# The Curvelet Transform For Image Fusion In Matlab

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***Abstract-*** *Wavelets generalize the Fourier Transform by using a basis the represents both location and spatial frequency. While wavelets are certainly suitable for dealing with objects where the interesting phenomena, e.g., singularities, are associated with exceptional points, they are ill-suited for detecting, organizing, or providing a compact representation of intermediate dimensional structures.*

***Keywords***- ImageFusion;Discrete Wavelet Transform; Fast Discrete Curvelet Transform

## I. INTRODUCTION

An image is an array, or a matrix, of square pixels (pictures elements) arranged in columns and rows. There are two general groups of 'images', vector graphics(or line art)and bitmaps(pixel-based or 'image'). The most common file formats are GIF, JPEG, TIFF, PS and PSD. An image defined in the "real world" is considered to be a function of two real variables, for example, f(x,y) with f as the amplitude (e.g. brightness) of the image at the real coordinate position (x,y).

Image processing is a technique used for to enhance raw images taken from cameras taken in normal day to day life for various applications or sensors placed on satellites, space probes and aircrafts. Various techniques are developed in image processing.Most techniques are developed for enhancing images obtained from unmanned space crafts, space probes and military reconnaissance flights.

Image processing is used in various applications like Remote Sensing, Medical Imaging, Film Industry, Graphics arts, Printing Industry. Common steps in image processing are scanning, storing, enhancing and interpretation. Image processing requires both high spatial and high spectral information in a single image. This is important in remote sensing.

Fusion means extraction of information acquired in several domains. Multi-Sensor dSata fusion is in demands which are used for number of applications. Image fusion is a process of combining multiple input images into a single output image which contain better description of the scene than the one provided by any of the individual input images.

In this method, Satellite image fusion uses high resolution panchromatic image and Low Resolution multispectral image. Image fusion based on the Fourier and wavelet transform methods. In remote sensing, image fusion is most valuable technique for utilization of multisensor, multispectral at various resolutions of earth observation satellites.

Fast Discrete Curvelet Transform (FDCT) retains better spatial and spectral details of the source image than that of Discrete wavelet transform (DWT) base image fusion

## II. LITERATURE REVIEW

The proceeding of Restoration of High Frequency Details, While Constructing The High Resolution Image by C.V. Rao, J. Malleswara Rao, A. Senthil Kumar, and A. S. Manjunath.. In this paper, to create high resolution (HR) image from coarser resolution AWiFS image called as emulated LISS-III like HR image. It will have HR (original LISS-III) image characteristics and minimal Mean Squared Error (MSE), ideally zero difference with LISS-III image as reference, which inturn processed for identical spatial resolution of LISS - III. Ground sampling distance (GSD) of AWiFS is equivalent to 2.4 pixels of LISS-III [1].

This method is suggested by ying li, xing xu, ben-du bai, yan-ning zhang northwest polytechnical university, China, for Remote Sensing Image Fusion Based On Fast Discrete Curvelet Transform. Wavelet transform has the good characteristic of spatial and frequency locality, but it isn't suitable for describing the signals, which have high dimensional singularities. Curvelet is one of new multiscale transform theories, which possess directionality and anisotropy, and it breaks some inherent limitations of wavelet in representing directions of edges in image. So when the curvelet transform is applied in image fusion, the characteristics of original images are taken better and implemented more easily[4]

This technique is represented by Zhou Wang, Student Member, IEEE, and Alan C. Bovik, Fellow, IEEE for A Universal Image Quality Index. In this they propose a new universal objective image quality index, which is easy to

calculate and applicable to various image processing applications. Instead of using traditional error summation methods the new index is mathematically defined and no human visual system model is explicitly employed, our experiments on various image distortion types indicate that it performs significantly better than the widely used distortion metric mean squared error[3].

In this Satellite Image Fusion Based on Improved Fast Discrete Curvelet Transforms presented by K. Jemseera Kuttippuram, Kerala, India P Noufal Kuttippuram, Kerala, India In this paper, an improved Satellite image fusion method based on Fast Discrete curvelet Transform (FDCT) via wrapping. The method uses an improved fusion rule, were the maximum FDCT coefficients from each cell of the Intensity component of the MS image and histogram matched PAN image are taken. The resulting image is then undergone a comparative analysis with the outcomes of existing methodologies.

The Satellite Image Fusion using Fast Discrete Curvelet Transforms method is represented by C.V.Rao, J.Malleswara Rao, A.Senthil Kumar, D.S.Jain, V.K.Dadhwal National Remote Sensing Centre, Indian Space Research Organization, Hyderabad, India. In this, a novel fusion rule via high pass modulation using Local Magnitude Ratio (LMR) in Fast Discrete Curvelet Transforms (FDCT) domain. For experimental study of this method Indian Remote Sensing (IRS) Resourcesat-1 LISS IV satellite sensor image of spatial resolution of 5.8m is used as low resolution (LR) multispectral image and Cartosat-1 Panchromatic (Pan) of spatial resolution 2.5m is used as high resolution (HR) Pan image.[1]

## III. PROPOSED SYSTEM

The fusion technique is carried out by integrating the principal components of images to be fused. PCA, DCT and DWT algorithms are based on fusion technique.

In DWT cost of computing is high and takes long compression time. PCA and Sparse fusion have specific advantages and disadvantages. PCA fusion will enhance the spatial quality but have dense nonzero entries that might represent uninformative features.

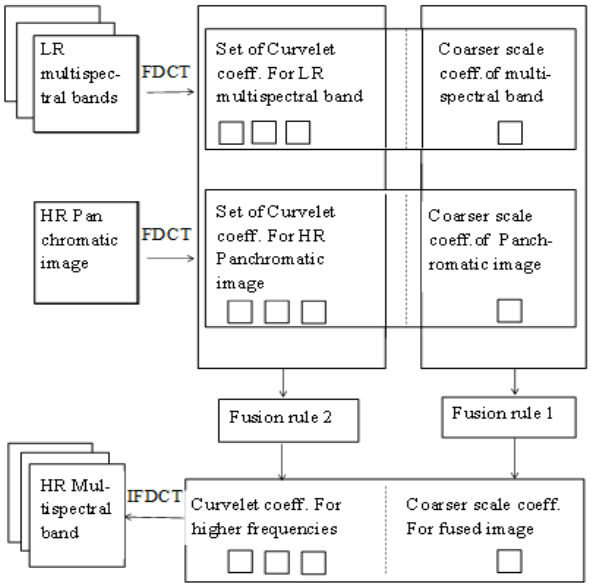


Figure of Image Fusion

To overcome these disadvantages an FDCT algorithm is used, which utilizes advantages of both PCA and sparse representation for fusing common and innovative features of captured images.

The proposed development of an algorithm based on FDCT domain is defined as follows -

1. Obtain Low Resolution multispectral image and panchromatic image. Resample LR multispectral image to the scale of High Resolution Panchromatic image to get both the images at identical geometry and same size.
2. Divide these two images into four different bands in terms of green red and near infrared bands.
3. Develop an algorithm to divide these bands using Fast Discrete Curvelet Transform technique to obtain curvelet coefficients for Low Resolution multispectral band and High Resolution Panchromatic image, coarser scale coefficients of the multispectral band for Panchromatic image.
4. Make fusion of low frequency band of Low Resolution image and low frequency band of Panchromatic image using fusion rule 1.
5. Make fusion of higher frequency bands of Low Resolution and higher frequency bands of Panchromatic image using fusion rule 2.
6. Develop an algorithm to obtain combination of output from fusion rule 1 and fusion rule 2 using Inverse Fast Discrete Curvelet Transform to get High Resolution multispectral band image.
7. Repeat steps 3 and 6 for each multispectral band.

8. Develop an algorithm to combine three resultant fused bands to get high Resolution multispectral fused image and to calculate entropy of High Resolution image.

## IV. CONCLUSION

The fast curvelet is low computational complexity and the computational speed of the algorithm is very good than the wavelet based schemes. The fast discrete curvelet transform (FDCT) improves upon earlier implementation based upon the curvelet so that they are conceptually simpler, faster and far less redundant.

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