Multimission Software Interface Specification (SIS)

NAIF
Orbit Number File

ORBNUM

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PURPOSE: This SIS describes the format and content of a Navigation and Ancillary Information Facility Orbit Number File. These files contain the start and stop times of each numbered orbit as well as some geometry associated with the orbit. An ORBNUM file is not a SPICE product, although it is derived from SPICE files and SPICE Toolkit software.

CHANGE LOG

Version	Date	Page Nos.	Reason
1.0	27 May 2000	All	New multimission version.
1.1	17 Jan 2004	Assorted	Reflect additional program capabilities

List of Acronyms

AMMOS	Advanced Multimission Operations System
ASCII	American Standard Code for Information Interchange
FTP	File Transfer Protocol
JPL	Caltech/Jet Propulsion Laboratory
MMO	Multimission Operations Office
NAIF	Navigation and Ancillary Information Facility
ORBNUM	Orbit Number File
PDB	Project Data Base
PDS	Planetary Data System
SCLK	Spacecraft Clock (time system)
SFDU	Standard Formatted Data Unit
SIS	Software Interface Specification
SPICE	S-, P-, I-, C- and E-kernels; the principal logical data components of a particular NASA ancillary information system
UTC	Coordinated Universal Time

Section 1
General Description

1.1 Purpose of Document

This Software Interface Specification (SIS) describes the contents and structure of an Orbit Number File, generally referred to as an ORBNUM file, produced by the ORBNUM program built and operated by the Navigation and Ancillary Information Facility (NAIF).

1.2 Scope

This is a multimission SIS, applicable for all flight projects where a NAIF ORBNUM file capability is deployed.

1.3 Reference Documents

No.	NAIF Document ID	Title
1.	339	ORBNUM User's Guide
2.	168	SPK Required Reading
3.	254	PCK Required Reading
4.	222	SCLK Required Reading

These reference documents are included in each delivery of the SPICE Toolkit.

1.4 Functional Description

A SPICE Orbit Number File (ORBNUM) defines the time boundaries of each orbit, and optionally provides certain geometric parameters associated with each orbit. SPICE-based orbit number specification files are produced using a program named ORBNUM (Ref. 1), constructed from SPICE Toolkit software. The ORBNUM program uses SPICE SPK (ephemeris), PCK (planetary constants), SCLK (spacecraft clock coefficients) and LSK (leapseconds) kernel files.

ORBNUM calculates orbit increments at a user-selected “event time” where the “event” is one of four orbit locations: apoapsis passage, periapsis passage, ascending node passage, or descending node passage.

1.4.1 Data Source, Destination and Transfer Method

ORBNUM output files may be made available to flight projects and science teams through whatever mechanism is used for providing access to ancillary data products, such as a Project Database (PDB), a File Interchange System (FIS) or a SPICE Server.

1.4.2 Labeling and Identification

An ORBNUM file does not contain any file-level internal labels or metadata. It does contain column labels for each output item.

1.4.3 Assumptions and Constraints

The SPK file(s) used by ORBNUM must contain data for an object (normally a spacecraft) that is in orbit around a known central body.

Section 2
Data Object Definition

2.1 Structure and Organization

SPICE-based ORBNUM files are ASCII files, with one set of output information per line. Each line contains a set of data for one orbit. Data items on a given line are separated by white space. (Note that white space is also used as the delimiter between the year, month, day and hour fields in the two UTC times.) The amount of white space between data items may vary, so users of ORBNUM files should NOT count spaces to determine the start of a given data item.

The output is in columnar format. Each column has an underlined name, so that the first two lines in each ORBNUM output file must be skipped to reach the first line of data. The column header delimiter is not restricted to any particular character.

The SPICE Toolkit contains modules that may be useful in reading data from an ORBNUM file. Look at the source code headers of the following modules for further information:

RDTEXT or rdtext_c	Read a line of text from an ASCII file
TPARSE or tparse	Parse a UTC time string
NPARSD or nparsd	Parse a character string to a double precision number
NPARSI or nparsi	Parse a character string to an integer number

2.2 Data Format and Definition

This SIS describes the current contents and format of the SPIC Orbit Number file. It is noted that earlier versions of the ORBNUM file (e.g. MGS and Odyssey) have a slightly different format.

Two significant kinds of data items are present: column names and data values.

2.2.1 Column Names

The column names that may appear in an ORBNUM file are shown below. Note that some are required (always present) and some are optional outputs, depending on instructions to the ORBNUM program. Of the four that are required, three of them will be taken from one of two sets, as shown.

Required

No.
Event UTC <event name>
Event SCLK <event name>
OP-Event UTC <opposite event name>

Optional

SolLon
SolLat
SC Lon
SC Lat
Alt
Inc
Ecc
LonNode
Arg Per
Sol Dist
Semi Axis

The “event name” and “opposite event name” are each one of:

PERI	for periapsis passage
APO	for apoapsis passage
A-NODE	for ascending node passage
D-NODE	for descending node passage

If the event name is “PERI” then the opposite event name is “APO,” and vice-versa. If the event name is “A-NODE” then the opposite event name is “D-NODE,” and vice-versa.

The single row of column names is followed by a single row of column delineators in the form of segments of the equals sign (“=======”), after which begins the orbnum data.

2.2.2 Data Item Descriptions and Formats

A description of each of the required and optional data items found in an ORBNUM file is given below. Angles are in degrees and distances are in kilometers. Longitudes are measured between 0 and 359 degrees. Latitudes are measured between –90 and +90 degrees. All contents are ASCII. Orbit numbers are represented as integers. UTC times are presented as “YYYY MMM DD HH:MM:SS”. SCLK times are presented as a character string formatted according to the conventions used in SPICE for the particular mission’s spacecraft clock [4]; a typical representation of SCLK is “p/nnnnnnnnnn.mmmmm”, where the “p/” provides the partition number and delimiter. “p” is generally “1”. All other numbers are represented as floating point values.

No. Orbit number.

[Default initial value is 1, but orbit number can be negative, zero or positive integer.]

UTC Periapsis	The UTC epoch of the moment of periapsis passage.
SCLK Periapsis	The spacecraft clock reading at the moment of periapsis passage.
UTC Apoapsis	The UTC epoch of the moment of apoapsis passage.
SCLK Apoapsis	The spacecraft clock reading at the moment of apoapsis passage.
UTC A-NODE	The UTC epoch of the moment of passage of the spacecraft through the equatorial plane of the central body (as defined by data obtained from a SPICE PCK file), transitioning from "south" to "north."
SCLK A-NODE	The spacecraft clock reading at the moment of passage of the spacecraft through the equatorial plane of the central body (as defined by data obtained from a SPICE PCK file), transitioning from "south" to "north."
UTC D-NODE	The UTC epoch of the moment of passage of the spacecraft through the equatorial plane of the central body (as defined by data obtained from a SPICE PCK file), transitioning from "north" to "south."
SCLK D-NODE	The spacecraft clock reading at the moment of passage of the spacecraft through the equatorial plane of the central body (as defined by data obtained from a SPICE PCK file), transitioning from "north" to "south."
SolLon	The central-body-fixed, geodetic longitude of the sun at the instant of time when the orbit number advances
SolLat	The central-body-fixed, geodetic latitude of the sun at the instant of time when the orbit number advances
SC Lon	The central-body-fixed, geodetic longitude of the spacecraft at the instant of time when the orbit number advances
SC Lat	The central-body-fixed, geodetic latitude of the spacecraft at the instant of time when the orbit number advances
Alt	Altitude of the spacecraft above the central body’s reference surface defined by data in a SPICE PCK file at the instant of time when the orbit number advances

Inc	Inclination of the osculating orbit, relative to the equator of the central body as defined by data in a PCK file, determined at the instant of time when the orbit number advances
Ecc	Eccentricity of the osculating orbit determined at the instant of time when the orbit number advances
LonNode	Longitude of ascending node of the osculating orbit, relative to the equator of the central body as defined by data in a PCK file, determined at the instant of time when the orbit number advances
Arg Per	Argument of periapsis of the osculating orbit, relative to the equator of the central body as defined by data in a PCK file, determined at the instant of time when the orbit number advances
Sol Dist	The distance (range) from the center of the central body to the Sun at the instant of time when the orbit number advances
Semi Axis	Semi-major axis of the osculating orbit determined at the instant of time when the orbit number advances

2.2.2 ORBNUM Example

Because an ORBNUM file contains lines of approximately 180 characters in length, an example is not provided in this document. Any staff member of the NAIF Team can provide users with a sample ORBNUM file.