

## Northeastern University

**Research Thrust R2 Presentations** 

CenSSIS Research Thrust R2: Physics Based Signal Processing and Image Understanding

January 01, 2007

# A Study on the Effect of Spectral Signature Enhancement

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## **Recommended** Citation

Alvira-Concepción, Enid Marie; Vélez-Reyes, Miguel; and Rosario-Torres, Samuel, "A Study on the Effect of Spectral Signature Enhancement" (2007). *Research Thrust R2 Presentations*. Paper 4. http://hdl.handle.net/2047/d10008962

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## A Study on the Effect of Spectral Signature Enhancement in Hyperspectral Image Unmixing

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### Abstract

Hyperspectral imagery (HSI) is an effective technology for quantitative monitoring of shallow water coastal environments. Hyperspectral sensors collect hundreds of narrow and contiguously spaced spectral bands of data organized in the so-called hyperspectral cube. Two challenges arise in the use of hyperspectral sensors for benthic habitat mapping: (1) low spatial resolution and (2) small signal coming out of the water compared to atmospheric clutter which requires good signal to noise ratio (SNR) sensors for remote sensing of benthic habitats. To deal with low spatial resolution, unmixing of the hyperspectral signature is performed. Spectral unmixing is used to retrieve subpixel information. Spectral unmixing is the process of decomposing the measured spectrum into a collection of constituent spectra, or endmembers, and a set of corresponding fractions or abundances. Unmixing algorithms are used to estimate bottom coverage of different species for benthic habitat mapping. Two algorithms are applied to HYPERION and AVIRIS imagery as pre-processing to improve its SNR: resolution enhancement filtering and principal component filtering. A study of how the performance of the unmixing algorithm is affected by the different pre-processing algorithms is performed. AVIRIS imagery from Enrique Reef and Kaneohe Bay is used in the experiments.

#### **Technical Approach**

The experiments consisted of a combination of Resolution Enhancement and PCA Filtering preprocessing stages before unmixing as indicated in the following figure. Endmembers were extracted manually from the image.



study site, AVIRIS data from Kaneone Bay in Hawaii, scatter plots are used to compare the estimates. For the following endmembers, Sand and Coral Reef, the resulting abundance estimates with and without filtering are quite similar, but for Algae the estimates are very different. Results show that data pre-processing can have a significant effect on the abundance estimates. Further work is needed to quantify the accuracy of the estimates and to be able to determine which method or combination of processing stages result in better abundance estimates.

#### References

N. Keshava and J.F. Mustard, "Spectral unmixing." In IEEE Signal Processing Magazine, Vol. 19, Iss. 1, January 2002.

S. Rosario-Torres and M. Vélez-Reyes, "An algorithm for fully constrained abundance estimation in hyperspectral unmixing." In Proceedings of SPIE Algorithms and Technologies for Multispectral, Hyperspectral, and Ultraspectral Imagery XI, Vol. 5806, pp. 711-719, April 2005.

Z.P. Lee, K.L. Carder, C.D. Mobley, R.G. Steward, and J. Patch, "Hyperspectral remote sensing for shallow waters I: A semianalytical model." In Applied Optics, Vol. 37 No. 27, September 1998.

A. Castrodad-Carrau, M. Vélez-Reyes, and J.A. Goodman, "An algorithm to retrieve coastal water optical properties, bathymetry, and bottom albedo from hyperspectral imagery." In Proceedings of SPIE: Photonics for Port and Harbor Security II, Vol. 6204, May 2006.



Work reported herein was funded primarily by the Center for Subsurface Sensing and Imaging Systems sponsored by the Engineering Research Centers Program of the US National Science Foundation under grant EEC-9986821.