A segmentation strategy was tested based on the "Felzenszwalb" algorithm for its simplicity and computational efficiency. This approach represents the hyperspectral image as an 8-connected grid of pixels that can begin as independent segments. Edges between nodes represent the distance between neighboring spectra, and each is weighted according to a measure of distance between pixels. The algorithm iteratively joins neighboring pixels together into larger segments, and describes each segment by the minimum spanning tree of edges that joins all segments in the cluster.

Hyperspectral segmentation algorithms partition images into spectrally homogenous regions. However, the exact definition of homogeneity is dependent on the chosen similarity metric. The segmentation algorithm is augmented with a task-specific distance metric. Here, a Mahalanobis distance metric is used, learned from training data. By leveraging a (small) set of labeled pixels with known mineralogical interpretations, the metric suppresses uninformative spectral content. Multiclass linear discriminant analysis (LDA) is used to maximize the ratio of between-class vs. within-class separation, defined by the Rayleigh quotient computed over labeled training data. Other distance metrics and segmentation strategies are possible, and can be substituted for these choices in modular fashion as different applications demand.

This work was done by David R. Thompson and Rebecca Castano of Caltech, Brian Bue of Rice University, and Martha S. Gilmore of Wesleyan University for NASA’s Jet Propulsion Laboratory. For more information, contact iaoffice@jpl.nasa.gov.

This software is available for commercial licensing. Please contact David Broderick of the California Institute of Technology at danielb@caltech.edu. Refer to NPO-48092.