Background:
Airborne methods for detection of unexploded ordnance (UXO) can realize large savings in cost and time when compared to ground-based detection methods. However, existing data processing tools do not enable airborne data collection methods to be as sensitive to small objects as methods that use surface deployed instrumentation. An additional problem common to both collection methods is the difficulty in discriminating targets from clutter in the analyzed data. This project attempts to address both of these problems by using the discrete wavelet transform to improve the signal-to-noise ratio (SNR) of airborne magnetic data and the continuous wavelet transform coupled with image processing techniques to distinguish targets from clutter.

Objective:
This project will investigate whether (1) wavelet based signal processing techniques can improve the SNR and extract more information from airborne and ground-based magnetic data than current signal processing techniques and (2) wavelet based signal processing techniques, in combination with probabilistic methods, hold promise as a method for discriminating targets from clutter.

Summary of Process/Technology:
The discrete wavelet transform will be used to filter airborne magnetic data. The data will be transformed into the wavelet domain, filtered based on wavelet coefficient energy, and transformed back into the original domain. The resulting signal is expected to be de-noised, thereby allowing target features to be more clearly identified and characterized. Ground-based data and/or airborne data that corresponds to known features will be transformed using the continuous wavelet transform. The result in the wavelet domain may be viewed as an image. Image processing techniques will be applied to extract features that distinguish targets from clutter. These features will be used to construct probability distributions for targets and clutter. A formal approach using these distributions and Bayes theorem will be used to distinguish targets from clutter.

Benefit:
This project will demonstrate whether wavelet filtering can improve the SNR of airborne magnetic signature, allowing the sensitivity of airborne methods to approach that of ground based methods. It should also indicate if the combination of wavelet analysis, image processing, and probabilistic methods can be used to distinguish targets from clutter. If successful, these results may make airborne methods comparable in accuracy and detail to ground based surveys and may allow targets to be accurately identified.

Accomplishments:
This SEED project began in FY 2002. Accomplishments will be noted upon completion of the project.

Contact Information:
Dr. Brian Damiano
Oak Ridge National Lab
Engineering Science and Technology Division
P.O. Box 2008
Bldg. 3500, MS-6010
Oak Ridge, TN 37831
Phone: (865) 574-5541
Fax: (865) 574-0431
E-mail: damianob@ornl.gov