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日本の惑星探査におけるデータの相互運用性
Interoperability of data in Japanese planetary explorations

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One of the important keywords of the data archives in Japanese planetary explorations is standardization. Before Hayabusa mission, an asteroid sample return mission, the concept of data archives was quite different from the current one. For example, HITEN was a lunar orbiter launched in 1990, but there is no available data in our hand. NOZOMI, a Mars explorer, measured some scientific data although the explorer could not be put into orbit. Those NOZOMI data are not archived and published officially at present.

The first archives in Japanese planetary exploration with standardization is Hayabusa mission that adopted Planetary Data Archives (PDS) in its files. Hayabusa was also the first mission to use SPICE to manage their ancillary data like orbit and attitude. At first, the project team created their data not in PDS. However, NASA helped to make archives in PDS version 3 (PDS3) and published a part of data from PDS website.

The second challenge of PDS and SPICE is the SELENE lunar orbiter launched in 2007. It carried many of scientific evidence through 21 month's operation. The SELENE project prepared the data in PDS3 compatible format. The "compatible" meant it was not strict PDS3 because they believed preparing data in PDS compliant format was a hard task beyond their scientific analysis. The data themselves were well documented and available for science, but it is confusing because the project used a keyword in a wrong way.

Akatsuki, known as Venus Climate Orbiter (VCO), is currently flying and trying to perform the Venus orbit insertion in December 2015. The data is also steadily prepared in PDS3. Already PDS4 was released to start the discussion of archives when Akatsuki's data archive started, but they chose to make their data in PDS3. The reason was why the other Venus mission, Venus Express (VEX), made their archives in PDS3, and also the team could not have an actual picture of PDS4 implementation together with scientific analysis.

Hisaki is a satellite to observe Jupiter's magnetosphere using extreme ultraviolet spectroscope (EUV). These observational data are located between astronomical satellite and planetary explorer. The project team uses SPICE for ancillary data, but the data format is in FITS.

The first mission in Japan to support PDS4 is Hayabusa2 mission. The Hayabusa2 project declared that the data are prepared in PDS4, and the project is going to collaborate with OSIRIS-REx that is NASA's sample return mission from an asteroid. The concept and design of Hayabusa2 and OSIRIS-REx are very much like, and collaboration in data archiving task is expected from the point of view of interoperability.

Prior to Hayabusa2's PDS4 discussion, BepiColombo, Mercury Orbiters with ESA, have started a study of PDS4. The ESA's study encourages to make PDS4 archives directly and indirectly for the Japanese PDS4 archives. The JAXA's part of Bepi-Colombo is a research of Mercury Magnetosphere where Common Data Format (CDF) is the most common format. Discussion of PDS4 and CDF are actively performed.

These obtained scientific data are transferred from a project to DARTS, a scientific data archives managed by C-SODA/JAXA. The DARTS has the purposes of long-term preservation and distribution for scientific utilization. Most of the planetary data are directly accessed via the Internet using HTTP, and DARTS also provides the interface of Planetary Data Access Protocol (PDAP) for interoperability. PDAP is a kind of Web Service API to search products designated by International Planetary Data Alliance (IPDA). Search parameters are set in URL, and the response of HTTP is a format of VOTable by default. The response is available for further applications to search across planetary missions.

Keywords: PDS, SPICE, PDAP, archive