USING LANDSAT TM IMAGES IN IRAN

Fuzzy Classification: a Case Study

Extraction of information from satellite images is a solution for countries without up-to-date base maps. Such images can be easily obtained and cover vast areas. Information is mostly extracted using multispectral classification, but many methods have been developed. The authors examined “fuzzy classification” and found it more accurate and requiring less computing time than other methods.

Multispectral classification is a convenient way of extracting information from satellite images, especially if the images consist of many (multi) spectral bands. “Maximum Likelihood” and “Minimum Distance” are often used methods. Each has its own characteristics. Maximum Likelihood gives better results but requires more computing time; also, all pixels are assigned to one of the specified classes, whereas they may belong to none of them. Minimum Distance requires less computing time but also assigns every pixel to one class.

Fuzzy Classification

An alternative is “fuzzy classification.” We developed a 3-step fuzzy classification method suited to multispectral images. In the first step an approximation of classes is derived, assuming normal distribution of input data. The Gaussian distribution is chosen because it represents a powerful general distribution model. Linear models are unable correctly to express the natural non-linear distribution of classes, and the class distributions are linearly independent of each other. The actual classification is done in the second step, the “Minimum” reasoning engine. In the third step classification is performed by a MAX operation to de-fuzzify the fuzzy output into crisp classes. The “Fuzzy” method has been implemented as a Matlab program. For comparison purposes, the Minimum Distance method was also implemented in Matlab.

Comparative Results

The study area is the Ahvaz region of Iran. We used bands 3, 4 and 5 of Landsat TM imagery, spatial resolution 30x30m and image size 408x374 pixels. The three major classes are river, bare soil and agricultural fields. In the first step we selected a set of pixels according to our knowledge of the region for each class.

The results of the Fuzzy method were compared with those of the Minimum Distance method. The overall accuracy assessment of both methods indicates that the Fuzzy method renders better accuracy than the Minimum Distance method. In addition, the Fuzzy method produces smoother results. However, the Minimum Distance method extracts borders more accurately. The computing time of both methods is comparable.

Conclusions

The strength of the Fuzzy method is its simplicity and its improved classification result through explicit fuzzyfication exploited efficiently by the MIN fuzzy reasoning rule. Another advantage of the Fuzzy method is that spectral bands can be easily inserted and removed without disturbing the remaining parts. With the advent of new generations of sensors providing many spectral bands (for example, HIRIS with 192 spectral bands), it is recommended that more research be carried out on the Fuzzy Classification method.

Acknowledgment

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Further Reading

- Valadanzoj M., Milan A., Evaluation of DLT model and orbital parameter model for geometer correction satellite imageries, five civil engineer conference, pp27-33, 1379.