SMALL SCALE ROUGHNESS EFFECTS ON THERMAL IR SPECTRA

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ABSTRACT:

Thermal infrared spectra of materials are affected by surface roughness: roughness increases interactions between surface facets shift spectra toward a blackbody. It also creates directional effects due to differential solar heating and view geometry. Three types of ground- based experiments were conducted to quantify roughness effects at scales on the order of about 10 cm or less. First, a radiosity model was implemented and validated for natural and artificial surfaces using an imaging spectrometer. Area and resolution create practical computational limits so most simulations were performed at a resolution near 1 cm over a 1 m area. Surfaces are specified using laser profilometer data but can be simulated. Second, a well calibrated radiometer was used to measure radiance for emissivity retrievals for gravels of different sizes and at different solar and view geometries. Finally, a reflectance spectrometer measured spectra for soft rocks sanded to different roughnesses. The results show that a simple radiosity model can simulate the broad scale effects of roughness. The shape of the roughness elements has a significant impact. Imaging spectrometers permit observation of small scale spatial variations which are not observed at pixel scales of a meter or more. Spectra go to blackbody spectra in small cracks and crevices. Precise measurements of two types of gravel; in three size classes of gravels, with a non-imaging spectrometer show an apparent saturation of roughness effects and a probable increase of directional effects with roughness. Measurements of soft rocks with single mineral features (alabaster, soapstone & chlorite) sanded to different roughnesses show a decrease of peak height with roughness at the higher roughnesses but the trend is reversed for two of three rock types for the smoother surfaces. Nevertheless, the peak height changes by a factor of two within the range of roughnesses used.

TOPIC: Physical modeling and signatures
ALTERNATIVE TOPIC: Multi-spectral and hyperspectral remote sensing