IMAGE RESTORATION AND ITS IMPACT ON RADIOMETRIC MEASUREMENTS

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INTRODUCTION

Deconvolution is a key issue in remote sensing science. The current needs for higher spatial resolution in all areas of remote sensing science make restoration technique an important tool for image enhancement. Due to the limitations of the sensor components such as diffraction, electronic filter, focusing error, etc, images acquired are subject to a blurring effect which can be corrected by restoration algorithms. Those algorithms use degradation parameters characterized by the Point Spread Function (PSF), in order to recover the original image[1]. A model of restoration process is given below [Figure 1], where f represents the original scene, h represents the Point Spread Function, n represents the addictive noise and g represents the final image[3].

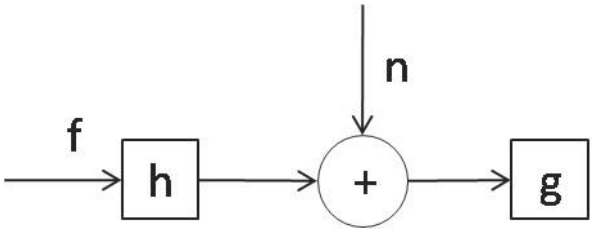


Figure 1 – Restoration Process Model

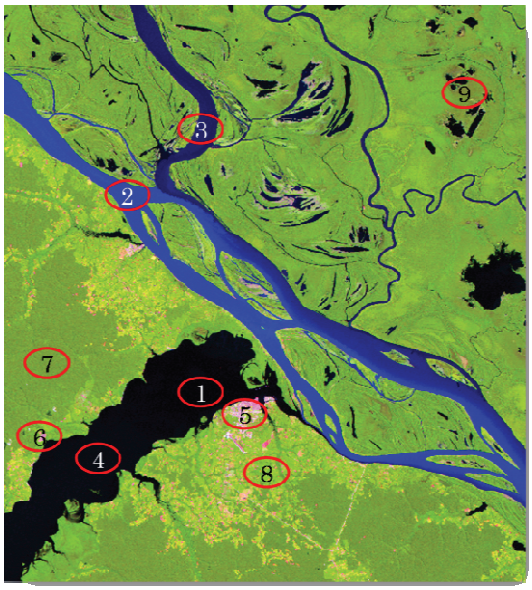
There are several restoration methods which can be divided into two large groups. The first group is that of the non- iterative methods. Those methods provide an explicit, closed-form inverse operation by which original images are converted into an image model, in one step. On the other hand the iterative methods are those which produce intermediary's solution through a finite number of iterations. Each method generates a specific solution and can differ depending on the image PSF [4].

In remote sensing science, most of the works aimed to studying spectral behavior through satellite images demand optimal correspondence between the real spectral behavior of a given earth surface target and what is measured by remotely sensed sensors. Any minute distortion in pixel values may modify spectral measurements which could lead to wrong assumptions about the spectral properties of the targets [5].

As any other image processing technique, restoration methods change pixel values. Therefore, we have risen the question of whether or not these new pixel values corrupt image radiometry to the point of jeopardizing spectral inferences. This work studies the impact of restoration methods on radiometry derived from remote sensing images. For that purpose, a group of six Landsat TM bands has been selected for the application of restoration methods. After that, the images generated were compared in order to test radiometry changes.

METHODOLOGY

The six bands from Landsat 5 TM sensor were taken on 06/24/2007, row 1, path 62. The images present a variety of targets, such as four different of water types, three different vegetation types, urban and bare soil. A Landsat TM image on color composite 5R-4G-3B (band 5 on red, band 4 on green and band 3 on blue) is shown bellow.



-4G-3B

Tested Regions

1- Water 1
2- Water 2
3- Water 3
4- Water 4
5- Urban
6- Bare soil
7- Vegetation 1
8- Vegetation 2
9- Vegetation 3

Initially, all bands were restored using two standard restoration methods namely Wiener filter [1] and Richardson-Lucy [2] filter as well as combined interpolation-restoration (CIR) method [3]. The next step transformed the seven original and restored Landsat TM bands images into "top of atmosphere (TOA)" reflectance and after that into "surface reflectance"[3]. The last step compares surface reflectance images, pre and post restoration, in each chosen region. A flowchart is show next.

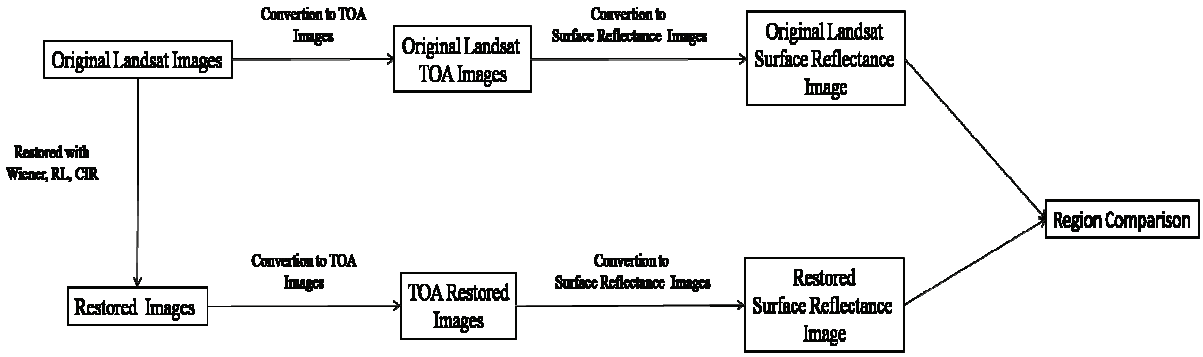


Figure 3 - Methodology Flowchart

CONCLUSION

Results demonstrate changes in pixel values for the original Landsat surface reflectance image and for the restored surface reflectance image, for each region tested. For water and vegetation areas, the restoration impact doesn't compromise image radiometry. In urban areas pixel values change, but modifications doesn't compromise significantly radiometric measurements. As restoration process enhances image border, on heterogeneous areas it has a major impact on pixel values. Otherwise, homogeneous areas suffer lower impact from restoration methods, which doesn't compromise image radiometry.

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