Name: Erwin J. Villiger

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Dissertation Director: Dr. Barry N. Haack

ABSTRACT

Investigators engaged in research utilizing remotely-sensed data are increasingly faced with a plethora of data sources and platforms that exploit different portions of the electromagnetic spectrum. Considerable efforts have focused on the application of these sources to the development of a better understanding of lithosphere, biosphere, and atmospheric systems. Many of these efforts have concentrated on the use of single sensors. More recently, some research efforts have turned to the fusion of sources in an effort to determine if different sensors and platforms can be combined to more effectively analyze or model the systems in question.

This study evaluates multisensor integration of Synthetic Aperture Radar (SAR) with Multispectral Imagery (MSI) data for land cover analysis and vegetation mapping. Three principle analytical issues are addressed in this investigation: the value of SAR collected at different incident angles, preclassification processing alternatives to improve fusion classification results, and the value of cross-season (dry and wet) data integration in a subtropical climate.

The study site for this research is Andros Island, the largest island in The Bahamas archipelago. Andros has a number of distinct plant communities ranging from saltwater marsh and mangroves to pine stands and hardwood coppices. Despite the island's size and proximity to the United States, it is largely uninhabited and has large expanses of minimally disturbed landscapes.

An empirical assessment of SAR filtering techniques, namely speckle suppression and texture analysis at various window sizes, is utilized to determine the most appropriate technique to apply when integrating SAR and MSI for land cover characterization. Multiple RADARSAT-1 SAR images were collected at various incident angles for wet and dry season conditions over the region of interest. Two Landsat Thematic Mapper-5 MSI datasets were also collected to coincide with the time periods of the SAR images.

A land cover classification process applied to the dry season and wet season MSI data achieved a total classification accuracy of 80.6% and 80.7% respectively. When combined into a single multiseason dataset the MSI data resulted in a total classification accuracy of 87.3%. SAR proved to be a valuable source of information especially when processed as a time series and with a speckle suppression algorithm applied. A 21-scene multitemporal SAR dataset achieved a total classification accuracy of *65.8%.* When a classification was applied to the multitemporal dataset following speckle suppression, the resulting total classification accuracy was as high as 83.8% depending on the speckle algorithm and kernel applied.

While texture measures have been successfully utilized for integrating SAR and MSI data, in this study speckle suppression proved to be significantly more valuable. SAR collection parameters such as look direction (ascending or descending orbit) and incident angle did not prove to contain uniquely valuable characteristics. The highest total classification accuracy achieved involved a combination of two MSI datasets and a multitemporal SAR dataset processed to suppress speckle using a Gamma- Maximum A Posteriori (MAP) filter with a 9x9 kernel.

This study sought to investigate processing alternatives when fusing SAR and MSI data. While not all of the results met with expectations, this study does determine that SAR and MSI are complementary data sources. A combination of SAR and MSI provide unique and valuable results that cannot be achieved by each variable used independently.