Geophysical Research Abstracts
Vol. 14, EGU2012-13547, 2012
EGU General Assembly 2012

Progress in Radargrammetric Analysis of Mini-RF Lunar Images

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We report on the production of rigorously controlled image mosaics and digital topographic models (DTMs) of the Moon from synthetic aperture radar (SAR) images obtained by the Mini-RF instrument on the NASA Lunar Reconnaissance Orbiter (LRO). Mini-RF was designed to obtain polarimetric SAR images at two wavelengths and two resolutions; the majority of observations, including those described here, were obtained in the S-band zoom mode (12 cm λ, 7.5 m/pixel). Nearly complete coverage of both lunar poles and $\sim$67% complete coverage of lower latitudes were obtained before the transmitter ceased to function in December 2010. We have developed software for radargrammetric analysis of Mini-RF images (analogous to photogrammetry but taking into account the geometry of SAR image formation) including the production of geodetically controlled and orthorectified (distortion corrected) mosaics in the USGS ISIS software system and production of digital topographic models (DTMs) with the commercial SOCET SET ® system.

A stereopair of part of the 71-km crater Jackson was obtained by specially targeting an image with reduced incidence angle to overlap a standard image from the previous orbit. First attempts to use these images resulted in DTM with good detail but substantial vertical distortions. We have shown that the distortions resulted from inaccurate interpolation of the spacecraft trajectory and that improving the interpolation approach improves DTM detail as well as eliminating the distortions. The targeted stereopair of Jackson was unique but the overlaps between images with standard incidence angle provide many fortuitous stereopairs. We are presently compiling controlled SAR mosaics and stereo DTMs of several of the 50 regions of interest identified by NASA's Constellation program and will show examples. In addition, we are collecting the image tiepoint data needed to control the hundreds of images of each lunar pole, with the goal of making controlled image mosaics. Unlike the uncontrolled mosaics currently available, these products will be effectively seamless and will register with other datasets to an accuracy of 10 m or better, greatly facilitating comparative studies of the geology and properties of the polar regions.