MER vistas: ground-truth for Earth-based radar

Albert F. C. Haldemann, Kristopher W. Larsen, Raymond F. Jurgens, Matthew P. Golombek, and Martin A. Slade
Jet Propulsion Laboratory, California Institute of Technology, Mail-Stop 238-420, 4800 Oak Grove Dr., Pasadena, CA 91109-8099, albert@shannon.jpl.nasa.gov

Earth-based delay-Doppler radar observations of Mars with four receiving stations were carried out during the Mars oppositions of 2001 and 2003 in support of Mars Exploration Rover landing site selection. This interferometric planetary radar technique has demonstrated radar mapping of Mars with a 5 km spatial resolution. This data for two Gusev Crater and Meridiani Planum indicated very smooth terrains, which can now be quantitatively compared to the surfaces discovered by Spirit and Opportunity.

Figure 1. Typical Gusev Crater terrains to the southeast from Spirit's landing location.

Figure 2. Haygros' model fit profiles along the sub-radar track on September 21, 2003, at 19:69. Each data point is the ambiguity-weighted average for 5 km x 150 km resolution cells on the sub-radar track. Top is Fresnel reflectivity, middle is rms slopes, and bottom is Mars radius.

Figure 3. Much better resolution is obtained away from the sub-radar track, when 4-station interferometry is used to remove the north-south range-ambiguity. This produces the radar backscatter map (5 km per pixel) shown below. Mid-Valles Valles leading to Gusev is clearly visible at 185 W.

Figure 4. Three views sampling typical terrains encountered by Spirit, and for each the rms slope versus length-scale is plotted from the slopes-derived standard DEM product used by the MRO mission. (a) A front-Northern view on sol 27 (image no. J2523525337/150P25192M01). (b) A Northerm view on sol 65 (EM2523525337/150P18585M01). (c) A Panorama view on sol 50 (EM2523525337/150P10504225_7M01).

Conclusions

The rms slopes and surface roughness observed at Spirit's Gusev landing site are in excellent agreement with the rms slopes derived from Haygros' model fitting of high spatial resolution (5 km x 5 km) Earth-based radar data of the landing site region. Similar ground-truth agreement is obtained at Meridiani Planum.

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