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EVOLUTIONARY COMPUTATION FOR FEATURE EXTRACTION FROM REMOTELY SENSED IMAGERY: EXPLORATION OF OPTIMAL PARAMETERS

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ABSTRACT:

A common problem faced by many organizations is the conversion of large amounts of imagery data into geospatial intelligence and/or actionable information in a timely and cost-effective fashion. The primary challenge is the development of technology to extract information from imagery with reduced human interaction. To address this issue, an innovative methodology integrating biologically inspired computer algorithms with standard image classification algorithms has been developed and tested in solving multiple information extraction problems in different domains. Genetic programming was used as the optimization engine to evolve feature-specific solutions represented as nonlinear mathematical expressions of the image spectral channels. During the evolutionary process, significant computational overhead is generated due the following factors: image size (spatial and spectral resolution) and selection of parameters controlling the evolutionary process. Limited studies were devoted to the exploration of selection of the optimal evolutionary algorithm parameters specifically applied to information extraction from satellite imagery. The primary goal of this research is to investigate the selection of optimal parameters, such as population size, percentage and the order of mutation and crossover, and generation numbers, in genetic programming to obtain desirable balance between accuracy of final solutions and computation resources (e.g, RAM and CPU). The proposed system was evaluated by addressing the task of extracting asphalt-based rooftop features from a set of high spatial resolution, but limited spectral resolution, images acquired at different dates and utilized in a cross-validation approach. Preliminary results demonstrate that the optimal population size is around 1500 candidate solutions, mutation plays an important role controlling diversity and it should be firstly applied to top candidate solutions rather than crossover. The results describing optimal parameters were derived from large experimental datasets and these findings provide guidance to other researchers in utilizing genetic programming algorithms to extract specific information from large remote sensing datasets.