Title: Hyperspectral microscopy in support of robust spectral signature development

Abstract: Hyperspectral imagery (HSI) microscopy provides a means for grain-scale measurements of geological materials such as soils and of individual crystals in thin-sections (or slabs) of rocks. The additional information measurements at this scale provides can play a key role in explaining spectral signature variability; it also generates more detailed metadata and sample descriptions to help explain differences between ground truth spectra and spectra from remotely sensed imagery. HSI microscopy complements traditional spectral signature measurements made with laboratory (and field-portable) point spectrometers. Additionally, the hyperspectral imagery collected at close range can be used as a rich source of scene data ("microscenes") for testing algorithms. NIST has developed a laboratory dedicated to measuring the optical properties of materials through the use of commercial and custom hyperspectral imagers. A description of the instruments, measurement methods, and example applications will be provided.

### Statistical Distribution of Spectra

A large number of spectra of a material allows for the evaluation of the parameters of the probability distribution (PD) that describes the data (i.e., density estimation); estimates of the multivariate PD are then compared to a multivariate normal PD. The PDs are used to build algorithms. Ref 2

### Non-Linear Spectral Mixing

Mixtures of pure materials can be examined and used to study non-linear mixing. The resulting data set can then be used to develop predictive models. Ref 3

### References:

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2) Ronald G. Resmini; Christopher J. Deloye; David W. Allen; An analysis of the probability distribution of spectral angle and Euclidean distance in hyperspectral remote sensing using microspectroscopy. Proc. SPIE 8743, Algorithms and Technologies for Multispectral, Hyperspectral, and Ultraspectral Imagery XIX, 87431I (May 18, 2013)

3) Ronald G. Resmini; Robert S. Rand; David W. Allen; Christopher J. Deloye; An analysis of the nonlinear spectral mixing of didymium and soda-lime glass beads using hyperspectral imagery (HSI) microscopy. Proc. SPIE, Algorithms and Technologies for Multispectral, Hyperspectral, and Ultraspectral Imagery XX, (May 2014)

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