ADVANCES IN "SPICE" SUPPORTING PLANETARY SCIENCE. C.H. Acton[1], N.J. Bachman[1], B.V. Semenov[1] and E.D. Wright[1], [1]Caltech/Jet Propulsion Laboratory, 4800 Oak Grove Dr., Pasadena CA 91109, charles.acton@jpl.nasa.gov.

Introduction: "SPICE"[1] is an information system providing scientists with the observation geometry needed to plan observations from instruments aboard robotic spacecraft, and to subsequently help in analyzing the data returned from those observations. In this sense "ancillary data" are items such as spacecraft orbit and attitude; target body size, shape and orientation; instrument field-of-view size and orientation; and time system computations. SPICE comprises not only these data, but also a set of software modules (subroutines) known as the SPICE Toolkit, used to read those SPICE data and compute many interesting derived quantities such as spacecraft altitude, sub-spacecraft LAT/LON, instrument filed-of-view projection on a planetary surface, and lighting angles. SPICE users incorporate a few of these modules into their own application program to accomplish whatever is needed. The SPICE system is managed by NASA's Navigation and Ancillary Information Facility (NAIF), located at the Jet Propulsion Laboratory.

SPICE has been used on the majority of worldwide planetary exploration missions since the time of NASA's Galileo mission to Jupiter (1995). Along with its "free" price tag and its lack of licensing and export restrictions, its stable, enduring qualities help make it a popular choice. But stability does not imply rigidity–improvements and new capabilities are regularly added. This poster highlights recent and new additions that could be of interest to planetary scientists.

Geometry Finder: For many years SPICE Toolkit software was limited to calculating a geometry parameter at a given instant in time. Fairly recently the NAIF Team added a "geometry finder" subsystem that works in somewhat the opposite fashion: within a confinement window of time, find all the times or time intervals when a particular geometric condition exists (e.g. occultation) or when a particular geometric parameter is within a given range or has reached a maximum or minimum. Quite a few of these kinds of calculations are now possible, and more are being added as time permits.

Digital Shape Kernel: For most of its existence the only means within SPICE to model the size and shape of a target body was with a tri-axial ellipsoid. Clearly this did not provide the precision needed for modern missions where highly irregular bodies such as asteroids and comets are the targets. The same is true for missions providing high-resolution observations of large bodies such as the moon, Mars and Mercury. NAIF has designed a means–the Digital Shape Kernel (DSK)–to contain more definitive models for such bodies: a tessellated plate model for irregular bodies and a digital elevation model for large, regular bodies for which terrain details are available. By ingesting shape data produced by others into the appropriate DSK format, scientists can make many of the traditional kinds of SPICE-based observation geometry calculations previously restricted to tri-axial models.

WebGeocalc: Until very recently the only way to use SPICE data was to write a program that incorporates a few of the SPICE Toolkit modules (subroutines) that read SPICE data files and compute derived quantities. While that method remains the primary means of using SPICE, an alternative approach has been released–one that doesn't require programming. WebGeocalc (WGC) provides a graphical user interface (GUI) to a SPICE "geometry engine" located at the NAIF facility. A WGC user need have only a computer with a web browser to access this geometry engine. Using traditional GUI widgets–drop-down menus, check boxes, radio buttons and fill-in boxes–the user inputs the data to be used, the kind of calculation wanted, and the details of that calculation. Pressing the "CALCULATE" button causes the calculation to be made with numeric and optional plotted results returned to the user's browser screen. Results can be saved for use in subsequent calculations, for use in another tool, or for publication.

Mission Visualization: The primary output of SPICE software is numeric–data intended to be used in other software for any number of purposes. But it's clear that visualization of space geometry can be very helpful to scientists, and even to the public that funds NASA. NAIF is now engaged in connecting SPICE data files to an open source mission visualization program: COSMOGRAPHIA. This tool can illustrate the ephemerides of solar system (target) bodies, spacecraft trajectory and orientation, instrument field-of-view "cones" and footprints, and more.

References: [1] Acton, C.H.; (1996) Planetary and Space Science, Vol. 44, No. 1, pp. 65-70.

[1] **S**pacecraft, **P**lanet, **I**nstrument, **C**amera-matrix, **E**vents See http://naif.jpl.nasa.gov