GEOPHYSICAL INVERSION OF HYPERSPECTRAL DATA: FROM MODEL TO REALITY

Freek van der Meer

Imaging spectrometers acquire physical measurements of radiation in small and contiguous wavebands in order to produce continuous spectral information that can be compared directly with field or laboratory measurements if the atmospheric attenuation is compensated for. Widely used processing strategies statistically compare unknown pixel reflectance spectra with known field/laboratory spectra and derive measures of similarity or abundances. In geological remote sensing-practice these yield “mineral maps” that portray the similarity of the measured signal with that of signatures of known minerals. Geologists can build-up a model of an area using these “maps”. Here the reverse processing strategy is proposed introducing the geologic model at the start of the processing chain and refining the model in an iterative way by comparing its mismatch with the observed reflectance measurements. Geophysical inversion of hyperspectral data is implemented using a Bayesian probabilistic model and a neural network to drive the iterations. A neighborhood function allows introducing geographical information and hierarchical geologic relationships such as the mineral paragenesis typical for certain mineral alterations. The geophysical measurements used are the imaged spectra and the geophysical variables are the geologic-physical model. The prior probability is estimated per pixel and is equivalent to expectation for the different geologic classes in the model, which is simply the probability derived from the number of occurrences. The neighbourhood distribution introduces the geologic knowledge on the expected mineral paragenesis in a pixel kernel. The results of geophysical inversion are compared to abundance estimates from spectral unmixing techniques.