shapeViewer, a mapping tool for the morphological analysis of small bodies and mission operations planning

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The cartography of celestial bodies is a fundamental tool in comparative planetology as maps display various types of information in a common reference frame. This allows a direct comparison of many data sets at different epochs and for different objects.

However, in the case of small bodies such as asteroid (433) Eros or comet 67P/Churyumov-Gerasimenko, a full high resolution mapping has proven to be a very difficult task due to the complexity of the object's shape, especially when very large concavities are present.

This poster present the publicly available software package *shapeViewer* [1, Fig. 1] developed for the visualization and mapping of such non trivial bodies. Although first designed to display a 3D shape of an asteroid from a ".shape" or ".ver" file as defined by the database of asteroids models DAMIT, it evolved into a more versatile software which let the user visualize all shapes in 3D in an interactive environment enhanced by several tools dedicated to geomorphological investigation.
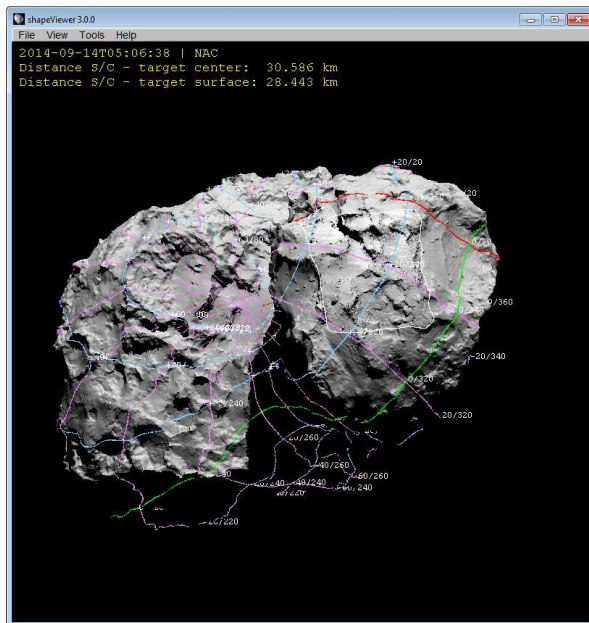

Figure 1: shapeViewer graphical user interface displaying a view of comet 67P with a graticule and one OSIRIS-NAC (Rosetta) image overlaid on the shape model.

shapeViewer provides:

- 3D display of small bodies shape models using photometric functions for realistic rendering,
- accurate projection of images and other datasets on the shape (on the fly, no need for any preprocessing of the data),
- orientation the shape according to SPICE kernels,
- retrieval of observation geometry and solar angles (incidence, emission, phase, elevation),
- interactive visualization of the illumination conditions as the object rotates, accurate shadows,
- real time rendering of operational scenarios (e.g. a fly-by),
- calculation and display of the gravity field and effective slopes on the surface,
- view and export cylindrical, orthographic maps,
- measure distances, areas,
- extract topographic profiles,
- … and many other features.

shapeViewer has been used extensively for planning and scientific analysis in the Rosetta (Fig. 1, 3) and Dawn (Fig. 2) missions since 2010, and is referenced in more than 20 papers in peer reviewed journals. As of 2017 we are providing the software to the CAESAR team (NASA New Frontiers comet sample return proposal) and the Lucy team (NASA Discovery mission to Trojans). We are finalizing a package to support JAXA's Hayabusa-2 mission as well, in preparation for the upcoming arrival at asteroid Ryugu in 2018.

Any mission/instrument can be supported with very little additional effort, contact me for information.
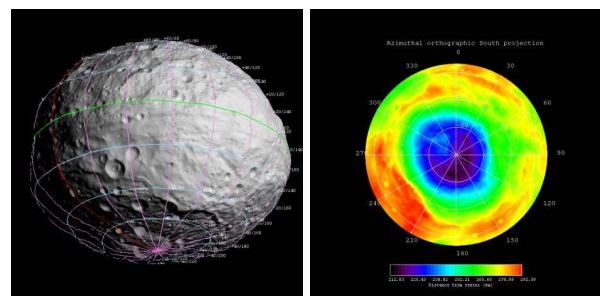

Figure 2: shapeViewer's rendering of the shape and surface elevation model of asteroid (1)Vesta.
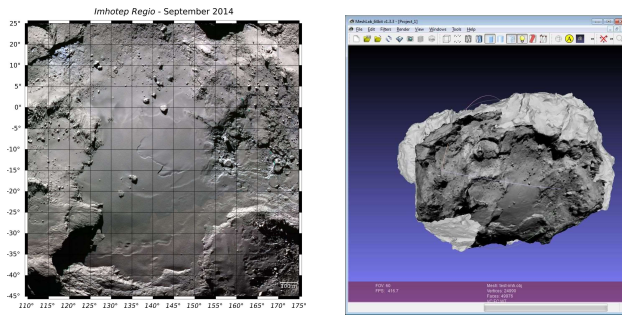
Figure 3: Maps and image projections can be visualized within the software, or exported to standard format to be processed by other tools (e.g. Meshlab).

References:

[1] http://www.comet-toolbox.com/shapeViewer.html