

The logo for FOSS4G 2006, featuring a stylized red and white graphic that resembles a ribbon or a stylized letter 'G'.

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Per-pixel classification confidence mapping using R and GRASS

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Land use / land cover maps are usually created using some form of minimum distance classification algorithm, which selects classes based on a minimized distance between the spectral characteristics of each pixel to a set of clusters in multidimensional spectral space. This leads to a single class assignment per pixel. We have been investigating the utility of retaining information about the distances in spectral space of each pixel from both the cluster that lead to the class assignment, as well as to the 'second-closest' cluster, in order to map classification confidence per pixel. Initial experiments made extensive use of the R statistics package and the GRASS/R link, whereas current developments are focussed on a GRASS module, to handle large datasets in a reasonable time frame.

Land use classification maps are often made by classifying remotely-sensed imagery with some form of a minimum distance algorithm. This procedure computes the distance between a pixel's unique spectral signature and a set of clusters within n-dimensional space that represent discrete land cover categories. Each pixel receives a label corresponding to the closest predefined cluster. Repeating this process for each pixel leads to a classified map, which reflects the most probable (maximum likelihood) case, given a set of spectral measurements.

One limitation to this approach occurs when pixels have virtually identical distances to two or more clusters. Especially if the distances are large, the pixel may not clearly belong to any single category, and may represent mixed land cover. Without further information, such pixel classifications remain suspect.

We have proposed that retention of the distance to the second closest cluster can shed light on the confidence in category assignment. In previous studies, we presented several examples of how such additional information might enhance accuracy assessments and improve classification confidence. Calculating multi-spectral distances to cluster centroids (an approximation of the Mahalanobis distance) allows comparison of all potential class assignments. This provides a measure of relative confidence in the actual classification at the level of individual pixels, and highlights easily confusable classes.

We have developed software to calculate the distances of each pixel to all possible clusters, and store the distances to (and corresponding class assignments of) the closest and second closest clusters. The algorithm was originally designed in R, using the GRASS/R link for handling spatial data, and a forest inventory dataset provided by the Canadian Forest Service. While that system proved effective for demonstrating the concept, the processing time for anything larger than a small area was excessive - e.g. processing a LANDSAT scene was definitely not practical. The algorithm has been converted into a new GRASS module in C. We present results using this module on a test dataset, and welcome discussion of future possibilities.

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