Radargrammetric Mapping of Titan with Multi-Image Bundle Adjustment

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The RADAR instrument on the NASA-ESA Cassini orbiter uses 2.2-cm microwaves to probe the surface of Saturns giant satellite Titan through its hazy atmosphere, in a variety of passive and active modes including synthetic aperture (SAR) imaging. To date, RADAR has obtained closest approach SAR swaths (175 m/pixel, 300â??1400 m resolution) on 31 Titan flybys, yielding 99 potential stereo overlaps. We have developed software and procedures for radargrammetric processing of these images and produced 21 DTM segments so far. The USGS software system ISIS is used to prepare images and metadata for processing in the commercial stereo software package SOCET SET, utilizing a rigorous geometric sensor model we have written.

The expected vertical precision of the DTMs varies from <100 for opposite-side viewing to several hundred meters for same-side image pairs, making delineation of Titans modest local relief (typically 1000 m or less) challenging. Depending on the terrain and the quality and resolution of individual images, fully automated, manual, or combined methods of DTM extraction may be needed.

Among the DTMs previously described was an area including several of Titans north polar hydrocarbon seas. Extending this coverage proved difficult because of the weak geometry of some available stereo pairs, but was achieved by adjusting a block of 6 images, from which 14 DTM segments were then collected. Adjustment residuals and comparison of the stereo DTMs with one another and with independently derived elevation profiles show a clear correlation with nominal expected precision and confirm that matching accuracies on the order of the resolution are being achieved.

Planned work includes adjustment of and DTM collection from a similar but larger block of images in Titans southern hemisphere, and experimenting with improved methods for automatic matching of radar images recently incorporated into SOCET SET.