Mapping spatially localized admittance function on Mars using spherical wavelet filter

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Abstract. The admittance function $A$ (geoid-topography ratio) has traditionally been determined fully in the wavelength domain for each specific region. Using wavelet transform, the admittance can easily be adjusted the balance of localization between wavelength and spatial domains. We have developed a 2-D continuous wavelet filter in a spherical coordinate and applied it to admittance calculation for Mars.

Spherical wavelet

Admittance & Correlation

$$A = \mathcal{F}[G^* \mathcal{W} r $$

$$A(\theta, \phi) = \frac{\int W(\theta, \phi, \alpha, \beta) f(\alpha, \beta) c(\alpha, \beta)}{\int W(\theta, \phi, \alpha, \beta) e(\alpha, \beta)}$$

$$C(\theta, \phi) = \sqrt{\int W(\theta, \phi, \alpha, \beta) f(\alpha, \beta) e(\alpha, \beta)}$$

$$A_{ij} = \sum_{\alpha} \sum_{\beta} w(\alpha, \beta) a_{ij}$$

$$C_{ij} = \sqrt{\sum_{\alpha} \sum_{\beta} w(\alpha, \beta) c_{ij}}$$

$$W(\theta, \phi, \alpha, \beta) = \exp \left( -\left( \frac{\mathcal{r}^{2}_{\alpha, \beta}}{2 \alpha^2} \right) \right)$$

Mars' geoid & topography

Geoid: JGM75D01.SHA
Topography: GM909AA.SHA

Mars Global Surveyor
Radio Science Reduced Data Product Archives
https://pds-geophysics.mss.com/pds/mss/pds/

Results:

We obtained uniform map of admittance value of Mars for entire sphere. Prominent feature is that high value around the Tharsis Montes and negative signal at some craters such as Utopia and Argyre, which resemble to Moon's Mas-Con. We note that admittance value is reliable only when the correlation at the same region is close to 1 or -1. In the feature, we visually mask the admittance image regarding to the correlation value. We will consider crustal and lithospheric structure based on this admittance analysis.