clear	Clear	Clear	Clear
	Violet	Violet	Violet	Violet
	Blue	Blue	Blue	Blue
	Green	Green	Green	Green
	Orange	Orange	Orange	Orange
	UV	-	UV	-

*Average over the entire frame (measured from reseaus)

**Central 100 pixels only (after Danielson et al., 1981)

The vidicon images obtained from Voyager cameras suffer from geometric and radiometric distortions. Before much of the quantitative analysis can be carried out it is necessary to correct the data for these distortions. The removal of the geometric distortions requires the use of the geometric distortion indicated by the known locations of the reseaus and their image locations. The radiometric distortion removal requires the shading files that contain tables of the vidicon response at each pixel for a given exposure.

3.2 PRE-PROCESSING OF THE VOYAGER 1 AND 2 IMAGES OF THE GIANT PLANETS AND THEIR SATELLITES

The images acquired from the Voyager vidicons suffer from two kinds of distortions: (a) photometric, and (b) geometric. The photometric distortions correspond* to the non-linear response of the brightness read-out across the image for a uniform incident illumination. This nonlinearity actually is from two distinct sources- (i) non-linear response of the vidicon itself, and (ii) the development of dark current on the vidicon as soon as the image is shuttered. The geometric distortion arises from optical distortions due to the magnetic focussing used in the vidicon system for reading out the image brightness data and results primarily in a barrel type distortion. It is possible to remove both of these distortions to a large degree as described below.

The systematic processing of Voyager images can be streamlined by using a macro command that daisy chains the steps described below as the processing steps need to be sequential. See the macro **DOVGR** for example which will begin with a either Wide or Narrow angle camera images acquired with a specific filter and will sequentially process it to fill the data compression gaps, determine reseau locations, correct for shading including dark noise subtraction using an appropriate dark noise file, perform geometric rectification, and determine a preliminary set of limb points for interactive navigation, all in a single command. Optionally, multiple images can be processed in exact same manner, sequentially.

Within McIDAS-eXplorer environment, whenever the original data are being modified in some form, the application program will always retain the original area and create a new version of the data in another area and will copy the accompanying directory and DDB information as well as make an entry in the audit trail. The original can then be deleted if no longer necessary. Thus if an error is made at any step, the process can be repeated as desired. The individual steps are described below.

3.2.1 Removal of Geometric Distortion

To account for this distortion a network of 202 3x3 reseau marks is etched on the faceplate of the each of the vidicons and their positions on the faceplate were carefully measured (to a thousandth of a mm) on the ground before launch (Benesh and Jepsen, 1977). The locations of these marks are first measured in the images (using key-in **RF**) and their ground measured locations used to compute the transformation between the observed and expected object space locations. The coordinates for other points in the image are then obtained by bi-linear interpolation. In order to minimize the effect of round off or truncation error, the output images size is set to 1000 x 1000 pixels, 25% larger than the original size in either dimension. The **GEOM** command accomplishes the latter task.

The required key-ins are as follows:

RF source_area_# *to measure and store the image locations of the reseaux marks.
The spacecraft and camera information as well as the nominal*

reseau locations are retrieved within the program from the area DDB.

(If the data are also to be corrected for radiometric distortion, then the command SHADE9 should be used before removing the geometric distortion.)

GEOM source_area_# output_area# SMOOTH =

This step uses the measured locations of the reseaux marks and their object space locations to remap the input image into another area that has the distortion removed. The SMOOTH=YES option smooths the output image by performing a local average of the immediate neighbors (2/3, 1/3 weighted). Note that typically the radiometric distortion is removed BEFORE this step as the shading correction files are useable only in the original (i.e. distorted) image. Further, the averaging is speeded up through the use of a look-up table that will currently handle DN values between 0-4095 only. The output of the shading correction program is generally 2-bytes and is within this range if the data are normalized using the IOF=1 default option. If the data are radiometrically calibrated to a greater dynamic range, then the SMOOTH option should be turned off as it will not produce proper averaging. If the resultant image is visually too granular, then it can be smoothed by running a low-pass filter with a small filter radius (e.g. 2x2).

3.2.2 Removal of Photometric Distortion

Photometric correction requires removal of the dark current signal or dark noise, and correction of the non-linear response of the vidicon. Both of these are image position as well as exposure time dependent. The dark current however has another cause and that is dependent on the rate at which the image is read out by the data system- the current starts building as soon as the image is exposed and keeps on increasing until the image is read out by the vidicon electronics. Thus, the lower the data rate the longer it takes to read out an image and the greater the dark current build up.

Dark Current Removal

The dark noise begins to build up on the vidicon faceplate as soon as the exposure begins, and is thus a function of the exposure time and the image readout time. The image readout time is determined by the data transmission rate. The rates used for transmission of data during the Voyager 1 and 2 encounters with the Saturn system typically used a 3:1 scan rate. The background brightness thus increases from the top of the image to the bottom and from the left to right. As may be expected, the dark noise has a quantization noise, so that there is a slight variation from frame to frame.

Typically the dark current is subtracted during the radiometric correction step (SHADE9 command). Occasionally the dark current subtraction alone is desirable for quick-look analysis, in which case the McIDAS MC command can be used to subtract the dark noise frame from the Voyager image of interest.

Shading Correction

The non-linear vidicon response to uniform incident light manifests itself in differing output brightness levels across the image. The non-linearity of the cameras was determined by measuring the output brightness level in terms of data numbers (DN's) for nine exposures for each filter, and a coefficient determined for each pixel of the image that describes the response of the vidicon for the input brightness at for a given filter at that pixel and saved as a "shading

file". Thus, given an image that is exposed at an exposure within the bounds of the shading files, the expected brightness at each pixel of the image can be interpolated from the actual vidicon response and the shading coefficients.

The shading correction files are voluminous, occupying nearly 12 mbytes per filter. Their names are of type VGRnXm, where n is 1 or 2 indicating Voyager 1 or 2 spacecraft, X is the camera identifier, N for narrow angle camera and W for wide angle camera, and m denotes the filter number on that camera. These files may be compressed to only about 24% of their original size using a loss-less compression scheme.

3.2.3 Image Navigation

Image navigation is the process of relating the image co-ordinates of a feature to their planetary coordinates or vice versa. For the Voyager images this step does not have the potential to add photometric "noise" to the image. However, the procedures to bring out subtle image features such as color composites or image normalization require a precise navigation. Thus navigation can indirectly add photometric noise to the processed image if the scattering angles are imprecisely or incorrectly computed. For Titan images the potential for such errors is not insignificant in view of the difficulty of navigating the Titan images precisely.

3.2.4 Center Finding

Because Titan is completely covered with clouds and no surface features (if any) are visible through this cloud cover, the navigation process relies on the observing geometry, the camera characteristics and the physical shape of Titan. The first task is to determine the location of the center of apparent disk of Titan. This is readily done for a spherical object by determining the position of the distinct periphery of the object, the "bright limb". Since the solid surface is not being imaged, the visible limb does not have a sharp edge characterized by sudden change in the brightness in a scan across the disk, but a gradual one and requires the use of an edge detection technique to locate the limb. The technique usually employed is the maximum brightness gradient one which usually is assumed to reflect the location of the level where the slant optical depth equals unity.

In the case of Titan this limb is several hundred km above the solid surface (determined from radio occultation data) and is known to be aspherical. Further, the height of the detectable limb has been measured to be different at different wavelengths from both Pioneer 11 observations (Tomasko and Smith, 1982) and our analysis of Voyager images. There is also evidence that the height of the detectable limb is considerably different at low (i.e. backward scattering) and high solar phase angles (i.e. forward scattering). The radii at different wavelengths that have been found previously from low phase angle images are given in Table 2. The dependence of limb location relative to the center of Titan on phase angle and wavelength has not yet been adequately investigated or measured.

3.2.5 Use of SPICE kernels

If available, the NAIF-SPICE kernels for an image can be utilized to attach navigation transform using the SPICEIN command. Utilities to modify the C-kernels to refine the navigation have not yet been released for use.

4. VENUS DATA from MAGELLAN and PIONEER VENUS MISSIONS

The Pioneer Venus mission and Magellan mission have returned a significant amount of imagery data. The Orbiter Cloud Photopolarimeter (OCP) instrument acquired nearly 4000 images of Venus' cloud cover over a time approximately 7 years in reflected sunlight and filtered through a narrow band 365-nm filter. It also acquired many full disk polarimetry maps at 270, 365, 550 and 935 nm over a longer duration. These data can be imported into McIDAS-eXplorer and manipulated. Magellan mission has returned radar images of the surface and high vertical resolution topography data over nadir footprints along the Magellan orbit tracks. These data can also be imported into McIDAS-eXplorer and manipulated as described below.

4.1 MAGELLAN SAR IMAGERY and ALTIMETRY DATA

Magellan data is the largest component of the PDS CD-ROM data with nearly 60 volumes of radar imagery of Venus surface and 15 volumes of nadir altimetry and radar reflectivity data on the Venus surface. These two data can be linked in a displayed frame. There is also one CD-ROM volume containing a global mosaic of the radar altimetry and radiometry data. There are separate McIDAS-eXplorer commands to import these data for analysis. The radar images require no further systematic processing as the required processing has already been performed. The only exception is if the radar reflectivity in calibrated units is required, in which case a special command converts the image from raw data units into calibrated units.

The radar images are stored in three different formats as components of a global maps. The individual components are mapped in a sinusoidal projection and are available at three different resolutions. Each CD-ROM volume also contains a 8-X reduced resolution 'browse' frame to provide a larger context for a specific geographic location. The steps in displaying a region of interest are described below.

FINDFF, GETMGN and TILES

These two commands enable the user to locate and import a radar image into McIDAS explorer. FINDFF searches the cumulative index (from the last MIDR volume, MG_0080 V1) to determine the CD-volume containing a region given by latitude and longitude.

Once the CD-ROM volume has been located and mounted in the CD-reader, GETMGN will import that frame into a McIDAS area from which it can be displayed using the DF command. If useful, the browse frame can be imported first, in which case the user is provided the option to import a full resolution image of one of the 56-component pieces (also called 'tile' or a 'framelet' or 'chip') of a browse frame by selecting a specific number from the displayed image. The tiles can be re-drawn using the **TILES** command.

FINDALT and GETALT

FINDALT searches the ARCDR index to locate a particular CD-ROM volume on which the altimetry and radiometry data corresponding to a given orbit is stored. The Magellan orbit number corresponding to a specific location on Venus is most readily determined by scanning the audit trail of an area containing a Magellan radar image (F or any C-MIDR) by using the LA *area* # FORM=AUDIT command.

GETALT will retrieve the radiometry and altimetry data for that orbit and plot it on the screen over a displayed image of that region.

4.2 Pioneer Venus OCPP images

Pioneer Venus OCPP images are normally available from NSSDC on 9-track tapes. The individual files containing the images can be imported into a McIDAS-eXplorer workstation via any available means (local tape drive or over a network). Unlike majority of the images acquired by NASA's solar system missions, the OCPP images were obtained using the spin scan technique pioneered by the geosynchronous earth weather satellites and also used on Pioneer 10 and 11 spacecraft to reconnoiter Jupiter and Saturn in the 1970's. In the case of the OCPP images the spin of the spacecraft provides a swath across the disk of Venus and the orbital motion of the spacecraft translates the successive scans across the disk of Venus. The OCPP telescope optic axis is in a plane containing the spin axis of the Orbiter spacecraft and can be pointed between 45° and 135° with the spin axis. The spacecraft spin axis nominally points towards the celestial south pole. At the beginning of acquisition of a full disk image the Telescope is pointed towards the farther cusp of Venus and held there such that the orbital motion will carry it to the other extreme of Venus disk. At this time to acquire another full disk image the telescope is repositioned. A full disk image thus takes anywhere from 2.5 to 5 hours to acquire depending on the position of the Pioneer Venus orbiter in its highly inclined (105°) highly eccentric (0.8453) orbit. Consequently, NAIF SPICE kernels are not available for these images. Instead these images are navigated using the knowledge of the spacecraft orbit and imaging geometry. A single McIDAS-eXplorer command will import and navigate the raw roll-by-roll images into McIDAS areas as described below.

GETCPP

This command will import a Pioneer Venus OCPP image into a McIDAS-eXplorer area and attach the necessary navigation transform to it by retrieving the appropriate information from supplementary files stored within the /mcidas/data sub-directory. The image can then be manipulated, e.g. remapped, gridded or brightness normalized using the general McIDAS commands.

CAUTION: If the time of observation is critical for analysis, e.g. in measuring cloud drift winds, then the nominal image start time with which McIDAS-eXplorer images are tagged with should not be used for Pioneer Venus images as each image takes several hours to acquire and time difference between the same regions on Venus in two successive full disk images is not constant. Use **CPPTIM** command to determine the observation time for a given location in a navigated OCPP image.

MclIDAS-eXplorer Command Guide

This section describes the **MclIDAS-eXplorer** commands that can be used with the planetary data in detail. These are in addition to the MclIDAS-X commands which are described in the MclIDAS-X Users Guide.

The syntax of the commands, keyword explanations and examples are given along with some explanatory remarks. A separate document containing detailed output from typical sessions is planned.

This manual can also be viewed on-line from within MclIDAS-eXplorer using the **EXPDOC** command.

McIDAS-Explorer Command Guide

This section describes the McIDAS-Explorer commands that can be used with the binary data in detail. These are in addition to the McIDAS-X commands which are described in the McIDAS-X Users Guide.

The syntax of the commands, keyword expansions and examples are given along with some explanatory remarks. A separate document containing detailed output from typical sessions is planned.

This manual can also be viewed online from within McIDAS-Explorer using the EXPDOC command.

ASTAT - Measure image statistics on a displayed image

ASTAT opt coord <keywords>
--

Parameters:

- opt - option type from one of the following:
 - BOX | rectangular outline (default)
 - CIR | circular or elliptical outline
 - IRR | irregular shaped outline
 - LIN | outline based on line between 2 points

- coord - coordinate type-- one of the following:
 - IC | image coordinates (default)
All options are designed to run interactively on the current image frame.
 - EC | earth coordinates
 - EC | station dist - sfc station loc and radius (km) for CIR
 - EC | lat lon dist - lat lon circle and radius (km) for CIR
 - EC | LAT=lat1 lat2 LON=lon1 lon2 - lat/lon pairs for BOX
 - EC | stn1 stn2 dist - point to point corridor (km) for LIN

Keywords:

- AREA = area number
- BAND = spectral band (default= current frame or, 1st band in area)
- COLOR = graphics color (default=2)
- CUT = lo hi | data range (default=0 10000)
- TAIL = pct | tail percentage 0-100 (default=5%)
- HIST = frame# | plot a histogram on graphics frame (default=no plot)
- LAT = lo hi | latitude range (LON= keyword must also be specified)
- LON = lo hi | longitude range (LAT= keyword must also be specified)
- ARC = lo hi | angular segment of an circle (CIR option only), where,
deg1 = degrees from 0 to beginning of arc segment, and
deg2 = degrees from 0 to end of arc segment
- FORM = output | format of output statistics
- output = 1 | standard statistics (default)
- output = 2 | standard stats + BRIT bins
- output = 3 | standard stats + BRIT bins + BRIT histogram
- LEVELS = nbin min max - UNIT=BRIT only
 - nbin | number of bins (defaults: VGA = 13, WWW = 16,
TOWR = 16)
 - min | minimum brightness level (default=0)
 - max | maximum brightness level (default = 255)

REMARKS

This command allows the user to obtain statistics about the contents of an image or a section of it as determined by one of the many selection. The IRR option lets the user draw an outline to enclose an area on a displayed image using the mouse. The data units are user selectable as well.

BOTSIM - Transfer navigation from the navigated frame to the unnavigable frame for a pair of Simultaneously shuttered Wide-Angle Narrow-Angle Voyager Images

BOTSIM navigated_area# unnavigated_area# SIMUL = YES/NO

(Uses transform matrix for simultaneous WA/NA Voyager (1 or 2) image pair to link the unnav_area# to a navigated navigated_area# using the WA/NA co-ordinate transform matrix.

Both images must have identical shutter times and be "BOTSIM" shutter mode.

(must have previously run SEDRIN to define the camera geometry for the unnavigated frame)

SIMUL = YES/NO | (YES is default, NO turns off date/time check for simultaneous shutter times. If times are not the same, no correction for rotation of the target planet between images is made.)

CENTER = LIN ELE | (Planet center line-element in unnavigated image, default is planet center translated from the navigated image)

NOTE: The north angle of the navigated_area is used for the unnavigated_area. This permits navigated_area roll angle and spin axis corrections to be propagated to the unnavigated

REMARKS

This command is useful for close encounter images from Voyager cameras of objects when the higher resolution narrow angle frame does not contain an adequate or any bright limb to be able to determine the object center with any accuracy. If a simultaneously shuttered wide angle frame is available, then this command transfers the navigation from the wide angle frame to the narrow angle frame, accounting for the misalignment (determined from ground based measurements) between the two cameras on both spacecraft. Note that because the resolution of the WA cameras is 7.5 times worse than that of the NA cameras, the navigation of the the NA frames navigated frames this way is no better than that of the wide-angle frames.

CALCMA - Calculates Transform Matrix for Planetary Navigation for framing camera image navigation. Currently is set up for Voyager images only.

CALCMA area No_Center_Find_Flag ROLLOFF =
--

Parameters:

AREA	area containing navigation block to be updated
NCFF	no center find flag (0 or any other number) (This parameter, if non-zero, forces program to use planet center coordinates already in the navigation block rather than perform a best fit to the bright limb points stored in the navigation block. (i.e. it forces the planet center position)

KEYWORDS:

ROLLOFF = roll offset correction (subtracted from north angle) as determined from optical navigation by determination of the actual roll (north) angle by referencing a star or a satellite and noting the difference from the SEDR value of the north angle.

EXAMPLES:

CALCMA *(updates matrix for area last accessed)*
CALCMA 1022 1 *(forces planet center for area 1022)*
 (will default to area last accessed)

CHANGEDD - Unmount/mount a CD-ROM volume in the UNIX workstation's CD-ROM reader.

CHANGEDD

Remarks

Most UNIX systems require that CD-ROM volumes be "mounted" before they can be used to read data. **CHANGEDD** command makes this process simpler by allowing the user to unmount and mount a CD in the reader.

COMBIN - Make a multiband area from several single band area. MAY ALSO BE USED TO REDUCE 2-BYTE DATA TO 1-BYTE DATA.

COMBIN outarea BANDS = area1 area2...areaN

PARAMETERS:

OUTAREA | area with N bands (maximum 6 at present).

KEYWORDS: (MANDATORY)

BANDS = BANDS = area1 area2 ... areaN
Single Banded area #s to regroup. Area1 will be BAND1 of outarea, area2, will be BAND2 of outarea, etc.

CUTOFF = Percent of data to CUTOFF in 2BYTE to 1Byte compression.
DEFAULT = 1.0% of data at upper and lower ends

BANDWIDTH = output range for 2-BYTE raw data, from 2 to 255. DEFAULT = 255
UNIT = BRIT or RAW input data type DATA: BRIT, RAW.
DEFAULT = RAW

NOTE: Change keyword DATA to UNIT in the program!

CONFIT - Program to fit a constrained conic fits to a set of points contained in a limb points file (see LIMBPT) and use imaging geometry information as available. (*Not fully implemented yet*).

CONFIT <i>area#</i>

KEYWORDS:

FILE = file number for non-Voyager images (i.e. no FDS #)
NPASS = Number of editing passes to make based on deviations
MAXDEV = maximum deviation in pixels for the curve fit to edit pts
ANGLE = BEGIN END STEP, ALL IN INTEGER DEGREES
LIMB = Target limb, whether RING or planet
COLOR = SPECIFY PLOTTING COLOR (RESIDUALS AS WELL AS EDGE)
LIST = Print residuals if a device is specified points are input from a file 'GRADXXXX' where XXXX is the area number. Use LIMBPT key-in to create the limb points file.

ROTATION ANGLE CAN BE SPECIFIED AS A RANGE OF ANGLES AND STEP SIZE

DSTNCE - Measure linear distances on a navigated and displayed planetary image, optionally plot range circles for a given distance (in km, nm or miles) on the displayed image.

DSTNCE	<i>opt</i>
DSTNCE	CIR <i>angle inc distance</i>
DSTNCE	ROT <i>angle inc distance ></i>
DSTNCE	STE <i>angle din distance ></i>
DSTNCE	E <i>lat lon</i>
DSTNCE	I <i>line ele</i>
DSTNCE	T <i>raster pictel</i>

where, *opt* is one of:

- (none) | measure distance between a pair of points or continuous segments indicated by mouse clicks
- CIR | draw a circle around the initial cursor location beginning at a specified distance and angle
- ROT | draw all or part of a circle around the initial cursor location beginning at a specified distance and angle
- STE | step the cursor away from the initial cursor location at a specified distance and angle
- E | step the cursor away from the initial cursor location by the specified latitude and longitude increments
- I | step the cursor away from the initial cursor location by the specified line and element increments
- T | step the cursor away from the initial cursor location by the specified raster and pictel increments

PARAMETERS

- angle | moves the cursor away from the original location by this meteorological angle (def = 0)
- din | increment to step the cursor along its straight-line path
- distance | distance to move the cursor from its original location
- inc | angular increment, in degrees
- lat | degrees of latitude to move the cursor; northward is positive
- lon | degrees of longitude to move the cursor; westward is positive
- line | number of image lines to move the cursor; downward is positive
- ele | number of image elements to move the cursor; rightward is positive
- raster | number of lines (rasters) to move the cursor; downward is positive
- pictel | number of TV elements (pictels) to move the cursor; rightward is positive

KEYWORDS:

- COLOR = graphics color level of the characters (typically between 1 and 7, but as permitted for the workstation). Default = 2
- SIZE = height of the plotted characters, in pixels (def = 5)
- SYM = character to mark points with (def = .). Allowable symbols are '.', '+', '*', 'o'.
- UNIT = distance units, one of:
 - KM | kilometers (default)
 - MI | statute miles
 - NMI | nautical miles

EDGES - Program to determine the limb points from an area containing a planetary image for finding the center for the purpose of image navigation. Particularly useful for ground based telescopic images of the planets as no navigation data are required either for EDGES or for IMGCTR.

EDGES <i>option</i>

Parameters:

option |

FIN		Find limb points from a displayed image and create a new limb points file to store the points and display them on the graphics frame
ADD		Append more limb points to an existing file
DEL		Delete limb points for locations within the cursor from the limb points file and erase them from the graphics display (not in McIDAS-X)
PLT		Plot the limb points for the displayed image from the corresponding file
LIS		List the limb points file corresponding to the displayed image

KEYWORDS:

DER = TOT for total derivative (actually max of gradient in the line or element direction)
DER = ELE to compute derivative in the element direction dB/dE
DER = LIN to compute derivative in the line direction, dB/dL

Remarks:

Limb points are found along the longer dimension of the cursor. This is crucial when finding limb points near the top or the bottom of the image when the planet's visible (bright) limb is almost tangent to one of the sides of the rectangular cursor (box). This command is useful when there is excessive noise in the background or when there are rings present such that automatic limb determination is problematic. Use IMGCTR to determine the shape, size and center of the object by a general conic fit to the image frame limb co-ordinates.

ELLIPS - Draw signature ellipses from a USCLAS classification

ELLIPS inarea LCLASS HCLASS MEAN STD

Parameters:

LCLASS - lowest class # to display

HCLASS - highest class # to display

MEAN - 1 to display class means only

STD - 2 is default.

Defaults are 0 to largest class present, ellipses displayed. The graphs are displayed in a new window which closes itself when all the graphs have been viewed.

EXPDOC - On-line help utility for McIDAS-eXplorer commands. This command will bring up different user manuals in a new text window which can be viewed using the vi editor commands

EXPDOC <i>guide_name</i>

where,

<i>guide_name</i>		USERGUIDE - introductory user guide
		COMMAND - command help (this section)
		DATA - data file structures

REMARKS

The vi editor commands can be used to search for specific items. See also EHELP which is a command that parallels the HELP command in McIDAS-X, except that EHELP accesses only the McIDAS-eXplorer commands.

FILLO - Fill zeroes in scan lines due to data compression in Voyager Uranus/Neptune images using the alternate side compression by averaging across lines that contain data

FILLO areain areaout OPT=LINE/BOX

KEYWORDS:

NUMAVG = 3 (default BOX size)
MINDN = 0 (minimum DN used to compute average DN in BOX)
OPT = LINE (Default) or BOX
(If OPT=BOX, then zeroes in image are filled by average of up to NUMAVG x NUMAVG non-zero or DN > MINDN pixels centered on a pixel)

REMARKS

After the Saturn encounter, the image readout for Uranus and Neptune encounters of Voyager 2 was changed to account for the lower data rate due to the increased range. So that more images could be returned, image data were compressed by editing out data on alternate lines alternating between the right and the left edges of the frame. These gaps need to be removed before reseaus can be found near the edges, and certainly before rectifying the images. The gaps are filled by interpolating across the gap element by element from the immediate neighbors above and below the compressed line.

FINDALT - Determine the Magellan ARCDR CD-ROM volume number containing altimetry and radiometry data for a specific Magellan orbit.

FINDALT <i>orbit_#</i>

Remarks

The orbit number passing over a given geographic location on Venus can be found using FINDFF which first locates the MIDR CD-ROM volume containing the Magellan radar image of a region of interest. The label of that image indicates the first orbit number used to create that image tile.

FINDFF - Determine the MAGELLAN CD-ROM MIDR volume numbers containing a given latitude-longitude region

FINDFF lat CHEM lon

PARAMETERS:

lat = LL (two digits, must be a multiple of 5)
CHEM = N or S (single letter, north or south hemisphere)
lon = LL (two digits, including leading 0, representing any longitude between 0-360 divided by 10)

[Program does a character search for records using the byte strings 'LLN', 'NLL', 'LLNLL' or 'LLSLL' assembled from keyin parameters, returns CD-ROM ID for each such record. Blank lat-lon fields are ignored, but N is assumed default.]

Examples:

FINDFF 30 S 12 *returns all MG_NNNNs for latitude -30 and longitudes between 120 and 129*

FINDFF 50 *returns all MG_NNNNs for 50N*

FINDFF 50 S *returns all MG_NNNNs for 50S*

FINDFF LAT=50 S *returns all MG_NNNNs for 50S*

FINDFF X S 23 *returns all south latitude MG_NNNNs for longitudes 230 to 239*

Remarks

FINDTM - Locate areas containing images from different spacecraft acquired within a given time window and send a string to the McIDAS Control program for execution

FINDTM SS= MIN= MAX= AREAS= "string command to processor

KEYWORDS

SS = ss1 ss2 ss3 ss4 | List of up to four McIDAS spacecraft SSS codes
MIN = DAY TIME | lower window limit) in YYDDD HHMMSS format
MAX = DAY TIME | upper window limit in YYDDD HHMMSS format
AREAS = MAX MIN | area limits to perform search. Default area limits are 1-9999. [string command limited to 8 tokens in length]

REMARKS

This is a macro command that is useful to locate areas from multiple satellites covering a planet for near simultaneous coverage. A command can be sent to the control program to execute once the areas are located. One example of such a command may be to remap and mosaic those areas to make a global composite, such as from earth satellite data.

GEOM - Remap a Voyager frame to remove vidicon geometric distortion using the reseau locations found by the Key-in RF

GEOM source_area destination_area
--

KEYWORDS: (all optional, only areas have to be specified)

SPLINE = Spline size (default= 12, limits depend on area size) for remapping.

SCALE = Area size scale (Default is **SCALE**= 1.0 for a 1000 line image)

SMOOTH = ON/OFF Smoothing option averages neighboring pixels a bit making nicer looking limbs at the cost of some resolution and line sharpness. (Default is ON)

GETCPP - Import a Pioneer Venus Orbiter Cloud Photopolarimeter image from a file in the NSSDC tape archive format (roll-by-roll). Attaches navigation at the same time. Requires files orbele.cpp and contact.cpp in /mcidas/data sub-sirectory

GETCPP *area_#*

REMARKS

The image can be immediately displayed and gridded using DF and MAP commands to check the navigation. Occasionally the roll angle or the look angle may have to be adjusted for a better fit. See **NAVCPP** command to accomplish this.

The program creates an image such that each image line contains a spacecraft scan (even if it is missing on the NSSDC tape) so that the time and image line numbers relate to each other through the average spin period of the s/c over the image duration. Further, the

GETFITS - Import an image stored in a FITS format file into a McIDAS-eXplorer area. Useful for earth-based telescopic images of planets.

GETFITS <i>fits_file area_# PIXSIZE = TARGET = target_name or naif_id_#</i>
--

KEYWORDS

PIXSIZ - 1 or 2 depending on the byte-depth of the data

TARGET - target identification (*not yet fully implemented*).

REMARKS

At present the DDB is not attached to the area -- pending.

GETMDIM - Import Mars Explorer (USGS Processed Viking Mars Data) images from CD-ROM into McIDAS areas.

GETMDIM area# file_name

PARAMETERS:

area# = Area number into which to load the image from the CD-ROM disk

file_name = A valid file name containing the image [OPTIONAL]
(Name must begin with " and be the last entry on input line)

NOTE: If full path is given, CDPATH in string table must be ' '. The string table can be listed using the **TL** command and entries in the table can be updated using the **TE** command.

KEYWORDS:

AREA = A valid McIDAS area number (1-9999) [REQUIRED, def=0]

REMARKS:

This command is used to import USGS processed Viking Orbiter images of Mars from PDS CD-ROM's.

GETMGN - Import a Magellan Mosaic Image Data Record (MIDR) image from CD-ROM into a McIDAS area.

GETMGN area framelet/ff# directory "file_name
--

Examples:

```
GETMGN      AREA = 23 FF=0 DIRECTORY = c130n333
GETMGN      AREA = 1211 FF= 23 DIRECTORY = c110n130
GETMGN      AREA = 20 "/cdrom/c130n333/c1f23
```

PARAMETERS:

file_name = Any valid source file name. [OPTIONAL]
(Must begin with " and be the last entry on input line)

NOTE: If full path is given, CDPATH in string table must be '
' . [CD-ROM is assumed mounted as /cdrom using the UNIX
commands "mountcd" and/or "umountcd" in the directory
/u1/mcidas/bin]

KEYWORDS:

FF = 0	extracts -8 blowdown of entire mosaic [default]
= 1-56	extracts numbered 1024 x 1024 framelet
= CUR	identifies framelet from displayed browse image
= ALL	extracts all 56 framelets into 56 consecutive areas starting at designated area AREA = nnnn

AREA = ANY VALID McIDAS AREA NUMBER (1-9999) [REQUIRED, def=0]

FRAMELET = Any framelet number 0-56 (0 means extract blowdown) (same as FF above)

DIRECTORY = Any secondary directory in /cdrom in the 8 byte format c1LLnOOO where LL=latitude and OOO=longitude (Remember that DIRECTORY and FILE NAME are case sensitive! Also, if FRAMELET is used, DIRECTORY must be used.)

CDPATH = string table path, including directory in which desired framelet c1FF resides (e.g. TE "cdrom/c1XXnXXX/) [this must be a blank string (e.g. TE ") if the FILE NAME in the keyin includes the path, since the FILE NAME is appended to CDPATH before the CD-ROM files are opened]

Remarks:

This command is planned to be improved so that it stays resident if the browse frame is requested so that by indicating with mouse clicks the individual tiles or framelets that make up the browse image can also be imported into McIDAS by moving the cursor and clicking over the browse

HSTTOMC - Import Hubble Space Telescope WF/PC image from a FITS format tape-file into a McIDAS area.

HST FILES ARE WFPC FITS FORMAT USUALLY WITH 4CCDS.
OUTPUT AREA HAS ONE BAND FOR EACH CCD.

HSTTOMC *infile outarea*

PARAMETERS:

INFILE - HST FITS file (.COH or .DOH extension).
>> **ENTER THE FIRST 8 LETTERS** <<

OUTAREA - MCIDAS multi band AREA.

KEYWORDS:

DATA - DATA=RAW uses .DOH raw data.
DATA=CAL uses .COH calibrated data.

EXT - File extension after INFILE's 8 chars.
Overrides the DATA keyword value.
(DEFAULT = t_cvt.c0h)

PIXSIZ - DATA TYPE OF OUTPUT FILE (1 OR 2 BYTE). (DEFAULT = 1)

HSTKNIT - Program to create a single area 1600 x 1600 containing four component 800 x 800 CCD images from WF/PC camera on HST.



The program is of the kind where because the actual alignment of the four component CCD chips is not precisely known and is significantly different from the nominal values, and worse, the positions of the four CCDs cannot be matched to each other, making the geometry practically useless. With the coming replacement of the WF/PC camera the four chip format will be replaced with a single 800 x 800 CCD.

IMGCTR - Determine the center (using a conic fit) of a planetary image for which limb points have been previously stored in a file (LIMBxxxx, where xxxx is the 4-digit area number) using EDGES or other programs.

HSTKNIT <i>area_#</i>

Remarks

This program is of limited interest because the actual alignment of the four component CCD chips is not precisely known and is significantly different from the handbook values, and worse, the calibrations of the four CCD's cannot be matched to each other, making the exercise practically useless. With the pending replacement of the WF/PC camera the four chip format will be replaced with a single 800 x 800 CCD.

IMGCTR area_#

REMARKS

If the current frame contains the image of interest, the area_# may need not be specified.

An unconstrained, general conic fit in the image co-ordinates returns the ellipse center, major and minor axes, eccentricity and the tilt with respect to the line direction. The positive x-axis is along the increasing line direction and the positive y-axis is along the increasing element direction.

This is useful for navigating full disk earth-based telescopic images of solar system objects, using PLANAV if the sub-earth point is known.

The format of the LIMBxxxx files is as follows. It is a fixed length file (4001 words), with the zeroeth word denoting the maximum index number of limb points stored in the file (4-byte binary integer). The next 2000 words contain REAL*4 line numbers (x-coordinate) of limb points and the next 2000 words contain the corresponding element positions of the limb points (y-coordinate). The slots may not all contain valid limb points as some limb points may have been edited out. Only non-zero entries are taken as acceptable limb points (either axis).

IMGTS - compile and display Time series Data for a given geographic region from image areas

IMGTS filename function KEYWORDS "text

Parameters:

lwfile		filename (default = none)
function		APPEND or PLOT, program function (default = PLOT)
"text		up to 40 characters, used if the LW file is new as the information for the first header line (default = lwfile)

Keywords:

AREA = a1 a2, sequential range of areas (default = current frame)
BAND = band number (default = current frame)
BOX = numlin numele | target box lin/ele pixel size, must be an odd number (default = cursor size)
CHECK = YES or NO, option to check LAT,LON,SSN,BAND,UNIT,FACTOR parameter values against the LW file header values (default = YES)
COLOR = color level of display symbols (default = 3)
ERASE = YES or NO, erase graphic frame before plotting (default = NO)
FACTOR = internal scaling factor for calibration type (default = 1.0)
GRA = specify graphics frame (default = current)
LAT = target box latitude location (default = cursor position)
LON = target box longitude location (default = cursor position)
MAX = upper value range limit (default = + 1.0E + 35)
MIN = lower value range limit (default = -1.0E + 35)
PAN = graphics panel selection 0,1,2,3,4 (default = 0 full screen)
FORM = NPT AVG STD MIN MAX, plotting format options (default = AVG)
SYMB = plot symbol can be any single alphanumeric character or DOT (1x1 box) (default = DOT)
TITLE = display title up to 12 characters (default = blank)
UNIT = internal calibration type unit (default = BRIT)
XL = x-axis label up to 12 characters (default = X)
XP = min max div sdiv, x-axis (area1 file) plot parameters
YL = y-axis label up to 12 characters (default = Y)
YP = min max div sdiv, y-axis (area2 file) plot parameters, where:
div - # of divisions sdiv - # of sub-divisions
ZERO = zero pixel value option as MISSING or DATA, or can indicate a specific non-zero integer as the missing value code (default = MISS)

Remarks:

- 1) If areas given, then the program will calculate the average, standard deviation, minimum, and maximum values for a user specified UNIT = calibration type within a user specified target box location and size.
- 2) If no areas given, then program will display the selected PLOT = option values of the user specified LW file.
- 3) The program appends new values onto the specified lwfile.
- 4) The location and size of the target box can be defined several different ways: using the LAT/LON/BOX keywords, using the LIN/ELE/BOX keywords, using the LIN/ELE keywords with double entries representing TV line and element ranges, or using no keywords and defaulting to the

current cursor's position and size (note the BOX keyword can be used to override the default cursor size).

- 5) Lat/Lon values may be entered in either a DDD.xxx format or a DDD:MM:SS format.
- 6) The program will display a time series of all LW file entries up to a maximum of 5000.
- 7) The program can be set to screen for a user defined range of pixel values using MAX/MIN keywords to define the upper and lower limits.
- 8) The program calculates the LW entries for a range of areas and stores them in the LW file in the order that the areas are sequenced regardless of the area's date and time.
- 9) The program is designed to order the LW entries before it plots their time series from lowest to highest date.

LIMPRO - Determine and plot the Limb Profile of a Planetary Image along a radial direction. Also plots the derivative profile on the next frame

LIMPRO option KEYWORDS

Parameter:

option | CUR a line plot using data through center of cursor
| SEG a line segment of the image
| RAD a radial plot at a given azimuth

KEYWORDS:

AXIS = LIN or LOG for y-axis scaling
COLOR = color (def=3)
PLOT = plot type: SLD, DOT, or any ASCII char (def=SLD)
MINDN = data \leq the specified value are set to 0.5 for the case when Y-axis is log for clarity.
BAND = band (def=current frame)
UNIT = calibration units (def=original from area)
= BRIT RAW RAD or TEMP
SCALE = ylo yhi xlo xhi | modify x and y scales to new values

Example:

LIMPRO RAD 135 200 SCALE= 10 1000 0 100

Draws a line plot, on the graphics, of the data along the line at an azimuth of (from the scan direction) 135 deg and a distance of 200 pixels from the planet center, to the planet center. Only the first 100 pixels along that line from the point are to be plot. The derivative of this profile is displayed in the right panel. Three files are also created that contain the profile data: LIMPRO, LOGPRO and DERPRO. These files are tagged by the FDS count and the scan end (image) co-ordinates.

Remarks:

A graph of image data is drawn on the graphics frame

LISCOM - Lists contents of PLAN navigation common from navigation blocks

LISCOM <i>area</i> CUR/COD <i>blknum</i>
LISCOM <i>area</i> CUR/COD <i>blkname</i>
LISCOM <i>area</i> CUR/COD, (lists all blocks in CURRENT or CODICIL)
LISCOM <i>area</i> (default is COD and all blocks)

(NOTE: All three parameters are positional only, no keywords are used in this command)

Block Numbers (blknum) and Names (blkname):

1. SECTID (Image identification)
2. COMMVN (Image geometry input)
3. NAVVEC (Navigation input)
4. VNEDGE (Bright limb points)
5. VNTERM (Terminator points)
6. MOSTIE (Mosaic link points to frames)
7. MISLEN (Odds & ends)
8. VNCOMM (Navigation output constants)
9. A (Inverse navigation matrix)
10. B (Navigation matrix and vector)
11. D (Inverse vector)
12. SQUASH (Oblate planet correction)

LISTAUD - List the audit (processing) trail for a McIDAS area.

LISTAUD <i>area_#</i>

Remarks

Most McIDAS-eXplorer applications programs that modify the contents of an area make entries in the audit trail. The processing that an image has undergone can be determined by examining the processing trail.

LISTDDB - List the Data Description Block for a McIDAS-eXplorer area.

LISTDDB *area_#* *type*

PARAMETERS

- type** | MAN to list the mandatory data (target, source) block
- type** | SC to list the spacecraft and camera specific block
- | BOD to list the target object specific block
- | GEOM t list the map projection and image geometry block (SPICE)
- | USER to list user computed quantities for that area
- | NAV to list the older PLAN type navigation block
- | ALL to list all blocks

LISTNAV - Lists any or all planetary SPICE navigation blocks for an area

LISTNAV *block_type area#*

(NOTE: The order of these arguments should be reversed!) The block_type can be unambiguously distinguished from the area# if entered.

PARAMETERS:

block_type can be any of the following:

SC	spacecraft & camera block)	[default	block]
BOD	central & picture body block)		
IMG	imaging geometry block)		
USER	user computed quantities block)		
ALL	list all SPICE blocks for area:		SC,BOD,IMG,& USER)
	(area navigation	block words 128-511)	
CUR	list current navigation block if PLAN, otherwise uses the LWU LIST		
	AREAXXXX 64 191 format		
PLAN	list PLAN navigation block 512-639)		

area# = area number for which to list the blocks specified (defaults to displayed frame)

EXAMPLES:

LISTNAV *(defaults to SC and displayed frame)*

LISTNAV BOD *(displays picture body block for displayed frame)*

LISTNAV USER 2335 *(displays user block for area 2335). If there is no displayed frame, will try last accessed area*

KEYWORDS:

AREA = area number whose blocks are to be listed (area defaults to displayed frame image)

LP-- Line-plot of Image Data at Cursor Location

LPOption <Keyword>

Parameter:

option | CUR a line plot using data through center of cursor
| SEG a line segment of the image

KEYWORDS:

COLOR = color (def=3)
PLOT = plot type: SLD, DOT, or any ASCII char (def=SLD)
BAND = band (def=current frame)
UNIT = calibration units (def=original from area)
UNIT = BRIT RAW RAD or TEMP
SCALE = ylo yhi xlo xhi
modify x and y scales to new values

Remark:

A graph of image data is drawn on the graphics

Example:

LP CUR
Draws a line plot, on the graphics, of the data
on the line through the center of the cursor

NOTE: The SEG option does not work as yet in the McIDAS-X environment. The x-axis scale lower limit needs to be changed to "0". It is currently "1"

MCLIMB - Simulate view from orbit of a planet from a nadir looking instrument and plot instrument IFOV's.

MCLIMB <i>inarea outarea</i>

PARAMETERS:

inarea - MAP AREA TO USE
outarea - OUTPUT AREA WITH ORBIT TRACKS

KEYWORDS:

ECCEN - ECCENTRICITY OF ORBIT (DEFAULT=0)
INCLIN - INCLINATION OF ORBIT (deg) (DEFAULT=155)
PREC - PRECESSION OF ORBIT, deg/day (DEFAULT=AUTO)
ORPSOL - ORBITS PER SOL \ choose 1 (DEFAULT=7)
PERIOD - ORBIT PERIOD / (DEFAULT=211.0)
 2ND PARAMETER = UNIT (min,hr,day) (DEFAULT=MIN)
GRAPH - PLOT, L=LIMB ELLIPSE, V=VIEW, VL=VIEW WITH LIMBS, B=BOTH
 (ALL)
 (DEFAULT=VL)
NUMPER - NUMBER OF PERIODS DRAWN (DEFAULT=1)
 2ND PARAMETER = PERIOD AFTER START TO
 BEGIN PLOTTING (DEFAULT=1)
TIMET - TIME PER ORBIT TICK (min) (DEFAULT=2)
CROST - DRAW EVERY NTH CROSS TRACK (DEFAULT=100)
IROTAT - INSTRUMENT ROT RATE (rpm) (DEFAULT=2)
FOVSTEP - DRAW EVERY NTH FOV (DEFAULT=1)
PLOTLON - LON PLOT TYPE (PLA OR SUN) (DEFAULT=PLA)
DATE - TEXT STRING OF START DATE (DEFAULT=1/JAN/2001)
TIME - TEXT STRING OF START TIME (DEFAULT=00:00:00.0)

REMARKS

This command is useful for determine the coverage obtained by an orbiter around a solar system object with a given orbit from nadir pointing spacecraft. A newer version will also compute the spacecraft visibility windows from a given set of surface locations.

MDCLAS - Spectrally classify a multi-band image
--- MDM CLASSIFICATION USING .SIG STATISTICS ---

MDCLAS inarea outarea sigarea

PARAMETERS:

INAREA = area to be classified
OUTAREA = Output classified area with the FINAL N spectral classes.
SIGAREA = AREA WITH .SIG STATISTICS FILE

KEYWORDS:

BANDS = BANDS = BAND1 BAND2 ... BANDN
Bands to classify, default is all bands in the area.

NULL = DATA DROP-OUT DECISION.
ANY: classify as ZERO if ANY band in image = 0.
ALL: classify as ZERO if ALL bands = 0.

Remarks:

MINFIT Determine Minnaert scattering Coefficients (I_0 and β) for a navigated image
($I = I_0 \mu\mu^\beta$).

MINFIT <AREA> LIN= ELE=

KEYWORDS:

AREA = Navigated McIDAS AREA (no default, must be specified)
LIN = BEGL ENDL (IMAGE LINES) (default uses brightness center)
ELE = BEGE ENDE (IMAGE ELEMENTS) (default uses brightness center)
SAMP = SAMPL SAMPE (SAMPLING INCREMENT) (defaults: SAMPL=1 & SAMPE=SAMPL)
LAT = MIN MAX (LATITUDE EXTENTS) (defaults=-90.0 90.0)
LON = MIN MAX (LONGITUDE EXTENTS) (defaults=-180.0 180.0)
COLOR = COLOR OF POINTS ON MINNAERT PLOT (default=3)
MUMU = LIMITS FOR LOG(MUMU0), X-AXIS (FROM STRING TABLE)
IMU = ACCEPTABLE RANGE FOR LOG(I* μ)
(Plot is not drawn if no limits are specified)

REMARKS:

Needs fixing yet! Plot doesn't work right....

NAMES - LISTS & PLOTS Planetary Feature names on displayed images.
(Currently the name is GEOB and contains only the Venus database)
(MIDR = Mosaic Image Data Record)

USAGE:

NAMES (Lists all features only)

NAMES LAT = *minlat maxlat* LON = *minlon maxlon*
(Selects features in region for plotting. (Features crossing 0
longitude must use $-180.0 < \text{LOW} < 0.0$). Default search bounds
are LAT = $-90.0 \ 90.0$ LON = $0.0 \ 360.0$)

NAMES "name (searches for all feature name/fragment matches)

NAMES P (Plot all features on displayed MIDR image)

NAMES PLOT (Plot all features on displayed MIDR image)

NOTE: There are 592 features named on Venus -- too many for a screen
printout -- so use DEV=PPP to get a permanent listing if lat-lon
bounds aren't used, or do a search using names or name fragments
(case sensitive) to reduce number of features returned.

The names are stored in a file called geo.tab which is copied from
MG0067.

PHYSCON - Program to obtain the Physical constants of an object. Either the NAIF ID (preferred) or its name (capitalized) can be entered. Radii and length-of-day are currently listed.

PHYSCON naifid

or,

PHYSCON OBJECT

Parameters:

- | | | |
|--------|--|--|
| naifid | | the NAIF identificaiton # for the solar system object or its name in UPPER CASE! |
| OBJECT | | If the NAIF identification # is not known, the name of the object can be specified in UPPER CASE . Only the first three characters are significant, except for PHOBOS and PHOEBE! |

EXAMPLES

PHYSCON 399
PHYSCON PHOBOS

Remarks:

1. NAIFID is determined from the name by subroutine BODCON. Only the first 4 characters of the object name are significant and must be in upper case.
2. At the moment the subroutine BODCON does not scan for Atmospheres, i.e. only the solid surface NAIF id is returned, which is ok since none of the PDS data distinguish between planet surfaces and atmospheres.
3. For bodies with massive atmospheres, the radii are defined separately for solid surfaces and atmospheres at the cloud-top level. In such cases the NAIFID is modified by multiplying by 10 and adding 1. Thus Venus (NAIF ID = 299) atmosphere becomes 2991 ($299 * 10 + 1$). In general the NAIF ID's for planets and satellites can be entered as the actual NAIF_ID multiplied by 10 without any confusion.
4. The NAIF ID's for asteroids are defined differently As of May 4, 1993, no asteroid data is available.
5. PHYSCON also prints the acceleration due to gravity (m/sec^2) and the escape velocity for the object (km/sec) along with the length of the day (hours) and the triaxial radii and equator/pole eccentricity for the spheroid.
6. If a new object is to be added to the McIDAS-eXplorer environment, or if any of the current parameters need to be updated, the subroutine

BODCON needs to be edited and recompiled. Naturally, all commands that call BODCON need also to be relinked. This is done primarily to ensure that the change is made deliberately and not inadvertently by editing constants from a file as with the NAIF physical constants kernel file (pck00003.tpc) which can be edited at will.

Note that BODCON constants are based on the pck00003.tpc file except when more current data has been available in scientific literature.

PLAREV - Flip the longitude system (east positive to west positive or vice versa) for an area with PLANAV created navigation. Useful for mapping earth data in the generalized perspective projection.

PLAREV <i>area_#</i>

Remarks

McIDAS uses a 0 - ± 180 longitude system for navigation, and for earth, the longitudes west of Greenwich meridian are considered positive and negative to the east. This convention is contrary to general usage and can create a reversed map than one intended if using PLANAV to attach navigation. PLAREV will reverse the convention.

POLEN - Program to convert Image Co-ordinates to RA-DEC (Voyager Images)

POLEN	FDS	LINE	ELE	OPT = TOEME	AREA =	SEDR =	LOC =
POLEN	FDS	RA	DEC	OPT = TOIMG	AREA =	SEDR =	LOC =
POLEN	FDS	OPT = TOIMG	POLE				
POLEN	FDS	OPT = TOIMG	POLE	C			

OPT is one of the following:

TOEME		conversion option for Line, Ele ---> RA & DEC (default)
TOIMG		conversion option for RA & DEC ----> Line, Element
TOIMG POLE		Calculates picture body POLE (default is ' ')
TOIMG POLE C		Corrects C-matrix for pic body (default is ' ')

Required arguments:

FDS = FDS number of the Voyager image (default=0.0)
LIN = Star or planet center line position in image
ELE = Star or planet center element position in image
RA = Input Right ascension for conversion (default=297.0)
DEC = Input Declination for conversion (default=-18.1)

OPTIONAL ARGUMENTS:

AREA = Area number (default is 0, which implies displayed frame)
SEDR = SEDR file name (default is 'VGRNSEDR')
LOC = CURSOR, next uses LIN,ELE keywords
(Default = 500.0 500.0)
IMAGE = RAW/GEOM (default is GEOM)
SKIP = Skip lines in searching for star centroid (default=1, no skip)
POLE = Source of pol RA & DEC
(default=SEDR values, else 42.81179327 & 298.857487705 satellite orbit).
SEDR values currently default to 42.8 & 298.9 respectively.
STARLOC = OPNAV (File containing star location)
SKY = HIST/AVG Method for subtracting background (AVG is default)
ROT = Roll angle offset (default=-0.91)
POLRAD = Polar radius of planet in image (Neptune default=24414.0)
STAR = Star identification (12 characters)
RA = Right ascension (default = 297.0)
DEC = Declination (default = -18.1)
COLOR = Plot color (3 is default)
TSIZE = Text size (default is =6 4)
SIZE = Star search region size (default is current cursor size)
LIST = 0,1,2 (Generates more debugging output, 0 is default)

These Keywords may be stored in the string table by using the TE command.

RESEAU - Lists and/or plots reseau data for Voyager spacecraft

RESEAU <OPTION> <COORDS> <SPCFT> <CAMERA> KEYWORDS =

OPTION = "LIST" - Lists coordinates on crt (or DEV = P,S)
"BOTH" - lists coordinates and plots on graphics.
May be abbreviated to "L", "P", OR "B".

COORDS = "NOM", "OBJ", OR "FND"
Default is FND for raw images, OBJ for GEOMED images.
May be abbreviated to "N", "O", OR "F" .

SPCFT = "A" = VOYAGER 1, "B" = VOYAGER 2 [def=current frame]
CAMERA = "WIDE" or "NARROW" angle, [def=current frame] May be abbreviated to "W" OR "N".

KEYWORDS:

AREA = Area number for "FND" reseau marks
(found reseaus are stored with area calibration)
RANGE = sets a min/max range of reseau marks to use in plotting; range must be 1..202.
COLOR = plotted reseau box & label colors (defaults = 1 2)
HEIGHT = height of reseau box label (default = 5)

EXAMPLES:

RESEAU
(Plots reseaus on the current displayed frame)

RESEAU P N
(Plots nominal reseaus on the displayed frame)

RESEAU P RANGE=20 40 COLOR=3 3
(Plots reseaus 20-40 in yellow)

RF - Locate reseaus in a Voyager image so that the vidicon geometric distortion can be removed using GEOM command

RF <i>area_#</i>

RF *area_#* RES=RBEGR END TOL=X.XX BOX=15 NOM=NO ZERO=
GEOM= YES/NO

AREA = UnGEOMed area in which to find reseaus (required)

KEYWORDS:

RES = n1 n2 | Reseau number range (Default is: RES= 1 202)
TOL = x.d | Threshold displacement from polynomial fit above which
 | reseaus will be adjusted to line up along line with neighbors
 | (default is TOL=0.6, so all reseaus deviating from
 | polynomial by more than 0.6 pixels will be shifted)

BOX = n | Maximum box size within which to search for a reseaux,
 | centered at its nominal position

NOM = YES or NO | to file nominal reseau locations instead of the fitted
 | locations (default=NO).

 | This implies reseaus are being found well beyond
 | their nominal locations and we are having trouble fitting to
 | specified tolerance. The image may be of poor quality, and
 | the reseaus cannot be easily located in noisy or low
 | contrast dark noise backgrounds.

ZERO = YES | default, initializes area storage block to zero before
 | adding found locations
 | = NO | overlays found locations on previous ones
GEOM = ON | Tests if word GEOM appears in audit trail (default). RF will
 | not modify the found reseau locations)
 | = OFF | Turns off GEOM test, so found reseau locations can be
 | modified (default=ON)

SEDRIN - Reformat SEDR data into navigation block for raw image

SEDRIN *area# fds# sedrfile target camera* REPLACE =

Program will attempt to pick up all parameters from the area or displayed frame. If navigation information already exists for the image the program will halt. Use keyin PLANAV to view the information SEDRIN stores in the navigation blocks for an area.

EXAMPLE:

SEDRIN 465

will search for a SEDR entry consistent with information stored with the image in area 465)

SEDRIN 465 FDS=4386645 REPLACE=YES

(repeat search with user specified FDS number)

KEYWORDS:

REPLACE = YES Forces rewrites of navigation block for area

AREA = Area number to add navigation (def = displayed frame)
(If navigation data already exists for the area, the REPLACE = YES keyword must be used.)

FDS = FDS number WITHOUT embedded decimal point (a range of acceptable values may be specified to adjust for varied data rates, since SEDR entries are given in starting FDS counts, not ending counts). **Defaults to word 20 in area directory)**

SEDRFILE = VGR1J, VGR2J, VGR1S, VGR2S, VGR2U, VGRNXXX

TARGET = JUPITER, SATURN, URANUS, NEPTUNE,
TITAN_CLOUDS, TITAN_SFC, other moons

		Voyager 1	Voyager 2
		-----	-----
CAMERA = NAIF_ID	Wide =	-31002	-32002
	Narrow =	-31001	-32001

Note that if the frame is not reloaded, the new navigation parameters will not be available for the displayed frame.

Always reload a frame after navigation is completed for an area, before running the MAP or PC keyins, or using the E key.

SEDRRD Load Voyager SEDR tape file records into LW file

SEDRRD sedrfile_name LWFILE PLANET= HEAD= "NO" (NO HEADER)
FDS=beginning_fds# ending_fds#

KEYWORDS:

INPUT = SEDR FILE NAME
LWFILE = MCIDAS LW FILE NAME FOR INDEX & DATA
PLANET = NEPTUNE or OTHER (OTHER IS DEFAULT)
(Neptune SEDR has a larger record size than others)
HEAD = YES/NO INDICATES PRESENCE OF HEADER RECORD IN FILE. (YES IS
DEFAULT)
FDS = RANGE OF FDS COUNTS TO ENTER INTO LW FILE (omit period).
(DEFAULT IS ALL RECORDS IN TAPE FILE)
COUNT = RANGE OF RECORDS TO ENTER INTO LW FILE
(DEFAULT IS ALL RECORDS IN TAPE FILE)
DEBUG = YES (Display INT, HEX, and ASCII listing of each record)

Remarks:

This command creates an indexed LW file from the SEDR tape records. As there is no on-line 9-track tape drive available on the system, it is assumed that SEDR file is copied onto disk first. The command actually accesses this file to create the LW file. The purpose of this command is to provide access to all of the SEDR words (which vary depending on the encountered planet) so that the pointing of the camera system can be up-dated, particularly the roll angle.

SPICEIN - Reformat SPICE data into navigation block for planetary image)

SPICEIN *area# fds# sedrfile* MODFDS = (-decrement) PART = <num> UTC

PARAMETERS:

- area** - Area number to add navigation data to (If navigation data already exists for the area, the area number should be negative to force replacement of existing data)
- fds** = FDS number without embedded decimal point (Defaults to FDS of area image)
- sedrfile** - VGR1J, VGR2J, VGR1S, VGR2S, VGR2U (NOTE: Program will default to using area information unless SEDRFILE is in string tables as a keyword, which then will force use of the name in string table.)

KEYWORDS:

- REPLACE** = 1 - Rewrite the existing SPICE navigation block
- LAT** = CENTRIC/GRAPHIC
- MODFDS** = Decrement for FDS when using area number and a simultaneous wide angle image. (MODFDS=-5 subtracts 5 from area FDS# before searching SEDR file.)
- PART** = Partition number for converting FDS to s/c time from launch (digit + /). Default time from launch is calculated for the first encountered FDS number. [A partition is a set of continuous FDS numbers between resets. A partition number will distinguish between two or more identical FDS counts. This field is optional. If UTC shutter time is not calculated correctly, you are probably in the wrong partition.]
- UTC** = A Universal time string *YYYY-DDD // HH:MM:SS.SSS (must be last keyin parameter) *1989-192 // 13:54:31.334
- TOL** = Search tolerance in FDS counts (default is 0.1)

EXAMPLE:

SPICEIN *area#*
(Searches SPICE data using area info)

NOTE: This key-in is not yet operational

TGET - Restore one or more McIDAS area files from tape to disk (i.e. in /mcidas/data sub-directory) from a DAT or an Exabyte cartridge written using TPUT.

TGET *tarea1 tarea2 darea* DEVNUM =

tarea1 = beginning tape area (required)
tarea2 = ending tape area (DEFAULT = tarea1)
darea = beginning tape area (required)

KEYWORDS

DEVNUM = i
(DEFAULT = 0)

Notes

TPUT writes the McIDAS area directory as well as the Data Description Block (DDB) attached to the area directory when saving the data to tape. **TGET** performs the reverse task, i.e., it copies the directory and the DDB from tape to the McIDAS data subdirectory when restoring the area. Thus all of processing history and navigation data are restored as they were when the data were initially written to tape.

Enhancements desired:

TGET should STAMP the area noting when the area was restored and from which tape/file it was restored.

TILES - Display a Magellan BROWSE format image from an area and show the constituent sub-frames (or tiles or framelets)

TILES	area#	frame#
--------------	-------	--------

PARAMETERS:

area# | Area containing browse image
frame# | Frame to load and grid

KEYWORDS

AREA = area_# | area containing the Magellan browse frame
FRAME = frame_# | frame # on which to display the browse area
COL = level | color to write the sub-frame id's in
OFF = linoff ieloff | pixel offset for the id#
SIZE = pixels | size of the sub-frame id label characters. Default is 7 pixels high

Remarks:

This program is a combination of the DF keyin and a special gridding routine specifically used for Magellan browse images. Normally, this keyin is SQXed by MCDROM, but you may call it separately to restore the browse image to the McIDAS screen if the browse frame was overwritten. 7 x 8 tiles assumed.

The display frame can be any size. TILES will display the area to fit the frame by appropriately scaling it down. The location of the component tiles (or sub-frames or framelets) is shown by a grid and the tile numbers are shown as well.

Currently TILES does not check the area to see if it indeed contains a browse frame.

TLST-Lists areas on a tape. SCSI tape drives only.

TLST VOLNAM = DEVNUM =

KEYWORDS:

VOLNAM = s (DEFAULT s=UNKNOWN)
DEVNUM = i (DEFAULT i=0)

TLST lists the contents of an area save tape written with **TPUT** on either the Exabyte or the DAT drive. The device number is likely to be site dependent.

Eventually this device number should be included in a setup file and the DEVNUM should be replaced with DEVICE = EXA or DAT.

TPUT -Save one or more McIDAS area files from disk to tape (i.e. in /mcidas/data sub-directory).

TPUT darea1 darea2 keywords

darea1 = beginning disk area (required)
darea2 = ending disk area (DEFAULT = darea1)

KEYWORDS:

APPEND = Y/N (DEFAULT=Y)
APPEND should be N for Exabyte and 1/4 inch

DEVNUM = i (DEFAULT=0)

Notes

When the areas are written onto the tape, all of the navigation information related to that area that is accessible using the LA or the LISTNAV commands is also stored along with it. Thus, the navigation, processing history etc. can be restored with the **TGET** command at a later date.

This utility is similar to the **PUT** and **GET** commands available on the mainframe system, except that it is currently restricted only to area format data files. The other difference is that it is assumed that the user will physically interact to mount and dismount the tape cartridge from either the DAT or the Exabyte drive.

The data can be "restored" by using **TGET** onto another workstation if McIDAS-X and the the PDADS extensions have been installed.

Enhancements desired:

TPUT should STAMP the area noting when the area was saved and to which tape/file it was saved. The tape listing should note when the tape was written and have an id issued to it.

USCLAS - Spectrally classify a multi-banded image using unsupervised multispectral classification.

USCLAS inarea outarea

PARAMETERS:

- inarea - area to classify
- outarea - Classified area with M spectral classes.

KEYWORDS:

- BANDS** = BANDS= BAND1 BAND2 ... BANDN
Band numbers from the area to classify (up to 6). Default is all bands present in the area.

- CLASES** = initial# of classes presented. Default is 100
- SKIP** = Pixel skip factor for iterative classification Specified numbers of lines and elements are skipped. MUST BE < 8. DEFAULT IS 4

- ITER** = Maximum # of iterations allowed. Default is 35.
- MERGE** = Cluster Merging factor, 0 TO 2000, If a divergence < MERGE then merge two classes.
0 = NO MERGING. DEFAULT IS 1400
- SPLIT** = SPLITTING FACTOR, 1 TO 10, IF BIG/SMALL DIMS. > SPLIT == SPLITTING
0 = NO SPLITTING. DEFAULT IS 3.0
- NULL** = DATA DROP-OUT DECISION.
ANY: CLASSIFY AS ZERO IF ANY BAND HAS 0.
ALL: CLASSIFY AS ZERO IF ALL BANDS = 0.
DEFAULT IS ALL
- MINPIX** = smallest # of pixels required in a class. DEFAULT = 0.01% OF DATA
- STRETCH** = LINE or STRETCH. *Output color stretch type.*
LINE: Linear stretch for class colors
HIST: histogram equalization stretch
DEFAULT = HIST

89091810242



b89091810242a

WHERE - List inventory of the image data imported within McIDAS-eXplorer as identified by target object, spacecraft source and selected image identifiers such as filter, camera etc.

WHERE	FRAME <i>1st_frame last_frame</i>
WHERE	AREA <i>first_area_# ending_area_#</i>

Remarks:

If the FRAME option is used, each of the displayed frames are annotated on the graphics frame with a one line summary of the displayed image (if any) and the area_# which was used for that frame display. Similarly, if the AREA option is specified, then if that area has been displayed on a particular frame, then that frame number is also indicated on the one line summary of each area.