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Pansharpening of Multispectral and Panchromatic Images for Color Distortion using MATLAB

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Abstract: ***This paper deals with new pan sharpening techniques/methods for multispectral pan sharpening. These techniques are functional to number of datasets and their usefulness, strength and health are (figured out the worth, amount, or quality of) with widely used performance indicators. Also, all the ways of doing things of pan sharpening thought about/believed in this paper were put into use in a MATLAB with toolbox. GUI was designed using regression method which reduces color distortion.***

Keywords: ***PAN-Panchromatic image; MS-Multispectral image; Pansharpening, Intensity Hue Saturation IHS-fusion, vibrational fusion***

I. INTRODUCTION

Pan-sharpening techniques permit to synthetize images starting from panchromatic and multispectral data. The first type of images has a higher ability to display or measure very small things (related to space or existing in space) but a lesser radio metric (ability to demonstration or measure very small things) than the next. Radiometric information, multispectral or multicolor data is present in merged images and the pixel sizes of the data generally panchromatic. In remote recognizing, pansharpening techniques allows to assimilate the geometric feature of PAN image along with radiometric feature of MS having lower resolution (related to space or existing in space).Numerous applications which makes use of pansharpening methods for satellite or aerial images were conducted. Pan sharpening targets at joining of PAN images with MS images. In recent years, many authors come up with numbers of processes (algorithms) and papers on pansharpening with multispectral data. These fusion methods due to its growing accessibility are now being adapted with hyper spectral images. In this paper, new pansharpening ways of doing things for hyper spectral records with specific methods for MS-pan sharpening. Also methods such as hybrid, matrix factorization, multiresolution analysis & component substitution were discussed & analyzed.

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II. MULTISPECTRAL IMAGE

A multispectral Images as shown in fig. 1.1(e.g. Color) are image data taken in clearly stated/particular wavelength collections across the spectrum of electromagnetic. Digital filters & instruments sensitive to wavelength such as electromagnetic with Infrared IR, gamma & ultraviolet. It was at firstly established for aeriel-space-based imaging and also has application in article and painting study for further understandings.

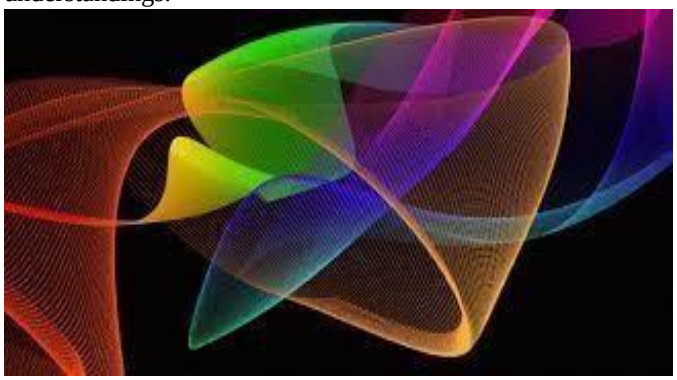

Fig 1.1 Multispectral Image

III. PANCHROMATIC IMAGES

Panchromatic images are made while the imaging sensor is (grouchy/needing careful handling) to a large change/differ of wavelengths of light, generally spanning a huge section of the spectrum. All imaging sensors need a positive minimum amount of not extreme/medium-level energy before they should come throughout a honor/difference in brightness. (as shown in fig. 1.2)

Fig 1.2 Pan Image

IV. LITERATURE REVIEW

In 2010, [1] Rahmani proposed two methods to improve spectral quality of images. First method deals with image coefficient in adaptive way & second edge HIS adaptive method. Based on experimental results first method was proposed. In 2012, [2] Aguilar M.A. make use of pan-sharpening techniques to WorldView-2 and GeoEye-1 images for classification basically object-based in urban environments; pan-sharpened orthoimages used this method to protect the classification accuracy. In 2015, [3] Maglione et al. used WorldView-2 imagery to reconstruct the Domitian Coastline's recent evolution; Zhang pan sharpening method was used to enhance multispectral image spatial resolution. Parente and Meneghini makes use of IHS pan-sharpening to GeoEye-1 images to check a replacement index for detection of shadow. Lastly, Parente and Belfiore confirmed WorldView-2 images to provide orthorectification and pan-sharpening for High Resolution Colored Ortho- Photos; they considered Zhang's method for enhancing multispectral image spatial resolution.

In pan sharpening method high resolution panchromatic and low-resolution multispectral images are combine to create a lone color image of high-resolution. This technique is used by Google Maps and almost every map making business to upturn quality of image. Pan-sharpening yields a color images with high-resolution of three or more extra multispectral satellite bands with low-resolution and a matching panchromatic band with high resolution:

Low-resolution color strips + High-resistance grayscale strip = High-resolution color strip

Blends of band are pushed with one data-sets of satellite, e.g. Landsat 7, which contains six multispectral bands. Commercial data packages for SPOT, GeoEye, and DigitalGlobe also generally contain both multispectral lower resolution bands and a panchromatic single band. Core reasons behind configuration of satellite sensors in this mode is to reduce weight of satellite, bandwidth and budget along with complexity. Pan-sharpening applies spatial information in grayscale high-resolution band and info in multispectral color bands to produce a color high-resolution image.

One of the frequently use class of pan sharpening algorithms is called "component substitution," normally involving the below mentioned steps:

Up-sampling Color bands

Bands towards lessen artifacts are aligned

Color bands are changes to orthogonal to the color information[11,12]

In transformed space, color band & pan band intensity were matched.

Substitution of pan band with transformed component.

Transform to novel color space.

HSI (hue-saturation-intensity), and YCbCr are common color-space transformations used for pan sharpening. Using PCA or wavelet decomposition and changing the first part with the pan unit, the same steps can also be performed. Pan-sharpening methods can effect in spectral distortions due to nature of panchromatic band, when pan-sharpening satellite images. For example, the Landsat panchromatic band isn't susceptible to blue light. As a result, the raw color image's pansharpened spectral characteristics may not accurately match to low resolution corresponding RGB image, resulting in transformed color tones. This helps in development of various algorithms attempting to decrease this spectral distortion and to yield images that are visually pleasing.

V. BROVEY TRANSFORM

Brovey Transform (BT) has been developed to visually increase the contrast at the low and high ends of a histogram of an image. It is a mixture of arithmetic operations and the spectral bands need to be normalized before multiplying them with the panchromatic one. The BT is likely to lead to color distortion, particularly if the spectral range of the input images is different or if major long-term temporal changes occur.(as shown in fig. 1.3 & 1.5)

Fig. 1.3 Study area: WorldView-2 RGB composition

The process of image fusion is described as collecting all the significant facts from numerous images, and its incorporation into smaller images, usually one. This solo image is extra detailed and precise than any solo basis image, and contains all the information needed. The goal of image fusion is to decrease the volume of data as well as to create images that are further suitable and reasonable for machine-human perception. Multisensory Image fusion is the procedure of joining significant facts from one, two or even more images into one image. The subsequent image is extra enlightening than other pictures input.

The BT would likely lead to color falsification, particularly if the spectral range of the input images is dissimilar or if there are major long-term temporal changes. The images fused with R, G and B (MSout) are described by the equations mentioned below

$$MS_{out} = \frac{MS_i}{MS_{tot}} \cdot PAN$$

MS_i=i-th multispectral image

MS_{tot}=combination of multispectral images & it can be calculated using

$$MS_{tot} = \frac{1}{n} \cdot \sum_{i=1}^{n} MS_i$$

or

$$MS_{tot} = \frac{\sum_{i=1}^{n} \varphi_i \cdot MS_i}{\sum_{i=1}^{n} \varphi_i}.$$

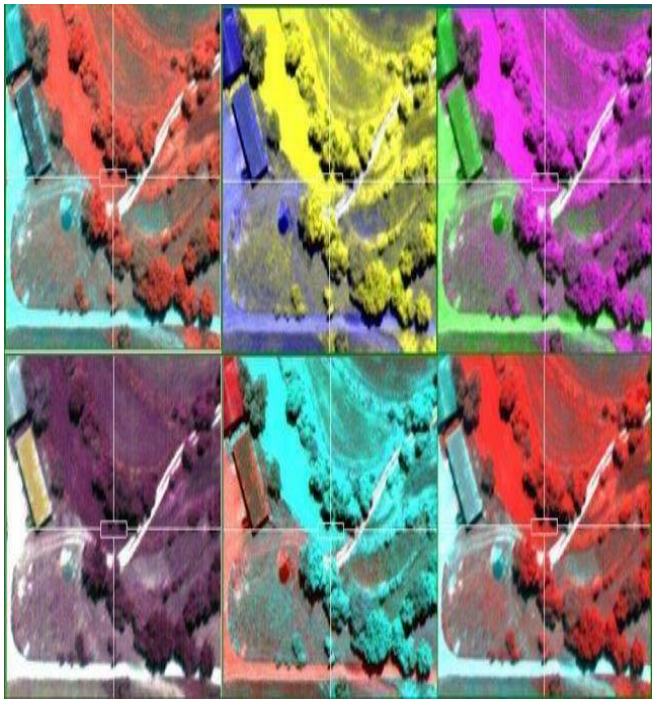

Fig 1.4 Multi spectral Image

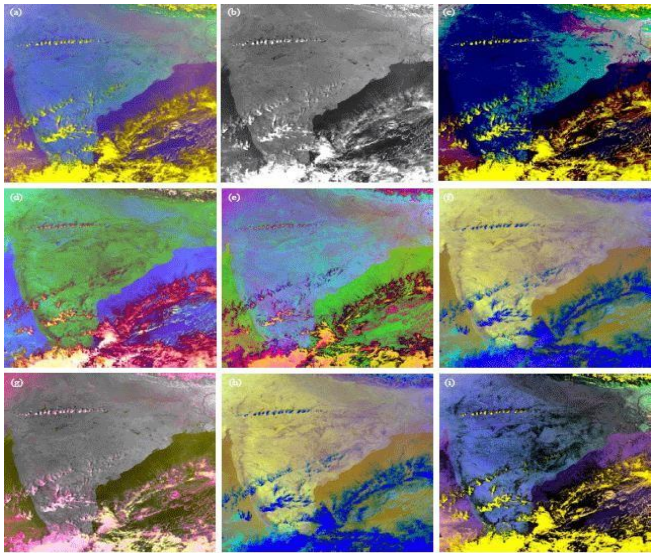

Fig. 1.5 Brovey Transformed Images

VI. DESIGN, IMPLEMENTATION & RESULTS

The GUI we created for pan sharpening using regression of classified multispectral and panchromatic images to reduce color distortion is elementary. The Pansharpened image can be generated easily in 3 steps.

Click on the Pan sharpening block, select the particular MS picture (fig 1.4) you want to pan sharpen then select the PAN image and automatically you will get the pansharpened image after successful selection of the images.

While selecting the images, we have to be careful as the PAN and the MS images have to be chosen of the same region to get the desired output. If, the images are of different region with different data, then the output we get will be distorted and inappropriate. So while selecting the images, we need to be careful for selecting both MS and the PAN image.

After selection of images, the respective images (MS and PAN) will appear in the assigned block, that is, MS image in the MS block and PAN image in the PAN block, and automatically the pansharpened image will be shown as a result in the Pansharpened block.

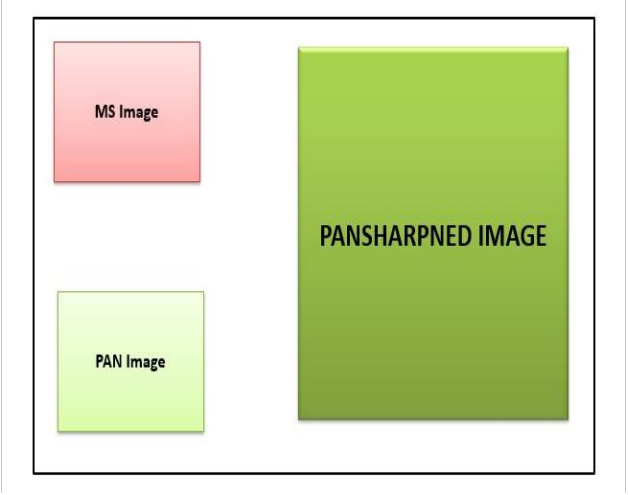

Fig 1.6. GUI Structure

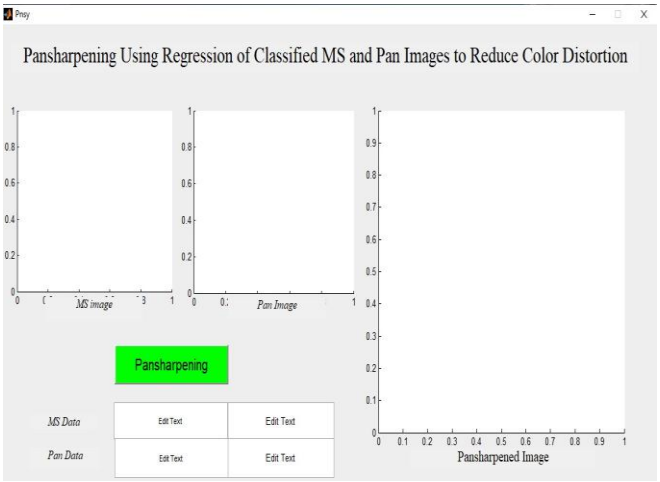

Fig 1.7 Design of implementation

In the above figure the 1st square represent the axis for the Multispectral image and 2nd square represent the axis for Panchromatic image , the pan-sharpening button is given so that the process of pan-sharpening is to be done .Text boxes are given below the button so that the path of MS data and pan data is visible the user.

In far below area the set of instructions are given to make GUI user friendly. Then the big square is for the output which will show the pan-sharpened image of multispectral and pan chromatic images.

To implement our project, we used MATLAB where we have a feature - GUI. In this, we designed the Graphic User interface with drag and drop method (by coding in backend). To use the GUI we have defined set of instructions as follows,

Step 1: - Click on Pansharpening Button.
Step 2: - Select the MS.mat Data file.
Step 3: - Select the PAN.mat Data file (of the same region).
Result: - Pansharpened Image.

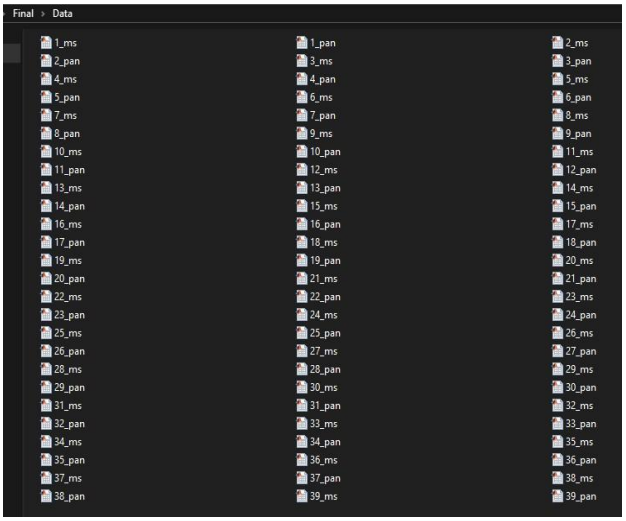

Fig 1.8. Collection of data files

Above is the collection of data files of different PAN and MS images of the particular region. We will have to select the images in the data form to get the output. The PAN and MS image must be of same region otherwise the output will be distorted.

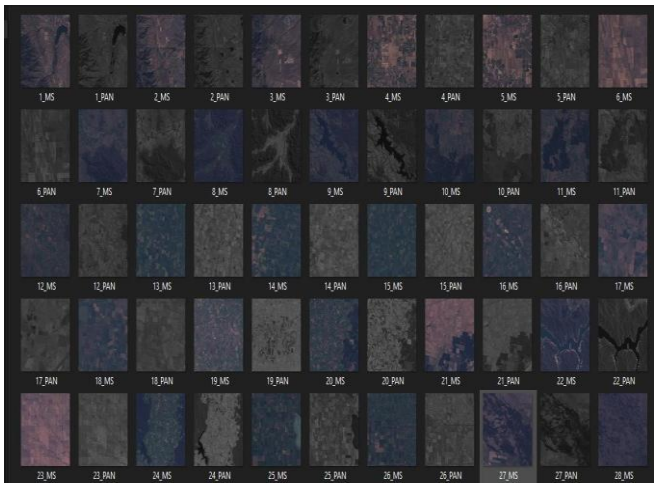

Fig.1.8 Examples of MS and PAN images

The figure above is the examples of MS and PAN images of the same data file which was stated above. This is the actual image of that data. We can also get the result by selecting these images but the result will be insignificant as the images will get compressed and pixels will be agitated. Hence we are using the data which is in the form of .math(file) so that we have the exact image with the proper data and pixels which will generate the desired output.

VII. RESULTS

After we click on the pansharpening block, another window will pop-up on the screen. Now, select the MS data first and then the PAN data of the corresponding region. After selecting it, the file name will appear in the specific MS and Pan Data block. We need to be careful as the file should appear in the specified block. After this, we can automatically see the result in the Pansharpened image block as shown in the fig 8. All the three different images are displayed in their stated blocks.

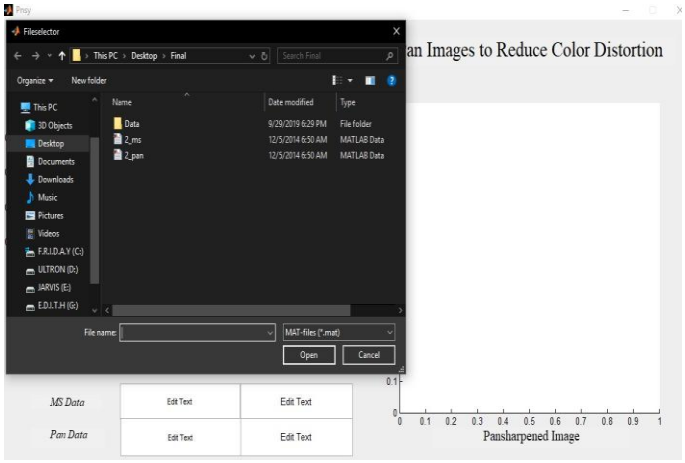

Fig. 1.9 Selecting ". mat" file

Fig .1.10 MS and Pan Images converted from dat

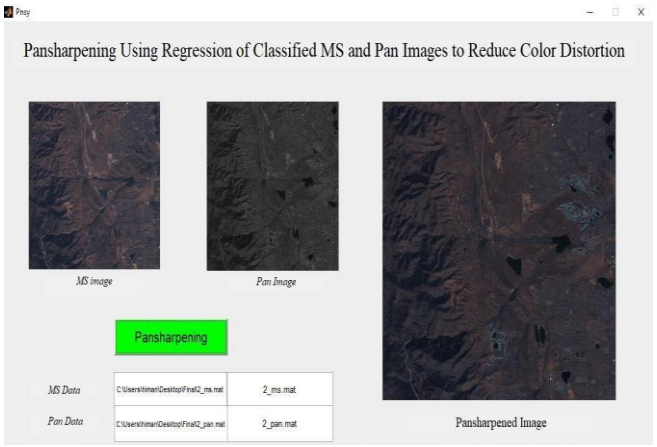

Fig .1.11 Output Window 1

Fig 1.12 Output Windows

VIII. CONCLUSION

In this research work, pansharpening using regression of classified multispectral and panchromatic images to reduce color distortion is obtained by using Brovey Transform method and implemented with designed GUI for getting Pansharped image for further research of data (as shown in fig.1.12). One can see the difference between all the three images where Multispectral image is colored but has low resolution while PAN image is black and white with high resolution. Both the Images are fed in the GUI we designed in the form of data file (.math). The image is then extracted from the data file, collated using Brovey Transform and displayed in the Pansharpening block. The output we get is colored and high resolution image where the land can be seen with dark color and water area seen in the form of light colored region. This is done to reduce the color distortion and for the better understanding of the picture. As a result, we get the desired Parsharpened Image using both the MS and Panchromatic Image.

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Dr. Pankaj H. Chandankhede is working as an Assistant professor in G H Raisoni College of Engineering Nagpur. He has completed his Ph.D from R. T. M. Nagpur University in 2019. His field of specialization is Embedded System & Soft-Computing. He has more than 11 years of teaching experience. He has published 30 papers in International & National-Journals & Conferences. He has guided more than 30 projects of under graduate & post graduate students. He is member of professional society members such as IEEE & IETE. He is coordinating two externally funded grants. He has one copyright published with his credential.

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