

## **SPICE Newsletter**

January 2014

CY 2013 yielded a mixed bag of accomplishments and challenges for NAIF. While a lot of core SPICE development was accomplished, much of that work has yet to see "first light." SPICE data archiving went well and NAIF Node (of the Planetary Data System) services improved. Involvement with foreign partners was challenging and was hampered by NASA travel restrictions.

Shown below are assorted items—some rather new and some not so new—that could be of interest.

### **Next SPICE Toolkit Release (Version N65)**

NAIF had planned on releasing the next SPICE Toolkit, version N65, in the Spring of 2011. It was planned to be a rather small, catch-up release. Now, almost two years later, we're still looking ahead to the release of the N65 Toolkit! What happened? It's a long story—suffice it to say that other work took priority.

The good news is that we're finally back to working on N65 full steam ahead (well, almost so), and that it will contain some newly supported computing environments, quite a bit of new capability, and some performance improvement (higher speed) in some situations. We're now hoping to have N65 available by about April, 2014.

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

In July 2010 NAIF announced the limited availability of an alpha-test version of the new Digital Shape Kernel (DSK). This test version comprised only one of two implementations of the new shape model—the tessellated plate model. The interfaces provided were not final. That alpha-test version of the plate model has seen considerable use, but work on it has not advanced. However, NAIF has done a great deal of work on the other DSK implementation: the digital elevation model. This effort was driven by the needs of the Soil Moisture Active & Passive (SMAP) project, an earth sciences mission managed at JPL. We'll hope to make this DEM portion of the DSK available sometime in the later part of 2014, along with completion of the plate model portion.

### **JNI Spice**

In February of 2010 NAIF announced the availability of an alpha-test version of some Java Native Interface (JNI) Toolkits. While some updates have been made, we still have not completed an official set of JNISpice Toolkits and have no 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 have no 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) )

## **WebGeocalc Tool (WGC)**

NAIF is still working on a new kind of interface to SPICE: a graphical user interface (GUI) using a client-server architecture. WebGeocalc will allow anyone with a standard browser to connect to a NAIF computation engine and 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.

## **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 IAU's 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 changes now nearly complete it can handle the other two formats as well. Both IMCEE and IAA have means to produce their ephemerides in SPK format. However, NAIF needs to release its version N65 Toolkit before the IAA-produced SPKs can be used.

### **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 at a new "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 hopes it will be allowed to conduct further domestic training classes, despite new JPL accounting policy that could squelch them. In any case, the next such class is likely many months off.

### **NAIF Website Updates**

NAIF continues to make updates to its website in hopes of better serving the planetary science community.

### **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, Soil Moisture Active and Passive).

ESA's Mars Express and Venus Express missions continue to offer SPICE versions of ancillary data for those European scientists interested in such. It seems Rosetta is doing the same, but NAIF is unfortunately now largely disengaged from this project so we don't know any details. Some of ESA's future planetary missions such as ExoMars 2016, BepiColombo and JUICE have expressed some interest in using SPICE, and it might be that some of ESA's non-planetary missions (e.g. Solar Orbiter) will use it. JAXA's Akatsuki mission (Venus) intends 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. ISRO's Mars Orbiter Mission elected to not use SPICE. NASA—and thus 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.

### **Looking Ahead**

Recent news from NASA Headquarters indicates NASA's intention to continue funding for the NAIF/SPICE activities for another five years.

Other news suggests that travel restrictions may get worse, such that future co-operation with foreign partners would remain difficult.