THE PLANETARY DATA SYSTEM NEW GEOMETRY METADATA MODEL. E. A. Guinness[1] and M. K. Gordon[2], [1] Dept. of Earth and Planetary Sciences, Washington University, St. Louis, MO (guinness@wustl.edu), Carl Sagan Center, SETI Institute, Mountain View, CA (mgordon@seti.org).

Introduction: The NASA Planetary Data System (PDS) has recently developed a new set of archiving standards based on a rigorously defined information model. The new standards are known as PDS4. An important part of the new PDS information model is the model for observational geometry metadata, which includes, for example, attributes of the lighting and viewing angles, position and velocity vectors of a spacecraft relative to Sun and to the observing body at the time of observation and the location and orientation of an observation projected onto the target.

Prior to PDS4 there were no standards on what geometry metadata to include in PDS labels. The result was that the data sets varied in the geometry information in labels from none to fully describing the geometry of an observation. The new PDS4 geometry model provides standardization in the definitions of the geometry attributes and provides consistency of geometry metadata across planetary science disciplines. This standardization will enhance the analysis and interpretation of observational data by the science community and will enable harvesting of the geometry information to support discipline level searches by users to discover data of interest to them.

Model Requirements: The PDS4 geometry metadata model is based on requirements gathered from the planetary research community, data producers, and software engineers who build search tools. Requirements are also based on a survey of geometry data contained in existing PDS data sets. An overall requirement for the model is that it fully support the breadth of PDS archives including a wide range of data types collected by instruments observing many types of solar system bodies such as planets, ring systems, moons, comets, and asteroids.

Specific geometry model requirements include: (1) Separate geometry classes are required to support different mission types, e.g., orbiters and flybys, landers and rovers, and Earth-based observations; (2) Geometry classes need to be flexible, require a minimum set of attributes, but define optional attributes to fit the wide range of planetary observations archived by the PDS; (3) References to source data, the methods used to compute geometry attributes, and relevant coordinate/reference systems need to be specified along with the geometry data; (4) The model needs to include footprints of observations projected onto a planet's surface that go beyond just the location of center or corner points; and (5) The PDS4 geometry model needs a method to handle updates to geometry data should instrument pointing or spacecraft position information improve.

Model Structure: The PDS4 geometry model is implemented in XML, as is the main PDS4 information model. Both models use XML schema for validation. The use of XML in PDS4 greatly enhances the ability to build a standardized structure for PDS labels in that parameters appear in a specified order and location in the label, and required and optional parameters are clearly indicated. XML also makes it easier to read the PDS labels using software that can parse an XML document, and label validation is straight forward by testing the label against the model schema.

The geometry model is structured such that there are several high-level components, each of which is focused on a specific class of missions. So far, the mission classes in the model include orbital/flyby and landed/rover missions. Future implementations of the model will include the case for observations made from earth-based telescopic instruments. The high-level components use lower-level classes that define fundamental objects such as generic vectors and quaternions. If a particular mission has a need for a set of specialized distances or vectors that are not included in the higher-level portion of the model for that mission class, then those specialized objects can be included by using the generic classes from the lower-level component to extend the higher level model.

The high-level model for orbital and flyby missions contains classes for specific distance and velocity vectors (e.g., spacecraft to target and target to sun), lighting and viewing angles, and the projected field-of-view onto the target for both an individual point (e.g., pixel in an image) or the full footprint of the observation (Fig. 1). The model requires a reference to the source data, time, and coordinate system used for generating the geometry parameters be included in the label. Geometry information can be provided for more than one body, such as a planet and one or more of its moon, in the same PDS label if multiple targets are observed.

The landed and rover mission high-level component includes classes to define the vehicle position and orientation. It contains classes to describe a camera model for image data. There are also classes that specify the position and orientation during an observation of a robotic arm and its tools (Fig. 2).

Status: An initial version of the PDS4 geometry model has been recently released as XML schema. This version is being reviewed by the PDS4 information model design team and by the International Planetary Data Alliance (IPDA) group. The XML schema for the geometry model, along with all other PDS4 XML schema can be obtained at http://pds.nasa.gov/pds/schema.

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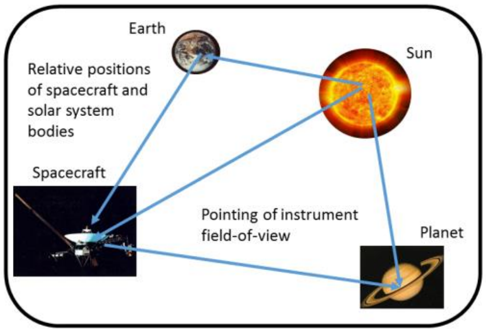

Figure 1: This diagram displays some characteristics of geometry for orbiter or flyby missions such as relative positions of the spacecraft and other solar system objects and the instrument position and field-of-view projected on the body being observed.

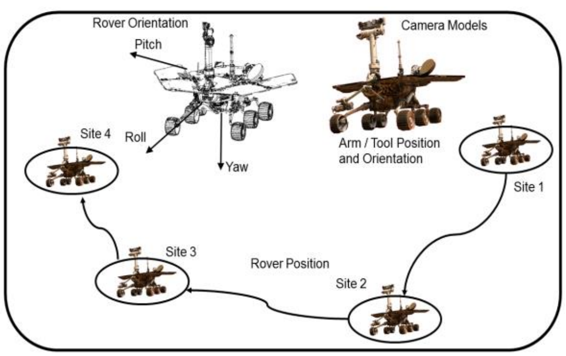

Figure 2: This diagram illustrates the components for a landed spacecraft geometry. The case for a rover is depicted. Rover geometry includes rover position and orientation, along with arm and tool position and orientation. Another important aspect is a camera model for each camera. The case for landers is similar except that the spacecraft position and orientation do not change with time.