Evolving Feature Extraction Algorithms For Spatio-Spectral Remote Sensing Of Vegetation

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ABSTRACT

Spectral imagery with moderate spatial resolution (of order ~10m) presents an interesting challenge to remote sensing algorithm developers, as both spatial and spectral signatures may be used jointly to identify features of interest. We now report on the application of a machine learning technique to the classification of vegetation. Our application is monitoring environmental change in the Jemez Mountains of New Mexico following the Cerro Grande/Los Alamos wildfire of May 2000. That fire devastated over 43,000 acres (17,500 ha) of mostly forested land, and destroyed over 200 structures in the town of Los Alamos. During and after the fire, remote-sensing data was acquired from a variety of aircraft- and satellite-based sensors, including Landsat 7 Enhanced Thematic Mapper (ETM+), AVIRIS, and the DOE/NNSA Multispectral Thermal Imager. Some of this imagery has been fused with USGS 1:24000 scale digital elevation model (DEM) data. Together with a rich database of ground truth, this dataset presents an interesting test case for developing remote sensing algorithms.

We apply a hybrid genetic programming/supervised classification technique to evolve automatic feature extraction algorithms. We use the GENetic Imagery Exploitation (GENIE) software for this purpose, which produces image-processing software that inherently combines spatial and spectral processing. GENIE is particularly useful in exploratory studies of imagery, such as one often does in combining data from multiple sources. The user trains the software by painting the feature of interest with a simple graphical user interface. GENIE then uses genetic programming techniques to produce a customized feature extraction algorithm. We demonstrate evolution of feature extraction algorithms for a range of vegetation types from several kinds of imagery.

Keywords: Genetic Programming, Image Processing, Hyperspectral Imagery, Multispectral Imagery, Digital Elevation Model, Data Fusion, Remote Sensing.