

**SPICE: A Cross-discipline Ancillary Information System Serving the International Space Sciences Community.** C. Acton, N. Bachman, B. Semenov, F. Turner, E. Wright; Caltech/Jet Propulsion Laboratory

NASA's SPICE system is used as the mechanism for capturing, archiving and disseminating a variety of ancillary information needed by scientists involved in observation planning, science data analysis, and correlation of data across instruments and missions. Key components of SPICE ancillary data are spacecraft trajectory, target body ephemeris, target size/shape/orientation, spacecraft orientation, reference frame specifications, instrument mounting and field-of-view geometry, and commands and events associated with the conduct of a mission.

SPICE is the de facto ancillary data standard for essentially all NASA planetary missions, used during all mission phases--conception through data archival in NASA's Planetary Data System. Some SPICE components are used in support of sun-earth connection, astrophysics, earth science and space technology demonstration missions. SPICE was ready for use on the ill-fated Russian Mars 96 mission, and it is now being deployed on ESA's Mars Express mission. It is anticipated to be used on Rosetta as well, supporting U.S. investigators.

SPICE has been applied to landers and rovers as well as to orbiters and fly-by vehicles. While originally focused on science needs, SPICE has found a multitude of applications in mission design and visualization, spacecraft operations, and even operation of core functions of the Deep Space Network tracking system.

The SPICE specification encompasses both data files and allied software. SPICE data files, often called "kernels," contain low level data from which numerous quantities of interest can be derived--items such as latitude and longitude, range, smear velocity, lighting angles (phase, incidence, emission), visibility windows, and similar quantities. SPICE kernel files can be easily ported to all popular platforms. Most SPICE files are generated by flight projects, although generic SPICE ephemerides for planets, satellites and some comets and asteroids are also available.

A major component of the SPICE system is a large suite of software--the SPICE Toolkit--consisting primarily of module (subroutine) libraries. These library modules are used to read SPICE files and to compute the derived quantities of most interest to scientists and engineers. Some modules are also used in mission operations to write SPICE files. The customer integrates appropriate SPICELIB subroutines into an application program designed to accomplish whatever is needed.

In addition to SPICELIB the Toolkit includes a number of related utility programs, a few example programs, and a large body of documentation. A separate collection of tutorials is also readily available.

The SPICE Toolkit is available in ANSI FORTRAN 77 and ANSI C. The C version is also becoming available with a set of Interactive Data Language (IDL) "wrappers." The Toolkit is ported to and tested on most popular platforms before being offered to the space science community. The environments supported include Sun/SunOS, Sun/Solaris, HP/HPUX, SGI/IRIX, PC/Win95/98/NT, PC/LINUX, MAC, NeXT, DEC Alpha/VMS and DEC Alpha/Digital Unix.

Implementation of the SPICE system is carried out by the Navigation and Ancillary Information Facility Team at the Jet Propulsion Laboratory, California Institute of Technology, under contract with the National Aeronautics and Space Administration.