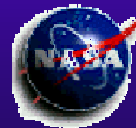




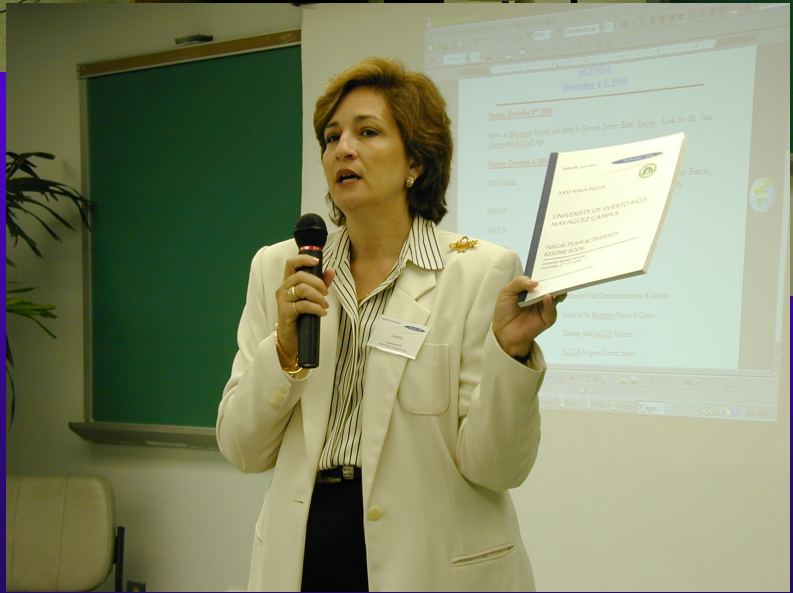
PaSCoR Advisory Board Meeting 2000

University of Puerto Rico at Mayagüez





Prof. Lueny Morell







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Prof. Luis Olivieri

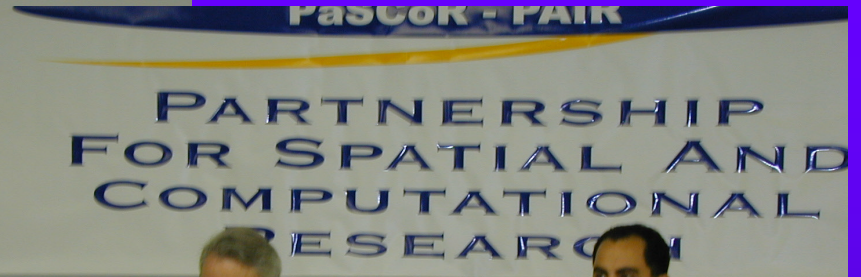








Dr. Ramón
Vásquez





PaSCoR students with their poster



Detecting Patterns in Hyperspectral Data by means of Unsupervised Algorithms and Band Selection

Prof. Luis O. Jiménez (UPRM), Prof. Miguel Velez-Reyes (UPRM),
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Goals
Recent development of more sophisticated sensors enable the measurement of radiation in many more spectral intervals at a higher spectral resolution than previously possible. Hyperspectral sensors gather enormous amount of information. Current algorithms are not able to extract a significant amount of accurate features. New generations of algorithms are being developed for this complex data set in order to improve data analysis. Future research will be performed to use Physics-Based modeling in order to extract subsurface information to previously unattainable levels.

Significance
New unsupervised classification algorithms are being developed to uncover patterns in this complex data. These methods integrated with Physics-Based modeling will enable us to extract hidden features embedded in highly complicated medium. Precise analysis using hyperspectral data will permit the recognition of hidden objects. Possible targets are coral reefs mapping, underwater pollution, oil spills, and other contaminants. Multisensor fusion approaches are being used to reduce the redundant information by a Band Subset Selection algorithm.

Technical Approach
Different Unsupervised Classifications schemes are being used in order to study hyperspectral data. These algorithms are different in the way they model the data. For example, ISODATA and c-means clustering algorithms model the data using first order statistics. They assume the variation in the data is due to noise. Whereas c-means and covariances clustering algorithms use both first and second order statistics and assume variation is an attribute of the object of interest. This results on an improved data modeling. Both of these types of methods use only the spectral information acquired directly from the sensors, ignoring spatial information. Contextual post-processing filters and the unsupervised ECHO classifier integrates the spatial and the spectral information.

Figure 1 Hyperspectral image
Figure 2 ISODATA classification
Figure 3 c-means and covariances

Figure 4 ECHO classifier
Figure 5 Contextual post-processing

Relation to ERC
These techniques are part of the Multispectral Discrimination Information Extraction Technique (MSDI). These images show the results of different methods that uncover patterns using multisensor fusion in hyperspectral data. Next step of the project is to use Physics-Based processing for subsurface sensing.

Current Status
The project is being funded in part by U.S. Army Corps of Engineering Topographic Engineering Center Grant DAAG55-98-1-0016, NASA Grant NCC5-340, and NASA URC Program under grant NCC9-0095.

Plans and Project Evolution
Different Statistical models have been applied to analyze the data. The use of first and second order statistics has improved the results. The integration of the spectral and the spatial information has produce better results in the detection of patterns. In the next three years Physics-Based modeling will be applied in the Hyperspectral Underwater Testbed. In 5-10 years we expect to develop a new method of hyperspectral data analysis for subsurface sensing that integrates Physics-Based modeling and Statistical Signal Processing.

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Dr. Johannes Schellekens with his group of students



