What's Been Recently Added to SPICE?

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SPICE Toolkit N66

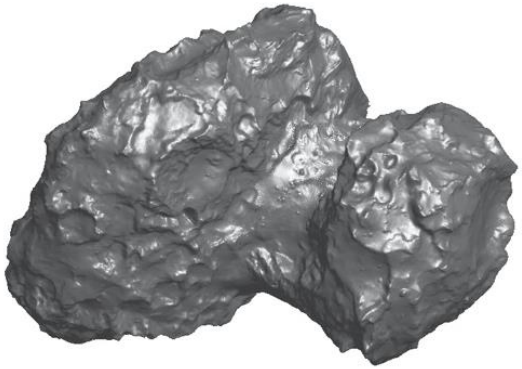
Navigation and Ancillary Information Facility

- **Released in April 2017**
- **Implemented in Fortran 77, C, IDL and MATLAB**
- **Available at https://naif.jpl.nasa.gov/naif/toolkit.html**
- **Also available as an alpha-test Java Native Interface (JNI) Toolkit at https://naif.jpl.nasa.gov/pub/naif/misc/JNISpice**
- **Python interfaces implemented by others are expected to be updated to the N66 Toolkit:**
  - **Andrew Annex: https://github.com/AndrewAnnex/SpiceyPy**
  - **Mark Showalter/Robert French: https://github.com/SETI/pds-tools**

Major New N66 Capability

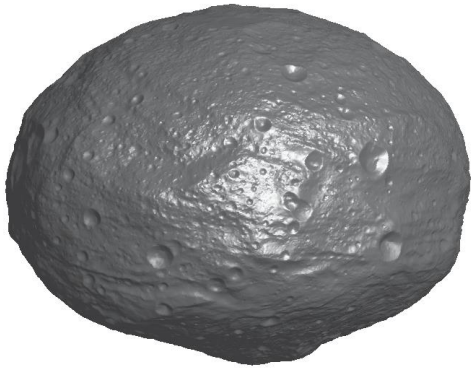
Navigation and Ancillary Information Facility

- **The tessellated plate portion of the Digital Shape Kernel (DSK)**
  - **Provides high precision shape models of irregularly shaped bodies**



Churyumov-Gerasimenko DSK model

(4000512 plates)



DAWN's Vesta DSK model

(3145728 plates)

DSK Subsystem

Navigation and Ancillary Information Facility

- **Digital Shape Kernel (DSK) subsystem**
  - **DSK capabilities are fully integrated into the SPICE Toolkit**
  - **More functionality, more thorough testing and more thorough documentation as compared to the previous (alpha-test) version**
  - **N66 retains the old alpha-test APIs for backwards compatibility purposes**

DSK Subsystem Utilities

Navigation and Ancillary Information Facility

- **MKDSK: means for producing a tessellated plate DSK from a number of popular shape model data formats**
- **DSKEXP: means for exporting DSK data into common text 3D shape formats**
- **For more information please see the poster "The SPICE Digital Shape Kernel (DSK) Subsystem" by Nat Bachman**

Additional N66 Capabilities

Navigation and Ancillary Information Facility

- **New routines added in support of the new DSK capability:**
  - **LIMBPT, TERMPT, LATSRF, ILLUMF, SRFNRM, DSKXV, DSKXSI**
- **Already existing SPICE high level geometry routines have been updated to support DSK as well as ellipsoidal shapes:**
  - **SINCPT, SUBPNT, SUBSLR, ILUMIN, ILLUMG, OCCULT, GFOCLT, GFOCCE**
- **Many new Icy and Mice wrappers**
- **The two-line element SPK type has been upgraded to use high-precision Vallado algorithms**

SPICE Tools

- **The WebGeocalc Tool (WGC)**
  - **A web-based Graphical User Interface to a SPICE geometry engine**
  - **Allows one to easily make many kinds of geometry computations without having to write code**
  - **Has access to a large collection of SPICE kernels**
  - **Is being updated to work with DSK shape models**
  - **https://naif.jpl.nasa.gov/naif/webgeocalc.html**

WebGeocalc Menu

Navigation and Ancillary Information Facility

Geometry Calculator

State Vector	Position and velocity of target relative to observer.
Angular Separation	Angle between 2 targets as seen from an observer.
Angular Size	Apparent size of a target as seen from an observer, as an angle.
Frame Transformation	Transformation between 2 reference frames.
Illumination Angles	Sunlight incidence, emission, and phase angles at a point on a target body as seen from an observer.
Sub-solar Point	Sub-solar point on a target body as seen from an observer.
Sub-observer Point	Closest point on a target body to an observer.
Surface Intercept Point	Coordinates of the intercept point of a ray in a reference frame, as seen from an observer.
Orbital Elements	Orbital parameters of a target body relative to a central observing body.

Geometric Event Finder

Position Finder	Find time intervals when target coordinate satisfies a condition.
Angular Separation Finder	Find time intervals when the angle between 2 bodies, as seen by an observer, satisfies a condition.
Distance Finder	Find time intervals when the distance between a target and observer satisfies a condition.
Sub-Point Finder	Find time intervals when the sub-observer point on a target satisfies a condition.
Occultation Finder	Find time intervals when a target is occulted by, or is in transit across, another body.
Surface Intercept Finder	Find time intervals when the surface intercept of a ray in a reference frame satifies a coordinate condition.
Target in Field of View	Find time intervals when a target is within the field of view of an instrument.
Ray in Field of View	Find time intervals when a specified ray is within the field of view of an instrument.

Time Calculator

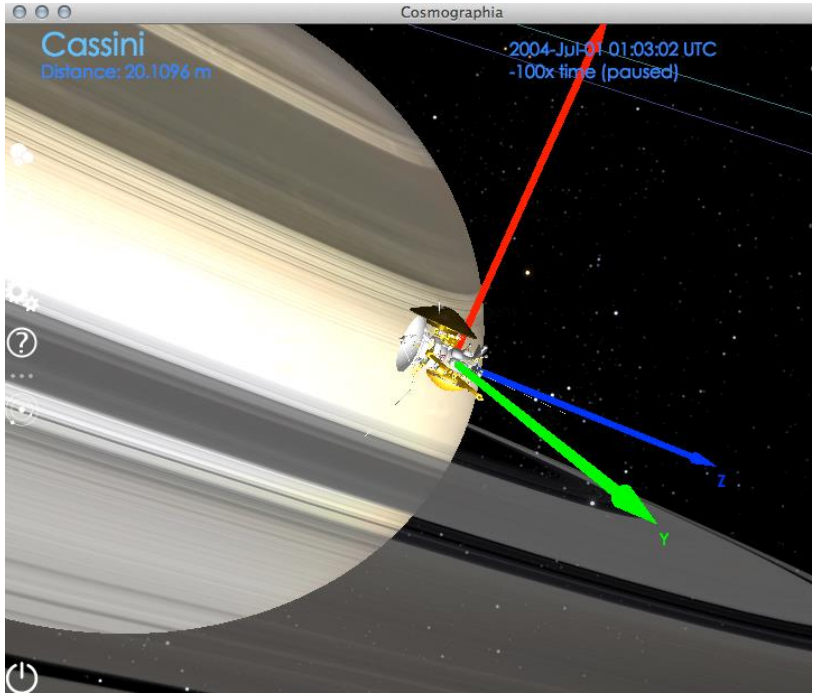
Time Conversion	Convert time values from one time system to another.

SPICE Tools

- **Cosmographia:**
  - **A SPICE-enhanced 3D mission visualization tool**
  - **Work in progress:**
    - ✓ **Modernization of infrastructure**
    - ✓ **Some time control and interface changes**
  - **https://naif.jpl.nasa.gov/naif/cosmographia.html**

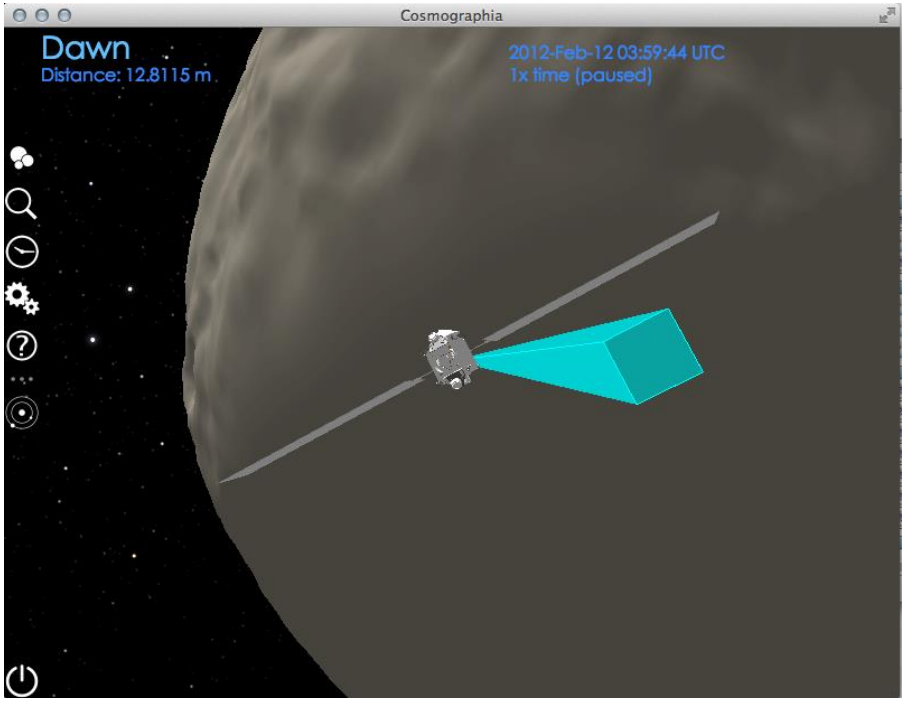
Cosmographia Screen Shots

Navigation and Ancillary Information Facility



Cassini at Saturn

Spacecaft XYZ Axes

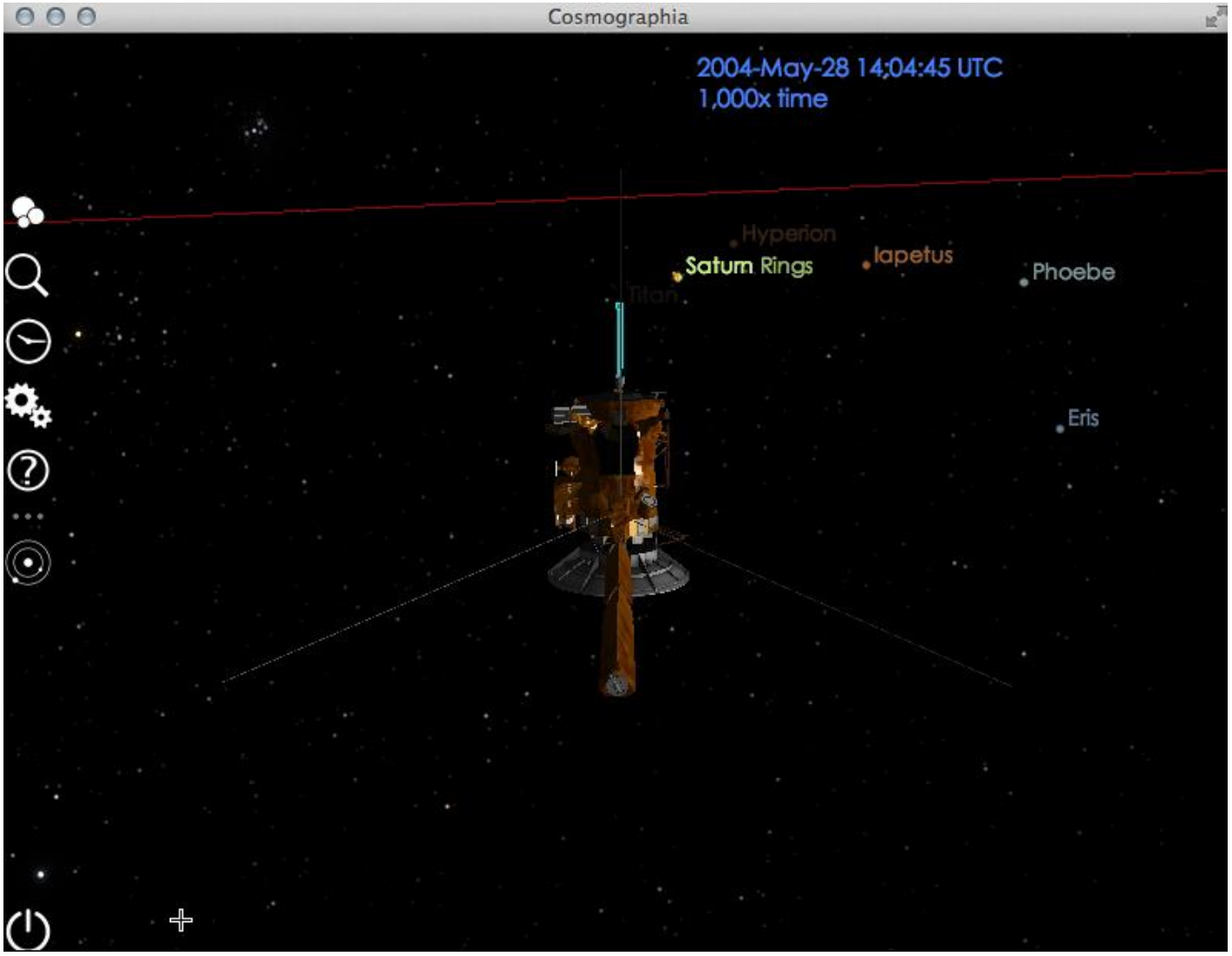


DAWN at Vesta

Framing Camera Footprint

Cosmographia Movie

Navigation and Ancillary Information Facility



SPICE Tools

Navigation and Ancillary Information Facility

- **For more information please see the poster: “WebGeocalc and Cosmographia: Modern Tools to Access SPICE Archives” by Boris Semenov et al**
- **Also see the WebGeocalc and Cosmographia demonstrations on Tuesday at 1:30 in the Agassiz breakout room**

SPICE Ongoing Developments

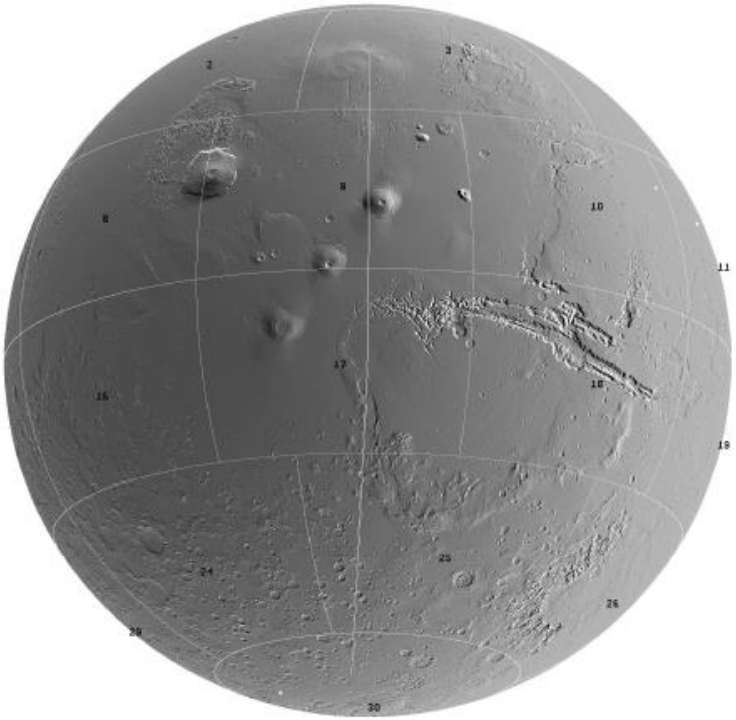
Navigation and Ancillary Information Facility

- **Additional geometry finder capabilities**
  - **Please see "The SPICE Geometry Finding Subsystem" poster by Ed Wright**
- **C++ implementation of the SPICE Toolkit**
  - **Object-oriented design**
  - **Support for concurrency**
  - **Some performance improvements**
  - **Support for all existing SPICE kernel types**
  - **Expected to be a 2-to-3 year development**
- **NAIF will continue supporting all existing SPICE Toolkits** 

SPICE Ongoing Developments

Navigation and Ancillary Information Facility

- **Completion of the digital elevation model (DEM) portion of the DSK subsystem**



SPICE Training

Navigation and Ancillary Information Facility

- **Domestic SPICE Beginner's training class on November 7-9, 2017, near Pasadena**
  - **Watch NAIF's "Announcements" webpage for details: https://naif.jpl.nasa.gov/naif/announcements.html**