A Simple Measure for Estimating Confidence at Pixel Scale in Fuzzy Land Cover Classification

M.S. Ganesh Prasad [1] , M.K. Arora [2]

[1] *Professor, Department of Civil Engineering, The National Institute of Engineering, Mysore, India – ganeshprasad@nie.ac.in*
[2] *Professor, Department of Civil Engineering, Indian Institute of Technology Roorkee, Roorkee, India – manojfce@iitr.ernet.in*

Abstract: Representing the quality of land cover classifications from remotely sensed data at pixel level is important in assessing their fitness for use. Conventional approaches to represent the quality in terms of accuracy depend on information from the reference data at the same scale. Any error in dubious reference data may have an impact on the assessment of quality. Map quality in terms of accuracy represented by the conventional error matrix derived values or kappa statistic are global/ class specific in nature. These measures fail to represent the spatial variation of accuracy of classification. Therefore, methods which complement the conventional accuracy measures are required to represent the quality of each pixel classified to a land cover class. Alternative to existing global accuracy indicators, measures of uncertainty and confidence at pixel scale may be used.

A few studies have been attempted to derive pixel level confidence. However, the results from these studies have not been widely adopted by the remote sensing community due to their limitations. In this paper, an approach from information theory has been adopted to derive a measure of confidence at pixel scale. The approach used here requires simple evidence which is fuzzy as well as uncertain. The output from a fuzzy classification can be used as simple evidence for estimating the confidence in classifying a pixel. A fuzzy classification method yields membership values for a pixel in different land cover classes considered. To derive the confidence in pixel level classification, two values *viz.* first and second highest class membership values are required. The utility of the proposed measure has been illustrated by subjecting a multi spectral image from Landsat ETM+ sensor at a spatial resolution of 30m, to Fuzzy *c*-means classification (FCM). The overall accuracy of classification was found to be 58% and 64.8% respectively from conventional and fuzzy error matrix.

The derived class membership values Fuzzy *c*-means classification were used to estimate confidence values at each pixel. The estimated confidence values were cross validated with classification errors by determining the number of misclassified pixels. Pixels with high confidence values exhibited inverse relation with the proportion of misclassification. The results were found to be optimistic and supported the utility of proposed measure in providing significant information about the quality of classification at pixel level. Due to its simplicity, the proposed measure may be used to represent the spatial variation of the quality of fuzzy thematic maps at pixel level.

Key word: Image classification, Confidence, Accuracy, Uncertainty, Quality