Geophysical Research Abstracts
Vol. 17, EGU2015-5343, 2015
EGU General Assembly 2015

A New 3D Shape Reconstruction Method for celestial bodies: Multi-Resolution Stereophotoclinometry by Deformation

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In astrophysics, direct measures on celestial bodies are not always feasible. 3D shape models allow to overcome this kind of problem.

We thus developed a new 3D shape reconstruction method which combines stereo, photoclinometry and the deformation of a triangular mesh describing the surface of the object. The method deforms the mesh - initially a sphere - until the set of synthetic images, created from the mesh (Jorda et al., SPIE 2010) match the observed one.
Stereo control points can be used as a constraint in the deformation of the mesh, but it is not required at low resolutions.

This new technique has been applied to images of the nucleus of comet 67P/Churyumov-Gerasimenko acquired by the OSIRIS instrument aboard the Rosetta spacecraft. It allowed to reconstruct the shape of the nucleus and to retrieve its rotational parameters from low-resolution images obtained with the narrow-angle camera of OSIRIS in mid-July 2014, when stereo-based techniques were still inapplicable. The technique has also been applied to higher-resolution images of the nucleus later on, using the stereo information as a constraint.