Geophysical Research Abstracts
Vol. 12, EGU2010-510, 2010
EGU General Assembly 2010

Suppression of vegetation in LANDSAT ETM+ remote sensing images

Le Yu (1), Alok Porwal (2), Eun-Jung Holden (3), and Michael Dentith (3)

(1) Institute of Space Information Technology, Zhejiang University, Department of Earth Sciences, Hangzhou, China (naisoild@gmail.com), (2) Centre for Exploration Targeting, Western Australian School of Mines, Curtin University of Technology, Perth, Australia, (3) Centre for Exploration Targeting, School of Earth and Environment, The University of Western Australia, Perth, Australia

Vegetation cover is an impediment to the interpretation of multispectral remote sensing images for geological applications, especially in densely vegetated terrains. In order to enhance the underlying geological information in such terrains, it is desirable to suppress the reflectance component of vegetation. One form of spectral unmixing that has been successfully used for vegetation reflectance suppression in multispectral images is called "forced invariance". It is based on segregating components of the reflectance spectrum that are invariant with respect to a specific spectral index such as the NDVI. The forced invariance method uses algorithms such as software defoliation. However, the outputs of software defoliation are single channel data, which are not amenable to geological interpretations. Crippen and Blom (2001) proposed a new forced invariance algorithm that utilizes band statistics, rather than band ratios. The authors demonstrated the effectiveness of their algorithms on a LANDSAT TM scene from Nevada, USA, especially in open canopy areas in mixed and semi-arid terrains.
In this presentation, we report the results of our experimentation with this algorithm on a densely to sparsely vegetated Landsat ETM+ scene. We selected a scene (Path 119, Row 39) acquired on 18th July, 2004. Two study areas located around the city of Hangzhou, eastern China were tested. One of them covers uninhabited hilly terrain characterized by low rugged topography, parts of the hills are densely vegetated; another one covers both inhabited urban areas and uninhabited hilly terrain, which is densely vegetated.
Crippen and Blom's algorithm is implemented in the following sequential steps: (1) dark pixel correction; (2) vegetation index calculation; (3) estimation of statistical relationship between vegetation index and digital number (DN) values for each band; (4) calculation of a smooth best-fit curve for the above relationships; and finally, (5) selection of a target average DN value and scaling all pixels at each vegetation index level by an amount that shifts the curve to the target digital number (DN). The main drawback of their algorithm is severe distortions of the DN values of non-vegetated areas, a suggested solution is masking outliers such as cloud, water, etc. We therefore extend this algorithm by masking non-vegetated areas. Our algorithm comprises the following three steps: (1) masking of barren or sparsely vegetated areas using a threshold based on a vegetation index that is calculated after atmosphere correction (dark pixel correction and ACTOR were compared) in order to conserve their original spectral information through the subsequent processing; (2) applying Crippen and Blom's forced invariance algorithm to suppress the spectral response of vegetation only in vegetated areas; and (3) combining the processed vegetated areas with the masked barren or sparsely vegetated areas followed by histogram equalization to eliminate the differences in color-scales between these two types of areas, and enhance the integrated image.
The output images of both study areas showed significant improvement over the original images in terms of suppression of vegetation reflectance and enhancement of the underlying geological information. The processed images show clear banding, probably associated with lithological variations in the underlying rock formations. The colors of non-vegetated pixels are distorted in the unmasked results but in the same location the pixels in the masked results show regions of higher contrast.
We conclude that the algorithm offers an effective way to enhance geological information in LANDSAT TM/ETM+ images of terrains with significant vegetation cover. It is also suitable to other multispectral satellite data have bands in similar wavelength regions. In addition, an application of this method to hyperspectral data may be possible as long as it can provide the vegetation band ratios.