

# SEMINAR NOTICE

Preston M. Green Department of Electrical and Systems Engineering

## IMAGE RECONSTRUCTION FOR HYPERSPETRAL CRISM DATA ON MARS

Ph.D. Preliminary Research Examination

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**Abstract:** The Compact Reconnaissance Imaging Spectrometer for Mars (CRISM) on the Mars Reconnaissance Orbiter (MRO) began operations in 2006 with a ground pixel size of 18 m. Hyperspectral images from 362 to 3920 nm have been acquired using a gimbaled along-track oversampled (ATO) mode since 2010. After removing effects of the solar energy, lighting and viewing conditions, and atmospheric gases and aerosols, the single scattering albedo (SSA) is retrieved. The SSA is a measure of the ratio of scattering efficiency to scattering plus absorption efficiencies of a single particle on the Mars surface. A new hypothesis test method verifies the resultant SSA is well modeled by a scaled Poisson distribution rather than an additive white Gaussian distribution. The standard method without regularization provides reconstructions with blurred images and noisy spectra. Therefore, a regularized maximum log-likelihood method (MLM) is derived to reconstruct and denoise the hyperspectral cubes. A new spatially dependent weighting on the regularization penalty that depends on spatial sample intervals is presented, substantially eliminating row artifacts that are present in competing methods. A new spectral weighting penalty as a function of wavelength is also introduced; this spectral weighting suppresses some noise due to aging detectors. Our MLM procedure can generate reconstructions with sharpened images (especially for details smaller than 55 but larger than 12 meters) and spectra in which the noise is suppressed but fine-scale mineral absorptions are preserved. For rocks on Mars, the spatial resolution and contrast are at least two times better than competing methods. These products supply the research on Mars with a favorable beginning.

DATE: Wednesday, March 8, 2017  
TIME: 1:00 p.m.  
PLACE: Green Hall, Room 0120

Thesis advisor:  
Dr. Joseph O'Sullivan

This seminar is in partial fulfillment  
of the Doctor of Philosophy degree