Mission Simulation Programs

Dr. James F. Blinn

JPL Computer Graphics Laboratory

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1.0 A Few Notes

All commands must be exactly four letters long, commands listed below that are shorter than four letters must be blank filled on the right. Most commands have one or more parameters, with most of these parameters optional. If a parameter is not specified, is previous value is normally used. Sometimes, omission of parameters will cause the program to calculate appropriate values.

Before any of the color picture drawing commands can be executed, the indirect command file [210,212]VGRINI must have been executed during the current system up status. This action must be performed by a system operator (just ask nicely, they won't bite). This operation will become unnecessary after a little more software development.

Commands are subject to change at any time. This software is not supported, but problem reports will be taken and probably fixed. The Voyager programs reside in the VOYAGR account; the Pioneer 11 programs are in the PIONEER account.

2.0 The Switches

A few of the PS switches are used in determining what to draw in a frame. The actions are performed if the switches are set. Switch 0 displays the encounter time in the lower left corner of the screen. This time is relative to closest approach. Switch 1 is used to terminate commands. All commands that involve dynamic displays (e.g. running the simulation or using the knobs) are terminated whenever switch 1 is set. Switch 2 causes a freeze action for the MOVI command. Switch 5 will display the names of the various bodies in the simulation. Switch 7 causes the Voyager scan platform azimuth and elevation angles to be displayed next to the time in the lower left corner of the screen. Switch 10 removes the back sides of spherical bodies from the display. Switch 11 displays a box on the screen indicating the portion of the image which would be transferred to the frame buffer. This is necessary because of the different aspect ratios of the two screens. All other switches are ignored.

3.0 General Commands

These commands apply to all versions of the Voyager and Pioneer programs. Other commands will divide into categories according to what data they operate on.

3.1 READ fname

Goes to the given file and reads commands from there until end-of-file. Be careful always to make sure an "SY:" is present in the file name; otherwise the program will attempt to read commands from the terminal.

4.0 Orbit Description

4.1 ORBS file.BIN

Reads in an orbit description file made with the ORBBIN program (described later).

5.0 Time Manipulation

5.1 TIME hh [,mm [,ss]]

Sets time relative to periapsis for viewing the scene. Time before closest approach is negative with a minus sign distributing over all three fields. E.g.

TIME -20,30

is equivalent to twenty hours, 30 minutes before periapsis.

5.2 MOVI mm

Runs time forward by an increment of -mm- minutes per frame until switch 1 is set. Switch 2 will cause the program to freeze on the current frame. -mm- may be a floating point value.

6.0 View Selection

6.1 FOV angle

Sets the field of view of the observer's eye to -angle- degrees. The default field of view is 45 degrees.

6.2 FROM name

Sets the body relative to which the observer is positioned. The observer is offset from this body by a vector derived by one of two mechanisms, selected by the DIST or the FIXF commands. -name- is the upper case name of a body, or a unique prefix string thereof, e.g. "SAT".

6.3 FIXF x,y,z

Sets the offset mode from the FROM body to "fixed". The observer will be offset from the body by the constant vector (x y z). If (x y z) is not given, it will be calculated from the current viewing offset, as set by other modes. Thus, omission of an explicit vector allows changing of modes without altering the picture. This vector can, in turn, be altered by the ADJ command or by interpolation between movie keyframes.

6.4 DIST a,x,y

Sets the offset mode from the FROM body to "screen relative". The observer will be offset from the body at distance -a- kilometers and in a direction which causes it to appear at the screen location (x y) -x- and -y- should be in the range [-1.0,+1.0], where abs(a)=1.0 represents a screen boundary. If one of the parameters is not given, they will be calculated from the current viewing offset, as set by other modes. Thus, omission of an explicit vector allows changing of modes without altering the picture.

6.5 PARS

Prints the viewing parameters for the current frame.

6.6 ADJ

Allows the user to adjust the viewing parameters with the knobs. Switch 1 terminates the command. Knobs 0,1,2 adjust foreground X, Y, and distance, respectively. Knobs 4 and 5 adjust reference body X and Y.

6.7 AT #,x,y,z (or) AT name,x,y

Sets the direction in which the viewer looks. This direction is calculated according to one of two modes. The first form sets "constant direction" mode. The viewer will look in the constant vector direction (x y z); the length of this vector is not used. The second form sets "body relative" mode. The viewer will look in the direction which causes the body -name- to appear on the screen at coordinates (x y) (as with the DIST command). -name- is given as with the FROM command. In either-case, omission of a numeric parameter causes values to be calculated from the current viewing direction, i.e. it allows changing modes without altering the current picture.

6.8 TURN angle

Modifies the AT viewing direction vector by rotating it -angle- degrees about the Z axis. This is useful primarily for creating sets of overlapping views to be mosaicked into panoramas.

7.0 Voyager Spacecraft Simulation

These commands apply only to Voyager related simulation programs; at this writing VOYAGR and VOYMOV.

7.1 AIM body (or) AIM #,az,e1

Aims the scan platform at the center of the body, where body is specified as with the FROM command. The “#" form will point the scan platform at the given azel.

7.2 GYRO number,a,angle

-number- defines a maneuver number. -a- is 1, 2, or 3 for roll, pitch, or yaw. -angle- is the number of degrees to turn.

7.3 THRU instrument,scale

-instrument- is in the range [0,9] and corresponds to Voyager specifications. Zero corresponds to the Voyager itself.

Instruments

1. narrow angle TV camera
2. wide angle TV camera
3. infrared interferometer spectrometer
4. photopolarimeter 1/16 degree fov
5. photopolarimeter 1/4 degree fov
6. photopolarimeter 1 degree fov
7. photopolarimeter 3.5 degree fov
8. ultraviolet spectrometer airglow port
9. ultraviolet spectrometer occultation port

-scale- is a factor used to shrink or expand the image. A scale factor of one maps the instrument image to the full screen; a scale factor of 0.1 maps the instrument range to 1/10 of the screen.

7.4 ADJP

Adjusts the spacecraft parameters with the knobs until switch 1 is set.

8.0 Movie Preparation

These commands are oriented towards setting up the key frames necessary for an animated sequence. Each key frame consists of a list of necessary parameters set by the viewing, time, and spacecraft simulation commands. When an intermediate frame is calculated, these parameters are interpolated in a reasonable manner. The movie descriptor list has 30 slots (more or less).

8.1 CLRF

In the VOYAGR program, clears the list. In the PIOMOV program, the key frame ID must be specified, with a value of zero clearing the entire list.

8.2 SETF n,int

-n- is the frame number, an integer in the range [1,32767]. -int- is a flag word which indicates the type of interpolation for various parameters. Each parameter corresponds to a bit in this word. A zero value for a bit means linear interpolation, a one value means cubic interpolation.

8.3 WRTF file.xM

Stores the list on the given file. The file name is user determined, -x- indicates the mission. Current "x"s are "V" for Voyager and "P" for Pioneer 11. If the file name is not given the list is displayed on the terminal.

8.4 DRAW

Makes a color picture of the current frame.

8.5 PLAY start,end,inc

Plays through the movie descriptor list, interpolating between key frames and displaying every -inc- frames. Switch 1 will terminate the command. The default value for -end- is -start-, and the default value for -inc- is 1.

8.6 LOOP start,end,inc

Combines the effects of PLAY and DRAW; i.e. for each iteration, the program does a DRAW, saves the frame buffer image on disk (in a VMxxxx.PIC file, where xxxx is the frame number), and goes on. Switch 1 will also terminate this process.

9.0 Jupiter Simulation

These commands apply only to Voyager related simulation programs.

9.1 SPOT degrees

Sets the red spot on Jupiter -degrees- west of the prime meridian in Jupiter system 2.

10.0 Footprint Calculation

10.1 FOOT inst (VOYMOV program only)

Displays the footprint of instrument -inst-. The instrument numbers are given above.

11.0 Orbit Descriptor Files

Descriptions of solar system bodies, their satellites, and spacecraft are given in classical orbital elements. The coordinate system for all bodies is Earth Mean Ecliptic of 1950. Source entries should be placed in a file of the name x.ORB, where -x- represents some meaningful name. Source files are converted to binary by the ORBBIN program in [210,212], and the results should be placed in a file of the name x.BIN, where "x" is as above. Input is free format, so numeric entries must be terminated by a comma. The first line of the ORB file is the Julian date at epoch. This is followed by 7 line data blocks for each body in the system. Each data block has the format:

1. NAME [KEY]
2. A,EE,AI,
3. 0,W,T,
4. RE,RP,GM,RATE,
5. P1,P2,P3,
6. E1,E2,E3,
7. ROTS,ISW,

Line 1 gives the name of the object; the letters should be in upper case. Special case bodies should specify a key (as given below) so that the software will know about them. The format for line 1 is (1X,15A1,I3).

Lines 2 and 3 are the classical elements: A is the semimajor axis in kilometers, EE is the eccentricity of the orbit, AI is the inclination angle in degrees, 0 is the longitude of the ascending node, W is the argument of periapsis, and T is the mean anomaly at epoch in degrees.

RE is the equatorial radius in kilometers, RP is the polar radius in kilometers, GM is the universal constant of gravitation multiplied by the mass of the central body. GM is used to calculate the revolution rate of the body. This is inaccurate over long periods of time if there are perturbations by other bodies. The revolution rate may be explicitly set by specifying GM=0 and placing the desired revolution rate (days per revolution) in RATE.

P1, P2, and P3 specify the unit vector of the axis of rotation. E1, E2, and E3 are the unit vector of the prime meridian at the epoch; this vector should be perpendicular to P1P2P3.

If E1, E2, E2 are all zeroes, the software will calculate a prime meridian pointed at the central body.

ROTS is the number of rotations per day. ISW is optional. If present, a value of zero specifies that the programs should use the given rotation rate, if nonzero, the software will calculate a rotation rate equal to the revolution rate. If ISW is not present, the program will assume a value of zero.

Special Body Keys

1. Jupiter
2. Saturn
3. Uranus
4. spacecraft
5. Sun
6. Earth
7. Halley's Comet
8. Tempel 2
9. Halley probe
10. KCET comet
11. KCET comet
12. KCET comet
13. KCET comet
14. KCET comet
15. reserved