An innovative approach to aid the detection of anomalies along the Mississippi Levees by bridging SAR and GIS

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Abstract

Monitoring the physical condition of levees for flood control is vital. The dynamics of subsurface water events cause continuous damage on levee structures which are not easily spotted prior to the appearance of slough slides or through-seepage. The traditional method of detecting these events involves physical surveys which are time consuming and expensive. Synthetic Aperture Radar (SAR) technologies are capable of identifying variations in soil properties that are related to the potential for such events. However, high spatial resolution SAR images are contaminated by multiplicative noise due to the radar wave coherence, so advanced "speckle" filtering is needed in order to reduce the noise. Based on the size of the objects of interest, the common solutions that use down sampled "multi-look" data as well as using ordinary low pass filters blur the edges of the objects that can significantly impair the assessment of geometrical, topological and contextual information for further classification process.

As part of finding an alternative way to explore the data, we propose the use of anisotropic diffusion filtering for single-look SAR images to serve as a basis for the segmentation of the object-based image classification. Anisotropic diffusion is part of scale-space family of image descriptions varying from fine to coarse representation of the details to compute the scale-space iteratively. The diffusion coefficients discourage inter-region blurring by inhibiting neighborhood smoothing where the local image gradient is large and a region boundary exists, thereby providing a good prospective tool for removing unwanted noise while preserving the edges of desired objects.

This paper reports preliminary results of applying anisotropic diffusion filtering and segmenting the SLC (single-look complex) data from the NASA Unmanned Aerial Vehicle SAR (UAVSAR) that uses fully polarimetric L-band. The output segments retain the shape and topological characteristics of the objects which can be further explored using GIS techniques. This approach results in better classification in addition to using multi-look data. The study area is located along levees near Vicksburg Mississippi.

Keywords: Levee slide, SAR, speckle filter, anisotropic diffusion, segmentation, object-based classification

Presenter's Bio: *Dr. Rodrigo Nobrega is currently an Assistant Research Professor at Geosystems Research Institute – Mississippi State University after been post-doctoral for couple of years at the same institute. Dr. Nobrega is Cartographer Engineer and received PhD and Msc degrees in Geospatial Analysis for Transportation Engineering from University of São Paulo – Brazil. He has over 10 years of industry and consulting experience in Photogrammetry and Remote Sensing as well as extensive research background using Commercial Remote Sensing and Spatial Information technology for transportation and infrastructure planning. Dr. Nobrega has significant interest in the application of high resolution and multi-source data for infrastructure design, modeling, and monitoring of constructed infrastructure and its context to the built and natural environment.*