

Advanced Digital Elevation Modeling Capability applied to Voyager images

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Project Objective:

The Voyager 2 flyby of Uranus provided the first, and to date only, imaging of its moons. Exploration of these potential ocean worlds is a key motivation for mission concepts that are currently being formulated. The Voyager flyby dataset continues to be one of the most important tools for understanding ice giant moons.

Digital Elevation Model (DEM) generation for these objects is particularly challenging due to the low quality, limited coverage, and limited number of stereopairs. Our goal is to optimize advanced DEM generation techniques to the Voyager 2 dataset and to apply it to the Uranian moons Ariel and Miranda.



The Uranian moon Ariel as seen by Voyager 2

The Uranian moon Miranda as seen by Voyager 2

FY18/19 Results:

We have developed a workflow for producing DEMs from the Voyager flyby dataset based on the freely available Ames Stereo Pipeline and ISIS3 software. This approach combines both stereophotogrammetry and photoclinometry (shape from shading) to produce high quality elevation estimates. Using this workflow, we have generated DEMs of regions on respectively, Miranda and Ariel.





300
100
-100
-300

-500

500

Create Pointcloud

Use stereo in ASP, if projected do not prealign else use homography, subtracted mean processing filter with a kernel size of 1.4, 11 initial correlation kernel size, and a subpixel correlation kernel size of 13 13, correlation window size of -40 -1 10 1, rm half kernel of 10 10

Create DEM

Use point2dem in ASP, DEM resolution equivalent to image resolution, set image projection to centered coordinates, search radius factor 1, use IAU projections (south pole stereographic a good option)

Use <u>sfs</u> in <u>ASP,use</u> stereo DEM as the guess DEM, use both stereopair images as input images, ~5 iterations, Smoothness 10% of DEM resolution, Lambertian reflectance, initial DEM height of 0, constraint weight of 9 x 10⁻⁵

Apply photoclinometry

Workflow for the generation of DEMs from the Voyager 2 flyby observations of the Uranian moons



Benefits to NASA and JPL:

We have established an advanced image analysis workflow that will produce DEMs from the challenging Voyager 2 dataset. This capability will be leveraged in science investigations of the possible ocean worlds Miranda and Ariel. The findings of these investigations can serve to inform future Ice Giant missions currently being formulated.

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