THEMATIC RESOLUTION ASSESSMENT MERGING LANDSAT AND SPOT 10M

Alzir Felippe ANTUNES
University of Parana, Brazil
Center of GIS- CIEG
Felippe@cce,.ufpr.br

KEY WORDS: Remote Sensing, Image Fusion, Segmentation, and Classification.

ABSTRACT

This paper presents image fusion procedures between high spatial resolution SPOT image and Landsat TM multispectral LANDSAT by the means of IHS and Principal Components Analysis algorithms. Are compared both methods efficiency. The Hybrids images generated are segmented in order to evaluate the thematic resolution improvement.

1 INTRODUCTION

New sensors are available with different spectral and spatial resolution these diversity of data sometimes might be gathered to improve pattern recognition. The fusion of multisensor satellite images shows an effective means of extracting information from different source of sensors. It plays an important role in image interpretation in many cases it enhances the thematic resolution of the images. This paper presents a classical image fusion process using the good spectral resolution of LANDSAT and the higher spatial resolution of panchromatic SPOT. In theory the fusion of LANDSAT TM and SPOT results into hybrid image which has 10 meters resolution of SPOT and spectral base of LANDSAT. In fact generated data set is supposed to contain the best of both sets.

The objective of this paper is to present two different methods used to image fusion Principal Component Analysis (PCA) and IHS- Intensity, Hue and Saturation. The new data sets are evaluated on their thematic characteristic by the means of image segmentation.

2 DATA CHARACTERISTICS AND TEST SITE

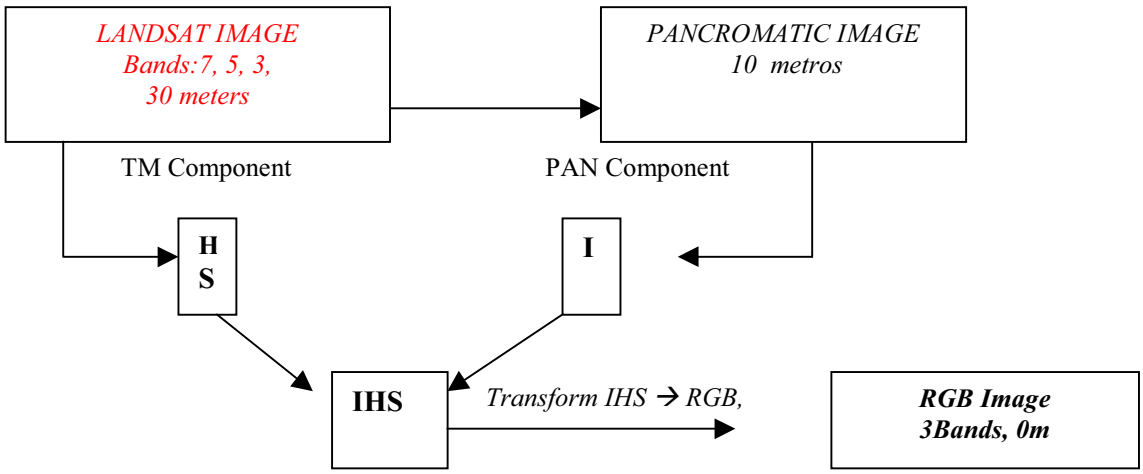
The TM data collected on June 1997 and the PAN data is also from June 1997, cover the 4 Km ^{2} of Curitiba surroundings in South Brazil (central coordinates 25^o 26,67 S and 49^o 40,72 W). The area focused on study is in Curitiba s Metropolitan Zone, which includes different types of classes, such as: bare soils, native forest, secondary forest; agricultural zones, urban area. The images were registered and then geometrically corrected using GPS control points.

3 METHOD

3.1 IHS

IHS is one of the most often used methods of merging multisensor image data. The method uses three bands of lower special resolution data set and transforms these data into IHS space. The higher spatial resolution image PAN has in general a contrast with the same variance and average as the intensity component image. The stretched, higher special resolution image replaces the intensity component image before the images are retransformed back into the original space. It happens because the intensity component with the stretched higher spatial resolution image PAN are approximately equal to each other spectrally (CHAVEZ et al, 1991). The figure 1 shows the steps of IHS transform.

Figure 1: IHS transform



3.2 PCA

In this sort of method the all TM bands might be used as input to a principal component analysis procedure. As with the IHS, the PAN data is stretched to have approximately the same variance and average as the first component (PC1). Thus, the PAN data replaces the PC1(first component) image before the data are retransformed back into original space. That replacement is based on assumption that the first component (PC1) is spectrally close to the PAN data. The TM data spectrally overlap the PAN data and also its spectral information will be represented in the first component image.

4 RESULTS AND COMPARISONS

The basic assumption made by the both methods is that the PAN data are very similar to the intensity and PC1. Therefore the PAN data can be replaced either of these two images in the retransformation of the data back to the original image space. The effectiveness of the merge depends on how close the PAN data are from the Intensity and first component (PC1).

Table 1 shows the correlation coefficients image generated from subgroups of bands. The values in table 1 presents that PC1image is more correlated to the PAN data than Intensity image.

Table 1: Correlation Coefficient

INTENSITY	INTENSITY *TM 5,4,3	PC1 TM 7,5,4	PC1 TM 7,5,4,3	TM 5,4,3
PAN	0.796	0.728	0.881	0.862

** Bands 1,2 were not used (not available)*

The correlation between the PAN data and PC1 using four bands is higher than other two intensity combinations. The result may be because the first component using four bands concentrates more information. Even if the bands 5,4,3 are combined the PC1 result has correlation coefficients a bit lower 0.862 but still higher than the intensity values. The TM bands combination used probably have a influence in these coefficients the higher coefficients is founded as the band 3 is included because band 3 has a 0.901 correlation coefficient with PAN data set.

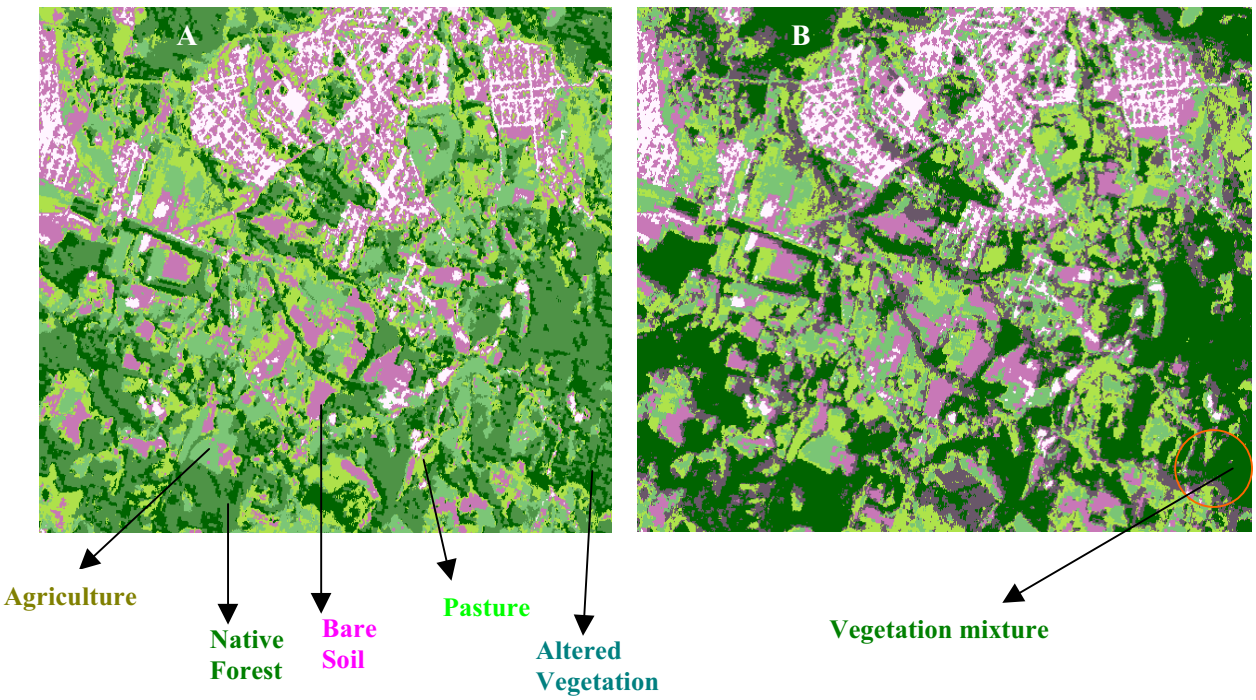
Visual comparison notice differences between Intensity and PC1. The fist component is quite close visually to PAN than intensity (figure 1).

Figure 1: Shows that first principal component is similar to Pan data than Intensity image:

The hybrids images are submitted to a segmentation process which consists of ISODATA clustering. This method uses spectral distance in the sequential way, but iteratively classifies the pixels, redefines the criteria for each segment, and classify again, so that the spectral distance patterns in the data gradually emerge.

The use of ISODATA segmentation shows useful in thematic analysis of the image. Actually the thematic resolution or the capability of patterns recognition can be evaluated using the clustering approach. The figure 3A and 3B shows that more classes could be detected using PCA hybrid than using IHS hybrid. Maybe the PCA hybrid image contains more information from the original images (PAN and LANSAT).

Figure 3: Shows that more classes can be separated on image 3A (PCA segmented) than the image 3B generated by the IHS method.



5 CONCLUSIONS

As a result the following might be concluded:

- The PCA(Principal Component Analysis) hybrid image presents better results than IHS as source of thematic information;
- The segmented image from PCA hybrid image provides a better results concerning to the thematic improvement, in other words the classes could be detected easier;
- The hybrid image is useful for features detection and classification process;

- The new sensor generation i.e, Ikonos, IRS, more images could be merged improving the classification process and patterns recognition by the means of texture analysis.

6 BIBLIOGRAPHY

ALMEIDA, F.R, VITORELLO, I. & BINS L.S. 1997. **Application of imagem merging, segmentation and region-classification techniques as a new approach for detailed thematic mapping of soil-vegetation assemblages.** Revista Brasileira de Geociências. Vol 27, número 2.

CHAVEZ P, SIDES ,S & ANDERSON,A. 1991. ***Comparison of three different methods to merge multiresolution and multispectral data: Landsat TM and Spot panchromatic.*** Phogrammetric Engineering & Remote Sensing. Vol 57, n 3, pp 295-303.

FONSECA, L & MANJUNATH, B.S. 1996. ***Registation techniques for multisensor remotely sensed Imagery.*** Phogrammetric Engineering & Remote Sensing. Vol 62, n 9, pp 1049-1056.

HARRIS, J.R & Murray R. 1990***. IHS transform for integration of Radar Imagery with other remotely sensed Data.*** Phogrammetric Engineering & Remote Sensing. Vol 56, n 12, pp 1631-641.