ADVANCES IN SPICE SUPPORT OF PLANETARY SCIENCE. C. H. Acton¹,
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Introduction: SPICE¹ is the de facto international standard for determining the geometric conditions—parameters such as altitude, lighting angles, and LAT/LON coverage of an instrument footprint—pertaining to scientific observations acquired by instruments on board robotic spacecraft. This system, comprised of data and allied software, is used for planning science observations and for analyzing the data returned from those observations. Use of SPICE is not a NASA requirement but is recommended by NASA’s Planetary Data System and by the International Planetary Data Alliance. Owing in part to its reliability, stability, portability and user support, the use of SPICE has spread to many national space agencies, including those of the U.S., Europe (ESA), Japan, Russia and India. SPICE has been in use since the Magellan mission to Venus and so has many well-known capabilities. But the NAIF² Team responsible for implementing SPICE continues to add new features; this presentation describes a number of these.

Geometry Finder: Until rather recently the kind of computations possible with SPICE were of the style "compute quantity X at time T." Not long ago the NAIF Team began adding somewhat of the inverse capability: "within these start and stop times, find the time(s) when such-and-such a geometry condition is true" (example: body X is occulting body Y), or "within these start and stop times, find the time(s) when a particular observation geometry parameter satisfies numeric condition X" (examples: altitude of my spacecraft is between Y and X km; phase angle has reached a relative or absolute minimum). This rather extensive new subsystem is called the "geometry finder" (GF) subsystem. While it can take non-trivial effort to learn how best to use the GF capabilities, doing so places a great deal of capability in a SPICE user's hands.

Shape Models: Target bodies—planets, satellites, comets and asteroids—have traditionally been modeled as tri-axial ellipsoids within SPICE. This low fidelity approach is clearly not sufficient for modern missions. NAIF is in the process of adding to SPICE a pair of new shape models: a tessellated plate model and a digital elevation model. Both of these are instantiated within a new SPICE data product named Digital Shape Kernel (DSK). As with the other SPICE components, NAIF does not create DSKs out of science observations: rather NAIF provides the means to place one's own plate model or digital elevation model into a SPICE DSK format. With this done a SPICE user can compute many of the traditional body-relative geometry parameters based on one of these higher fidelity models. Some of this new capability is already in use by flight projects.

Graphical User Interface: Throughout its history SPICE computational capability has been available to scientists in the form of Application Program Interfaces (APIs, also referred to as modules or subroutines). The SPICE user would write her/his own program to accomplish a needed function; this program would include calls to a few SPICE APIs to provide observation geometry needed by the program. These API libraries have been offered in Fortran 77, C, IDL and MATLAB, and are available for most popular computing platforms. This approach seems to have satisfied many scientists and engineers, but certainly not all. Some are not trained to write their own programs, and some feel the time needed to learn how to use SPICE APIs is excessive. The NAIF Team believes the need for the API offering is substantial and will remain, but the team also decided to try providing a web-based Graphical User Interface (GUI) to SPICE, using a client-server model. Provisionally named "WebGeocalc," this tool is under development and, by the time of the 44th LPSC, will have completed a first round of community evaluation. The WebGeocalc user needs only a computer with any standard browser installed. The user connects to the WebGeocalc server located at the NAIF facility at NASA/JPL. Using traditional GUI widgets, such as drop-down menus, radio buttons, check boxes and fill-in boxes, the user specifies the kind of SPICE computation to be made and the various options and inputs needed for that computation, then presses a CALCULATE button. The answer(s) and optional plot(s) appear in the user's browser window.

Demos: The author of this paper will be available to demonstrate and discuss these and other SPICE capabilities, as well as to hear suggestions for improvement of the SPICE system or the NAIF services.

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