Geophysical Research Abstracts
Vol. 13, EGU2011-11345, 2011
EGU General Assembly 2011

Systematic Photometric Modeling for Correcting Topographic Shading Effects on HRSC Imagery

Sebastian Walter (1), Randolph L. Kirk (2), Patrick C. McGuire (3), and Gerhard Neukum (1)

(1) Freie Universitaet Berlin, Planetology and Remote Sensing, Berlin, Germany (sebastian.walter@fu-berlin.de), (2) U.S. Geological Survey, Astrogeology Science Center, Flagstaff, USA, (3) University of Chicago, Dept. of the Geophysical Sciences, Chicago, USA

Introduction

In a systematic approach, we want to use the exact orientation information of an image sequence of the High Resolution Stereo Camera (HRSC, [1,2]) to derive a synthetic photometric model and compare it with the recorded HRSC image. This model can then be used for several purposes, one of which would be the isolation of albedo features from the topographic shading effects.

Photometric Surface Model

The HRSC orientation data together with geometric camera calibration data are used to calculate unit vectors of the Sun and the pixel's position in the Mars-fixed coordinate system for every single pixel. They are saved in floating-point images exactly aligned to the original image sequence and can then be transformed to the image geometry of the map-projected HRSC DTM. After rotating these vectors by the slope and aspect angles of the surface, we get the illumination angle ι of the sun's incidence and the emergence angle ϵ of the observer to the surface normal.

Teillet et al. [3] describe a simple but robust topographic correction method based on the *Minnaert* photometric model. The empirical parameter k can be determined by linearizing Minnaert's equation logarithmically, leading to the equation:

$$log(r_M \mu) = log(A_M) + k \times log(\mu_0 \mu) \quad (1)$$

With r_M being the reflectance on the surface depending on the angles ι, ϵ and the wavelength ψ, A_M the *Minnaert Albedo*, μ and μ_0 the substitutions for cos(ϵ) and cos(ι). Now the parameter k can be determined as the slope of the linear regression line. To consider the atmospheric contribution, we subtract an estimated shadow value from the real image beforehand.

On our poster we want to show representations of the synthetic model for a HRSC orbit sequence and the result of the topographic correction.

Outlook

As Veverka et al. [4] point out, the linearization of the Minnaert equation could lead to improper weighting of the data points. To address this issue, the initial guess of the k parameter could be refined by a subsequent nonlinear fit. For a systematic approach, the atmospheric contribution has to be determined more precisely. Hoekzema et al. [5] describe robust methods to derive the optical depth of the Martian atmosphere. Alternatively, Kirk et al. [6] show that if an appropriate value of k can be determined based on past experience or a physical photometric model, then a fitting approach similar to that discussed here can be used to determine the atmospheric opacity.

References

[1] Neukum, G. et al. (2004), *ESA SP-1240*, pp. 17-36; [2] Jaumann, R. et al. (2007), *Planet. Space Sci. 55*, pp. 928-952; [3] Teillet, P. M. et al. (1982), *CJRS 8*, pp. 84-106; [4] Veverka, J. et al. (1989), *Icarus 78*, pp. 14-26; [5] Hoekzema, N. M. et al. (2010), *EPSL 294*, pp. 534-540; [6] Kirk, R. L. et al. (2003), *ISPRS WG IV/9 Workshop*.

We gratefully acknowledge funding of this work by the German Space Agency, on behalf of the German Federal Ministry of Economics and Technology.