

## **SPICE Newsletter**

(Some new news; some not-so-new news)

December 2014

(Updated February 2015)

### **Recent and Next SPICE Toolkit Releases**

NAIF released the version N65 Toolkit suite in July 2014. This was way later than had originally been envisioned. The delay resulted mostly from unanticipated work on other projects and the decision to include in N65 more new and improved capabilities than had been planned.

We contemplate focusing on the first official release of part of the "new" Digital Shape Kernel (DSK)—that portion using a tessellated plate model for small, irregularly shaped bodies—as the driver for the N66 Toolkit release. The second half of 2015 is a guess when N66 might be available.

### **Digital Shape Kernel (DSK) Subsystem**

Two new means for modeling solar system body shapes are joining the existing tri-axial shape model. Both are part of the new Digital Shape Kernel (DSK) subsystem.

#### **- Tessellated Plate Model Component of the DSK**

At least a few scientists associated with the Rosetta and DAWN missions are using the alpha-test version of the tessellated plate Digital Shape Kernel. Their efforts show some success with the DSK and also illuminate areas where more functionality and means to make faster computations would be helpful. We're hoping to provide a first official release of this portion of the DSK in our next (N66) Toolkit release in the second half of 2015.

#### **- Digital Elevation Model Component of the DSK**

While it may sound strange, in addition to tessellated plate data, the DSK subsystem can also hold digital elevation model (DEM) data. Such data can be used to better represent the shapes of large, regular bodies such as earth, the moon, Mars and Mercury. This capability has been built with the earth science mission named Soil Moisture Active and Passive (SMAP) as the first user. SMAP will launch in January 2015. When we'll be able to include this portion of the DSK in an official Toolkit release is not yet clear.

In both cases the source shape data come from outside of NAIF. SPICE simply provides a standard way of packaging shape data and then computing a variety of observation geometry based on those shapes.

You can learn more about the Digital Shape Kernel by looking at the "Shape model preview" tutorial accessed from the NAIF website: <http://naif.jpl.nasa.gov/naif/tutorials.html>

### **JNI Spice**

In February of 2010 NAIF announced the availability of an alpha-test version of Java Native Interface (JNI) Toolkits. While some updates have been made, we still have not completed an official set of JNISpice Toolkits and haven't a prognosis for when this will be finished.

## **Python SPICE**

Some work was done long ago, but there has been no advancement since then. Unfortunately we haven't a prognosis for when a PySPICE set of Toolkits will be completed and released. (Some SPICE users have made their own, partial versions of a Python-CSPICE interface: you could inquire on the "spice\_discussion" Mailman bulletin board if interested in finding one of these: [http://naif.jpl.nasa.gov/mailman/listinfo/spice\\_discussion](http://naif.jpl.nasa.gov/mailman/listinfo/spice_discussion) )

## **New Toolkit Architecture?**

NAIF has a bit of funding this year to study if and how the Toolkit architecture should evolve to best support the wide assortment of SPICE users. We will address questions such as these. Should Fortran 77 be dropped as the base language in favor of something else? Can/should NAIF offer thread-safe and/or object oriented Toolkits? What new (new for NAIF) languages should be supported? Should additional effort be put into further developing the WebGeocalc GUI interface to SPICE? (See description below.)

*NAIF is very interested in your opinions on this topic!*

## **WebGeocalc Tool (WGC)**

NAIF will very shortly announce the availability of a new kind of interface to SPICE: a graphical user interface (GUI) using client-server architecture. WebGeocalc will allow anyone with a standard browser to connect to a NAIF geometry computation engine having access to all the SPICE kernels resident on the NAIF server. Using traditional GUI widgets to select a computation and to provide specific directives and inputs needed, a WGC user will be able to rather quickly and easily make quite a few of the traditional SPICE computations. But WGC is not intended to replace use of the SPICE Toolkit for most users.

## **Cosmographia Visualization Tool**

Cosmographia is an open source mission (trajectory) visualization tool implemented by a private citizen, Chris Laurel. Some people at JPL working on design of the proposed Europa Clipper mission augmented Cosmographia somewhat to make better (more) use of SPICE. The NAIF Team became aware of this effort and decided it could be useful to the general SPICE user community if this tool, ready-built and with instructions on connecting it to SPICE data collections, could be made available. It appears we will shortly resolve all license and distribution questions and then be able to offer the JPL-augmented version of Cosmographia from the NAIF website. We also have arranged a bit of funding to continue work on both the tool itself and the means for connecting SPICE data to it.

## **SPICE-Aware Tools**

With co-operation from many of our customers we assembled a list of "SPICE-Aware" tools. Perhaps you'll find some useful entries in this list. Look for it here: <http://naif.jpl.nasa.gov/naif/links.html>.

## **Generic Satellite SPKs**

NAIF continues to receive new (improved) generic satellite ephemeris files from JPL's Solar System Dynamics group. They arrive at irregular and unpredictable times. We post these to the appropriate spot on our server:

[http://naif.jpl.nasa.gov/pub/naif/generic\\_kernels/spk/satellites/](http://naif.jpl.nasa.gov/pub/naif/generic_kernels/spk/satellites/) ,

move the older versions to a sub-directory (./a\_older\_versions), and update the three kernel summary text files (aa\_summaries, aa\_spk\_production\_dates\_by\_alpha, aa\_spk\_production\_dates\_by\_date). The file named "aa\_summaries" is probably the most useful of these three, showing for each ephemeris file the time span covered, the objects included, and the center of motion for each object.

Which SPICE ephemeris objects are found in which SPK files is a consequence of how the ephemeris producer processes his data. But remember, you can "load" multiple SPK files into your program in order to have access to the full set of satellites for a given planet(s).

For your convenience, each of these satellite SPKs also includes the location of the planet itself, the planetary system barycenter, the earth and earth-moon barycenter, and the sun.

(If you need to brush up on this terminology, take a look at the SPK tutorial found here on the NAIF website: <http://naif.jpl.nasa.gov/naif/tutorials.html>. The file name is "19\_spk".)

### **SPK as an IAU Ephemeris Standard**

The International Astronomical Union (IAU), Commission 4, Working Group on Standardizing Access to Ephemerides and File Format Specifications, elected to use the SPICE SPK format as its standard for planetary ephemerides. (Possibly for other natural bodies as well sometime in the future?) There are three ephemeris-producing groups associated with this Working Group: the Institut de Mécanique Céleste de Calcul des Éphémérides (IMCCE) in France (INPOP ephemeris), the Institute of Applied Astronomy (IAA) in Russia (EPM ephemeris), and the Solar System Dynamics Group (SSD) at NASA/JPL (Developmental Ephemeris, or DE for short). SPICE was originally built to accommodate the JPL DE ephemeris, but with some extensions have been made to handle the other two formats as well. Both IMCCE and IAA have means to produce their ephemerides in SPK format.

### **Broader SPICE Participation in the IAU?**

The International Astronomical Union (IAU) is going through a major re-organization exercise right now. There is some chance a new Fundamental Standards Commission will be established as a result, or perhaps a commission that would include some of the ideas behind the proposed Fundamental Standards proposal. If this comes to pass, NAIF may have a role in offering "standards" based on SPICE and perhaps in providing training on use of SPICE. Stay tuned...

### **SPICE Self Training**

In years past NAIF was able to provide "live" SPICE training classes, both in the U.S. and at a number of foreign partner sites. It's not clear how much of this sort of training, if any, will be possible in the future. NAIF staff believes the live classes, taught by NAIF team members, offer real benefit over the do-it-yourself approach. But if funding and other restrictions reduce or prevent future live classes, perhaps some folks will make the effort to learn on their own. To support such efforts, NAIF has now published a typical class agenda, the shortened tutorials, and the lessons used in the live classes. The difference between these shortened tutorials and the standard ones available from the NAIF website is that the class tutorials have been reduced in scope and depth to fit the class agenda, and the lessons are a subset of the standard set available from the NAIF website. Anyone interested in working through the self-training

materials can find the needed information on the "Self-training" link on the NAIF website:  
[http://naif.jpl.nasa.gov/naif/self\\_training.html](http://naif.jpl.nasa.gov/naif/self_training.html).

### **SPICE "Live" Training**

The NAIF Team offered a live training SPICE beginner's class in Maryland, in October 2014. We have no specific plans for future classes, but imagine there will be some. *NAIF is interested to know if there is further interest in SPICE beginner's classes, and/or perhaps in a new advanced user's class?*

### **NAIF Website Updates**

NAIF continues to make updates to its website in hopes of better serving the planetary science community. We also post announcements there, some of which are not sent to the "spice\_announce" Mailman distribution list.

### **Flight Projects Using SPICE**

All current NASA planetary projects, whether now in flight or in the planning stages, do or will use SPICE to some degree. A number of NASA projects from other science disciplines are also using SPICE (e.g. Solar Probe Plus and Soil Moisture Active and Passive).

ESA's Mars Express and the now ended Venus Express missions continue to offer SPICE versions of ancillary data for those scientists interested in such. Rosetta is doing the same, but NAIF is unfortunately now largely disengaged from this project so we don't know details.

ESA's ExoMars 2016 project has asked NASA to provide NAIF support, and NASA has agreed. **[UPDATED]** ESA has stated it will also use SPICE on BepiColombo, JUICE and Solar Orbiter.

JAXA's Akatsuki mission (Venus) and Hayabusa-2 mission reportedly intend to use SPICE for science purposes.

We can speculate that future Russian planetary missions (ExoMars 2018, Venera-D, Luna-Glob) might consider once again trying SPICE, but there's been no specific conversation about this.

**[UPDATED]** NAIF has heard that ISRO's Mars Orbiter Mission (MOM) is using SPICE, and will release these data to ISSDC registered users after a validation and peer review period.

NAIF is still precluded from having bilateral involvement with the Chinese Space Agency, so we assume there is no use of SPICE on their missions.