Developmental Networks with Classification Uncertainty

Siam Lawawirojwong, Tanita Suepa, and Jiaguo Qi
Department of Geography
Center for Global Change and Earth Observations
Michigan State University
MI, USA,

Paul Cornwell and Juyang Weng
Department of Computer Science and Engineering
Michigan State University
MI, USA

***Abstract*—Land cover map derived from remotely sensed classification is universally used and it is probably the most important data in the terrestrial dataset. Many approaches based on neural network have been shown to be very efficient and extensively used in automated land cover classification. However, the result of classification has a less than desired accuracy. Such errors may lead to erroneous and misleading interpretations. Therefore, the objective of this study is to evaluate the classification uncertainty by considering the impact of possible factors on the spatial variation of classification accuracy associated with the input images. We used the framework of Developmental Network (DN) where each area was inspired by a brain area's bottom-up and top-down projections. In other words, both the bottom-up input space (images) and top-down input space (classes as vector) were used for the development of dually optimal internal features, called Lobe Component. The features are spatially optimal in the sense that the target of representation is the best that minimizes the reconstruction error in the input (bottom-up and top-down space). Such a DN was used to evaluate the classification uncertainty in this research. MODIS-EVI time-series imagery was used for image classification. In addition, Monte Carlo simulations technique is applied to assess the reliability of the classification outputs. The results of this study provide the better understanding of the spatial allocation of classification accuracy and the uncertainty from input data, as well as how sensitivity and reliability of land cover map classified by DN. Moreover, the results are also able to suggest how to select the appropriate values of DN configurations for the improvement of classification.**

***Index Terms*—features; feature maps; Monte Carlo simulation; neural network; remote sensing**