SPICE for ESA Planetary Missions

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Abstract

SPICE is an information system that provides the geometry needed to plan scientific observations and to analyze the obtained. The ESA SPICE Service generates the SPICE Kernel datasets for missions in all the active ESA Missions. This contribution describes the current status of the datasets, the extended services and the SPICE support provided to the ESA Planetary Missions (Mars-Express, ExoMars2016, BepiColombo, JUICE, Rosetta, Venus-Express and SMART-1) for the benefit of the science community.

1. Introduction

SPICE is an information system the purpose of which is to provide scientists the observation geometry needed to plan scientific observations and to analyze the data returned from those observations. SPICE is comprised of a suite of data files, usually called kernels, and software -mostly subroutines [1]. A customer incorporates a few of the subroutines into his/her own program that is built to read SPICE data and compute needed geometry parameters for whatever task is at hand. Examples of the geometry parameters typically computed are range or altitude, latitude and longitude, phase, incidence and emission angles, instrument pointing calculations, and reference frame and coordinate system conversions. SPICE is also very adept at time conversions.

2. The ESA SPICE Service

The ESA SPICE Service (ESS) leads the SPICE operations for ESA missions. The group generates the SPICE Kernel datasets for missions in operations (ExoMars 2016, Mars Express) missions in development (ExoMars RSP, BepiColombo, JUICE) and legacy missions (Rosetta, Venus Express). ESS is also responsible for the generation of SPICE Kernels for Solar Orbiter. The generation of these datasets includes the operation software to convert ESA orbit, attitude and spacecraft clock correlation data into the corresponding SPICE format. ESS also provides consultancy and support to the Science Ground Segments of the planetary missions, the Instrument Teams and the science community. ESS works in partnership with NAIF.

3. Status of the Kernel Datasets

The current status of the SPICE Kernels datasets for the before mentioned missions will be described in this contribution. In general, the ESS is reviewing the legacy and operational datasets and is developing the ones for the future missions, the first reviews have shown that the Mars Express and Venus Express kernels need to be updated whereas the rest are in very good shape.

3.1 SPICE Kernels Archived in the PSA

ESS is also responsible for the generation of PDS3 and PDS4 formatted SPICE Archives that are published by the PSA. ESS in close collaboration with NAIF peer-reviews the operational kernels for the PSA [2] to publish being compliant with the Planetary Data System (PDS) standards and uses them in the processes that require geometry computations [3].

4. Extended Services

The ESS offers other services beyond the SPICE Kernels datasets, such as configuration and instances for WebGeocalc and Cosmographia for the ESA Missions [4].

4.1 SPICE-Enhanced Cosmographia

NAIF offers for public use a SPICE-enhanced version of the open source visualization tool named Cosmographia. This is an interactive tool used to produce 3D visualizations of planet ephemerides, sizes and shapes; spacecraft trajectories and orientations; and instrument field-of-views and footprints. ESS Service provides the setup in order to load the ESA Planetary Missions in Cosmographia, this contribution will demonstrate its usage within the ESA Planetary missions.

4.2 WebGeocalc

The WebGeocalc tool (WGC) provides a web-based graphical user interface to many of the observation geometry computations available from the "SPICE" system. A WGC user can perform SPICE computations without the need to write a program; the user need have only a computer with a standard web browser. WGC is provided to the ESS by NAIF. This contribution will outline the WGC instances for ESA Planetary missions.

References

[1] Acton C., Ancillary data services of NASA's Navigation and Ancillary Information Facility (1996), Planet. And Space Sci., 44, 65-70.

[2] Bessel, S. et al., ESA's Planetary Science Archive: Preserve and Present Reliable Scientific Datasets (2017) Planet. And Space Sci. (submitted).

[3] Besse, S. et al., The New Planetary Science Archive (PSA): Exploration and Discovery of Scientific Datasets from ESA's Planetary Missions (2017), Proceedings of the 3rd Planetary Data Workshop, Flagstaff, June 2017.

[4] Acton, C. et al., A Look Towards the Future in the Handling of Space Science Mission Geometry (2017) Planet. And Space Sci (submitted).