Journal of Engineering Sciences
Vol 10, Issue 12, Dec /2019
ISSN NO:0377-9254

HIS AND DWT BASED REMOTE SENSING IMAGE FUSION USING MATLAB

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Abstract

In this paper, an ideal proposed that improving the accuracy of the road information by enhancing the quality of image source. Apply the image information fusion algorithm that based on HIS transform and wavelet transform to the multispectral remote sensing images and QuickBird panchromatic remote sensing images fusion, the experimental results show that the quality of image source is substantially improved, and this ideal inaugurate a method for extract road information by the use of satellite remote sensing images accurately.

Despite its ability to handle occlusions and noise, sparse tracking may be inadequate to describe complex noise corruption, for instance, in urban road tracking, where road surfaces are often significantly disrupted by the existence of occlusions and noise in high-resolution (HR) satellite imagery. To address this issue, this letter presents a semiautomatic approach for road extraction from HR satellite images. Firstly, a multifeature sparse model is introduced to represent the road target appearance. Next, a novel sparse constraint regularized mean-shift algorithm is used to support the road tracking. Furthermore, multiple features are combined by weighting their contributions using a novel reliability measure derived to distinguish target from background. The experiments confirm that the proposed method performs better than the current state-of-the-art methods for the extraction of roads from HR imagery, in terms of reliability, robustness, and accuracy.

I.INTRODUCTION

Image fusion is a sub-field of image processing in which more than one images are fused to create an image where all the objects are in focus. Image fusion is of significant importance due to its application in medical science, forensic and defense departments. The process of image fusion is performed for multi-sensor and multi-focus images of the same scene. Multi-sensor images of the same scene are captured by different sensors whereas multi-focus images are captured by the same sensor. In multi-focus images, the objects in the scene which are closer to the camera are in focus and the farther objects get blurred. Contrary to it, when the farther objects are focused then closer objects get blurred in the image. To achieve an image where all the objects are in focus, the process of images fusion is performed either in spatial domain or in transformed domain. Spatial domain includes the techniques which directly incorporate the pixel values. In transformed domain, the images are first transformed into multiple levels of resolutions. An image often contains physically relevant features at many different scales or resolutions. Multi-scale or multi-resolution approaches provide a means to exploit this fact. After applying certain operations on the transformed images, the fused image is created by taking the inverse transform.

Image fusion is generally performed at three different levels of information representation including pixel level, feature level and decision level . In pixel-level image fusion, simple mathematical operations such as max (maximum) or mean (average) are applied on the pixel values of the source images to generate fused image. However these techniques usually smooth the sharp edges or leave the blurring effects in the fused image. In feature level multi-focus image fusion, the source images are first segmented into different regions and then the feature values of these regions are calculated. Using some fusion rule, the regions are selected to generate the fused image. In decision level image fusion, the objects in the source images are first detected and then by using some suitable fusion algorithm, the fused image is generated.

1.1 Image fusion: In computer vision, Multisensor Image fusion is the process of combining relevant information from two or more images into a single image. The resulting image will be more informative than any of the input images. In remote sensing applications, the increasing availability of space borne sensors gives a motivation for different image fusion algorithms. Several situations in image processing require high spatial and high spectral resolution in a single image. Most of the available equipment is not capable of providing such data convincingly. The image fusion techniques allow the integration of different information sources. The fused image can have complementary spatial and spectral resolution characteristics. But, the standard image fusion techniques can distort the spectral information of the multispectral data, while merging. In satellite imaging, two types of images are available. The panchromatic image acquired by satellites is transmitted with the maximum resolution available and the multispectral data are transmitted with coarser resolution. This will be usually, two or four times lower. At the receiver station, the panchromatic image is merged with the multispectral data to convey more information.

Many methods exist to perform image fusion. The very basic one is the high pass filtering technique. Later techniques are based on DWT, uniform rational filter bank, and laplacian pyramid.

1.2 Why Image Fusion

Multisensor data fusion has become a discipline to which more and more general formal solutions to a number of application cases are demanded. Several situations in image processing simultaneously require high spatial and high spectral information in a single image. This is important in remote sensing. However, the instruments are not capable of providing such information either by design or because of observational constraints. One possible solution for this is data fusion.

1.3 Standard Image Fusion Methods

Image fusion methods can be broadly classified into two - spatial domain fusion and transform domain fusion. The fusion methods such as averaging, Brovey method, principal component analysis (PCA) and IHS based methods fall under spatial domain approaches. Another important spatial domain fusion method is the high pass filtering based technique. Here the high frequency details are injected into upsampled version of MS images. The disadvantage of spatial domain approaches is that they produce spatial distortion in the fused image. Spectral distortion becomes a negative factor while we go for further processing, such as classification problemial distortion can be very well handled by transform domain approaches on image fusion. The multiresolution analysis has become a very useful tool for analysing remote sensing images.

1.4 Satellite Image Fusion

Several methods are there for merging satellite images. In satellite imagery we can have two types of images

- Panchromatic images - An image collected in the broad visual wavelength range but rendered in black and white.
- Multispectral images - Images optically acquired in more than one spectral or wavelength interval. Each individual image is usually of the same physical area and scale but of a different spectral band.
- The SPOT PAN satellite provides high resolution (10m pixel) panchromatic data. While the LANDSAT TM satellite provides low resolution (30m pixel) multispectral images. Image fusion attempts to merge these images and produce a single high resolution multispectral image.
- The standard merging methods of image fusion are based on Red-Green-Blue (RGB) to Intensity-Hue-Saturation (IHS) transformation. The usual steps involved in satellite image fusion are as follows:

1. Resize the low resolution multispectral images to the same size as the panchromatic image.

2. Transform the R,G and B bands of the multispectral image into IHS components.

3. Modify the panchromatic image with respect to the multispectral image. This is usually performed by histogram matching of the panchromatic image with Intensity component of the multispectral images as reference.

4. Replace the intensity component by the panchromatic image and perform inverse transformation to obtain a high resolution multispectral image.

1.5 Medical Image Fusion

Image fusion has become a common term used within medical diagnostics and treatment. The term is used when multiple patient images are registerd and overlaid or merged to provide additional information. Fused images may be created from multiple images from the same imaging modality, or by combining information from multiple modalities, such as magnetic resonance image (MRI), computed tomography (CT), positron emission tomography (PET), and single photon emission computed tomography (SPECT). In radiology and radiation oncology, these images serve different purposes. For example, CT images are used more often to ascertain differences in tissue density while MRI images are typically used to diagnose brain tumors.

For accurate diagnoses, radiologists must integrate information from multiple image formats. Fused, anatomically-consistent images are especially beneficial in diagnosing and treating cancer. Companies such as Nicesoft, Velocity Medical Solutions, Mirada Medical, Keosys, MIMvista, IKOE, and BrainLAB have recently created image

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fusion software for both improved diagnostic reading, and for use in conjunction with radiation treatment planning systems. With the advent of these new technologies, radiation oncologists can take full advantage of intensity modulated radiation therapy (IMRT). Being able to overlay diagnostic images onto radiation planning images results in more accurate IMRT target tumor volumes.

II.LITERATURE SURVEY

2.1 Image Fusion Based On Wavelet Transforms

The image fusion is the process of combining relevant information from two or more images into a single image. The resulting image will be more informative than any of the input images. A new approach for object extraction from high-resolution images is presented in this report. In this paper, we have presented image fusion based on wavelet transform. Medical Image Fusion is a sort of data fusion and developed from that into a new data fusion technology. As an advanced method of image processing technology to integrate multi-source image data, image fusion is to integrate two or more images into a new fusion image. The aim of fusion is the combination of images to integrate the information of each individual technique and reduce the uncertainty of the image information. Computed tomography (CT), and positron emission tomography (PET) provide data conditioned by the different technical, anatomical and functional properties of the organ or tissue being studied, with values of sensitivity, specificity and diagnostic accuracy variations between them. Their fusion enables the "unification" of the various technique-dependent data, thus "summing" the diagnostic potential of each individual technique. Because of the image fusion technology which can effectively integrate the image information, the fusion images are more intelligible and readable and have more information than the images that are got through single channel, and this technology has been concentrated very much, and has had a great development.

Truly the image fusion is the process of combining relevant information from two or more images into a single image. The resulting image will be more informative than any of the input images. A new approach for object extraction from high-resolution images is presented in this report. In this we present a new approach to better extract information from CT (Computed Tomography) /PET (positron emission tomography) which will be helpful to diagnose diseases. Since there are various methods and algorithms for fusion of these images and as there are special advantages for each algorithm along with ever growing need to use of this technique, as a result research about this field of study becomes more sophisticated. Many methods exist to perform image fusion. The very basic ones are the Probabilistic Approximation model. The wavelet approach gives better accuracy and increased information compared to the previous techniques

III.EXISTING METHOD

BLOCK DIAGRAM

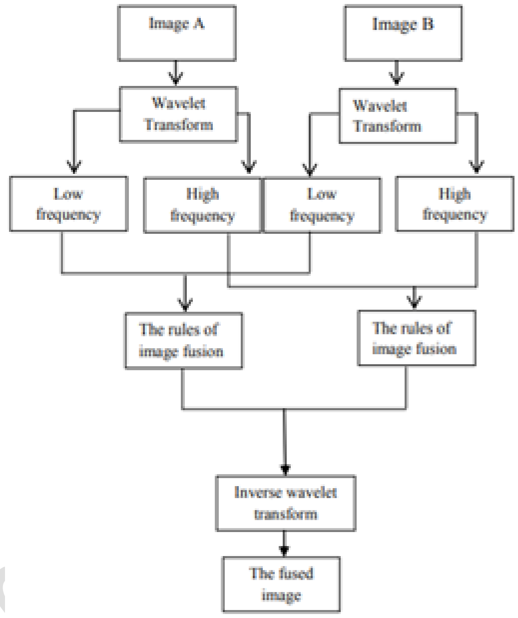

Figure 1: Process of image fusion

Figure 1 explained that how image fusion performs firstly load image 1 then load image 2 after that use wavelet transform, after that apply the fusion rules and then take inverse discrete wavelet transform to get the fused image with better quality and reliability and also for the clear vision

IMAGE FUSION

In computer vision, Multi sensor Image fusion is the process of combining relevant information from two or more images into a single image. The resulting image will be more informative than any of the input images.

In remote sensing applications, the increasing availability of space borne sensors gives a motivation for different image fusion algorithms. Several situations in image processing require high spatial and high spectral resolution in a single image. Most of the available equipment is not capable of providing such data convincingly. Image fusion techniques allow the integration of different information sources. The fused image can have complementary spatial and spectral resolution characteristics. However, the standard image fusion techniques can distort the spectral information of the multispectral data while merging.

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available and the multispectral data are transmitted with coarser resolution. This will usually be two or four times lower. At the receiver station, the panchromatic image is merged with the multispectral data to convey more information.

Many methods exist to perform image fusion. The very basic one is the high pass filtering technique. Later techniques are based on Discrete Wavelet Transform, uniform rational filter bank, and Laplacian pyramid.

Why Image Fusion

Multi sensor data fusion has become a discipline which demands more general formal solutions to a number of application cases. Several situations in image processing require both high spatial and high spectral information in a single image. This is important in remote sensing. However, the instruments are not capable of providing such information either by design or because of observational constraints. One possible solution for this is data fusion.

Standard Image Fusion Methods

Image fusion methods can be broadly classified into two groups - spatial domain fusion and transform domain fusion. The fusion methods such as averaging, Brovey method, principal component analysis (PCA) and IHS based methods fall under spatial domain approaches. Another important spatial domain fusion method is the high pass filtering based technique. Here the high frequency details are injected into upsampled version of MS images. The disadvantage of spatial domain approaches is that they produce spatial distortion in the fused image. Spectral distortion becomes a negative factor while we go for further processing, such as classification problem. Spatial distortion can be very well handled by frequency domain approaches on image fusion. The multiresolution analysis has become a very useful tool for analysing remote sensing images. The discrete wavelet transform has become a very useful tool for fusion. Some other fusion methods are also there, such as Laplacian pyramid based, curvelet transform based etc. These methods show a better performance in spatial and spectral quality of the fused image compared to other spatial methods of fusion. The images used in image fusion should already be registered. Misregistration is a major source of error in image fusion. Some well-known image fusion methods are:

- High pass filtering technique
- IHS transform based image fusion
- PCA based image fusion
- Wavelet transform image fusion
- Pair-wise spatial frequency matching

Discrete Wavelet Transform

Wavelet transform provides a framework in which a signal is decomposed, with each level corresponding to a coarser resolution or lower frequency band, and higher frequency bands. There are two main groups of transforms, continuous and discrete. Of particular interest in DWT, which applies a two channel filter bank (with down sampling) iteratively to the low pass band (initially the original signal). The wavelet representation then consists of the low pass band at the lowest resolution and the high pass band obtained at each step. This transform is invertible and non redundant. The DWT is a spatial domain decomposition that provides a flexible multi resolution analysis of an image. In a 2-D DWT, a 1-D DWT is first performed on the rows and then columns of the data by separately filtering and down sampling, this result in one set of approximation coefficients

FLOW CHART:

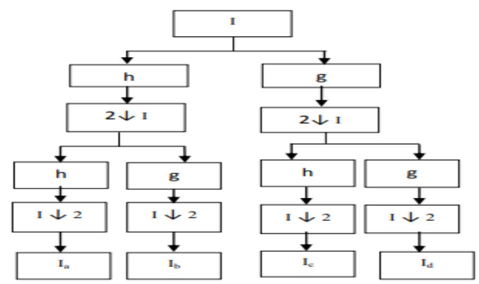

Figure 2: structure of 2D-DWT

In the language of filter theory, these four sub images correspond to outputs of low-low (I_a), low-high (I_b), high-low(I_c), and high-high (I_d) bands. By recursively applying the scheme to the LL sub band multi resolution decomposition with a desire level can be achieved.

2.6 FLOW CHART

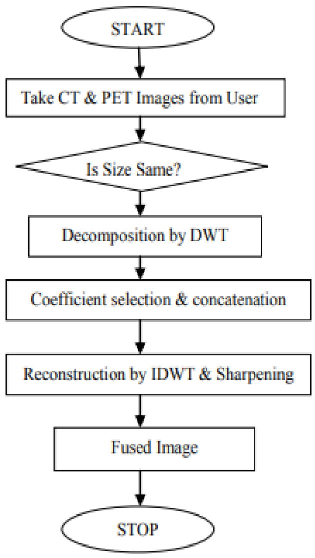

Figure 3: Flow chart

III. PROPOSED METHOD

3.1 INTRODUCTION OF EXPERIMENTAL IMAGE DATA AND ROAD EXTRACTION METHOD

Landsat is designed based on the purpose that detecting the earth's resources. The United States launched the Landsat1 which is the first truly Earth observation satellite the first time in the world in 1972. Landsat thematic mapper (TM) is a sensor that carried by Landsat4 and Landsat5 carry, Landsat TM image contains 7 bands, that the spatial resolution of bands 1 -5 and band 7 is 30 meters, and the spatial resolution of band 6 (thermal infrared band) is 120 meters. QuickBird satellite was launched in 2001, the acquired image data in two ways: panchromatic band image, wavelength is 0.445-0.9 m, the ground resolution is 0.61m; multi-spectral image, have 4 bands that contain blue (0.45 - 0.52 m), green (0.52-0.60 m), red (0.63-0.69 m), near infrared (0.76-0.90 m), and its ground resolution is 2.44m. We use the remote sensing images of the Wuhan area in this paper; the imaging time of TM image is February 7, 2007, the imaging time of QuickBird image is January 13, 2010. The QuickBird images have a high spatial resolution, but its spectral resolution is less than TM image. So, it becomes particularly important in identification and extraction of road information that how to fuse ideal image source that make full use of the spectral information of TM image, but also up to the spatial resolution of QuickBird images. TM image data need to be composed by multi-band as the TM images have different spectral characteristics in different bands. In 7 bands of TM spectral images, in general, the information of the 5th band features is the richest, there is considerable duplication in three visible bands(i.e. the 1st,2nd,3rdband) and two mid-infrared band(i.e. the 4th,7thband) , it has a high correlation between these band information. There are very low correlations between the 4th Band and other bands, indicating that the information in this band have great independence. The color composite image which composed of a visible light band, a mid-infrared band and the 4th band has abundant information of the surface features generally. We select the correspondence scheme that correspond the 7th, 4th, 3rd band to R, G, B respectively (Figure 1), it can colligate the characteristics of different bands comprehensively, enlarge the difference in spectrum of different objects on the ground, and exhibit different kinds and forms clearly. As it can be seen in Figure 1 that river is in bright blue, lake is in deep blue, roads are in off-white, residential areas are in brown maroon, and vegetation is in green.

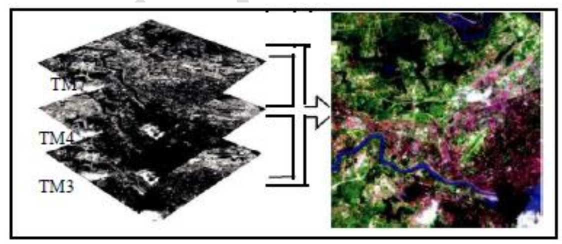

Figure 1. multi-spectral color map composed by TM7, TM4, TM3

Road Extraction Method

The road extraction algorithm used generally at present that enumerated in the literature are the road extraction algorithm based on pixel and background arithmetic operator model; the road extraction algorithm based on the model of differentiate tree configuration characteristic; the road extraction algorithm based on parallel; the road extraction algorithm based on binarization and knowledge and so on. In this paper, the road extraction method is based on the SPEAR tool in ENVI4.6, take a extraction of objects that have same spectrum characteristic on the ground, and then convolution filtering, a better extraction result is able to obtain at last.

REMOTE SENSING IMAGE FUSION ALGORITHM

IEEE International Remote Sensing Data Fusion Technical Committee divided remote sensing data fusion into data-level fusion, feature-level fusion and decision-making-level fusion , which are divided based on the different stages of data fusion. Many current studies are directed at data-level fusion, which is also known as pixel-level fusion according to research in the field of image processing. It include: Principal component analysis method (PCA), the weight added fusion method, Brovey

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transform method, IHS transform method etc. We use the image fusion algorithm that based on HIS transform and wavelet transform in this paper.

A. Introduction of Wavelet Transform in Image

In 1988, S.Mallat put forward the concept of multiresolution analysis when constructing orthogonal wavelet bases, and illustrated the features of wavelet multi-resolution vividly with the concept of space, and unified all of the construction method former for orthogonal wavelet bases, and then given the construction method of orthogonal wavelet and

For a digital image $C\ j-1$ can be decomposed to four subimages according to the formula above: $c\ j$, $d\ j1$, $d\ j\ 2$, $d\ j\ 3$ (Figure 2), the $c\ j$ in which is the approximate component, it collects the low-frequency information of the original image; $d\ j1$ is the vertical component and it collects the vertical high frequency information of the original image; *dj2* is the horizontal component and it collects the horizontal high-frequency information of the original image; *dj3* is the diagonal component and it collects the diagonal high-frequency information of the original image.

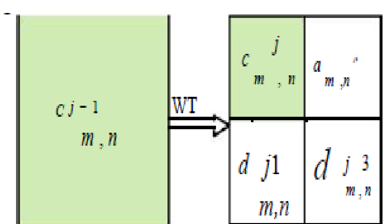


Figure 2 Schematic diagram of image wavelet decomposition

Wavelet Transform Fusion Algorithm description

RGB color model and the HIS (Hue, Intensity, Saturation) color model are the commonly used in digital image processing. In the HIS color model, H, I, S are relatively independent, I-component is mainly storage the space details, it contains the most useful information of remote sensing images. A large number of algorithms are easy to use on HIS color space in the image processing and computer vision, the H, I, S can be processed separately, and the workload of the image analysis and processing can be reduced greatly in HIS color space. This image fusion algorithm used in this paper is based on the HIS color model actually.

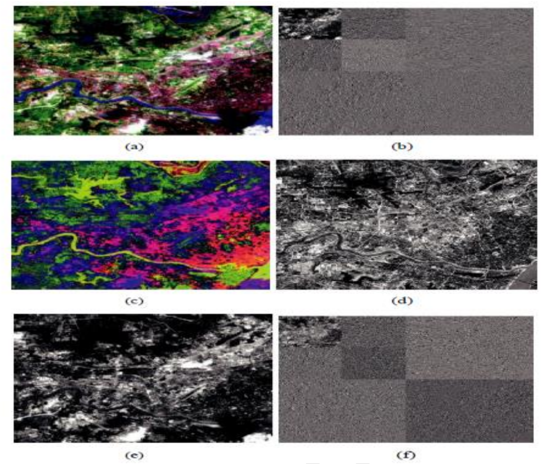


Figure Pre-processing and wavelet transform of remote sensing image

In Figure 2.7.4, Figure (a) is the color multi-spectral images composed by TM7, TM4, TM3; Figure (b) is HIS color model transformation diagram of Figure (a); Figure (c) is the I-component of Figure (b); Figure (d) is the wavelet decomposition graphic of Figure (c) in scale 2; Figure (e) is he QuickBird panchromatic image; Figure (f) is the wavelet decomposition graphic of Figure (e) in scale 2.

It can be observed that the road information in HIS multi-spectral images is mainly concentrated in the I component, so we only use the I-component of the TM multi-spectral image and QuickBird panchromatic image to make a wavelet image fusion in this article, and the main steps of the remote sensing image fusion method in this article can be summarized as follows:

a) Compose the color multi-spectral image by three TM multi-spectral image bands: TM7, TM4 and TM3;

b) Processing the color multi-spectral images and QuickBird high spatial resolution panchromatic image by cropping and registering, and create two images that matching in space location and have a same size: multi-spectral image A and panchromatic image B;

c) Transform multi-spectral image A to HIS color model from RGB color model, and get the H, I and S component of the image;

d) Eliminate the impact of differences in light conditions and the undulating terrain by making a histogram matching to panchromatic image and the I-component;

e) Make wavelet decomposition of panchromatic image and I-component respectively, and get the low-frequency components and high frequency-components of each image, then reconstruction the fusion image C by inverse wavelet transform with high frequency components of panchromatic image and low-frequency components of I-component.

IV.EXPERIMENTAL FLOW AND RESULTS ANALYSIS

A Experimental Flow

We can institute the experimental flow correspond the fusion algorithm designed in this paper, the corresponding flow shown in Figure 5. 4: The whole experiment is divided into three parts: the first step is pre-process the remote sensing images, including the band combinations, registration, etc.; followed by is image fusion of remote sensing, create high-quality map sources; last get the road layers by road extraction.

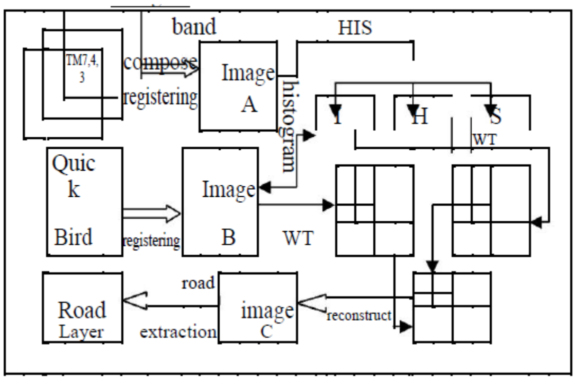


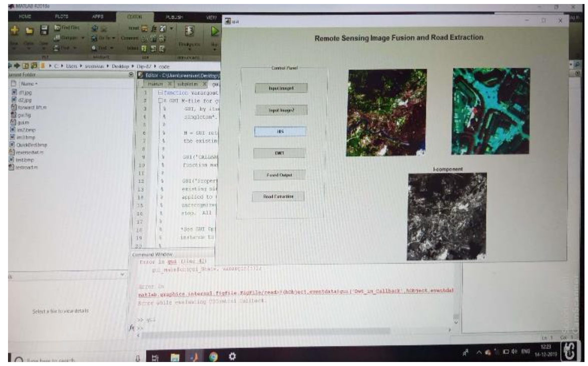
Fig: schematic diagram of experimental flow

B Experimental results and analysis

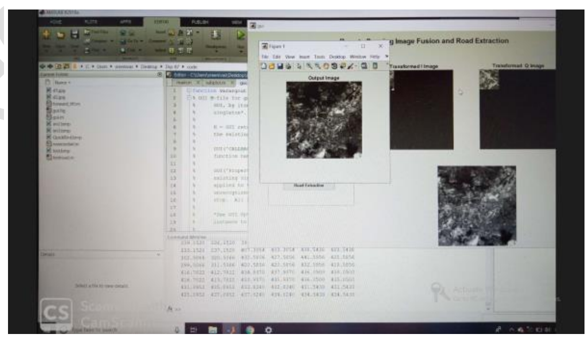
Based on the experimental flow above, get the final fusion image and road layers, in order to extrude the experimental results, we choose the original TM multi-spectral image to extract the road layers, and make a comparison with the road layers by the method this article introduced, as shown in figure In Figure 5, Figure (a) is the fusion image create by the fusion algorithm introduced in this article, Figure (b) is the road layer after road extraction, Figure (c) is the color multispectral image, Figure (d) is the road layer by the same road extraction method from Figure (c). It can be seen from Figure 5 that the image source which create by the fusion algorithm in this article is more suitable for surface features identification and extraction than the untreated image source, the extracted features is more accurate and clear. However, we can see that the road information in the upper part of the map is more clear and accurate, but it's hazily in the bottom of the map, the reason on the one hand is that area is residential area, and the materials of the road in this area is mainly asphalt, but it's outskirts in the bottom of the map, and the materials of the road in this area is mainly cement, the spectral characteristics of the two materials are very different, so the display of multi-spectral images vary greatly; on the other hand, the TM multi-spectral remote sensing image has a ground resolution of 30 meters, and resolution in this level is relatively insufficient for extracting road information

V. RESULTS ANALYSIS

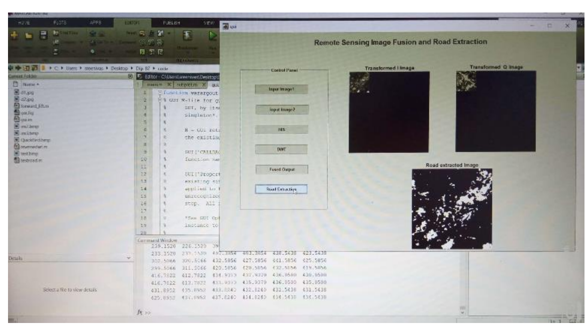
EXISTANCE METHOD



In above output we can give input image 1 and as well as image 2 then we will get an output image of an HIS and also we will can get all the parametric values of that image.



From above output we can see the transformed I image and Q image by using those images we will get the output image of an road extraction and at the bottom of the output we can get all the parametric values of that image.



PROPOSED METHOD

First open a MATLAB and write the proposed method code without any errors and then

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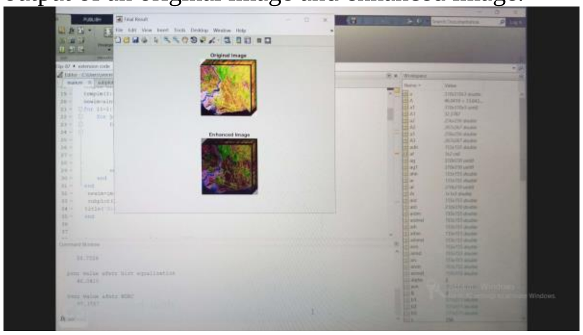
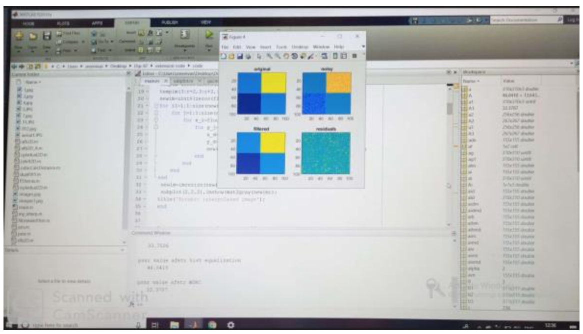
save that code and run that code. After that we get the output of an original image and enhanced image.





In above fig we will see that how noise is reduced by filtering from the original image.

VI.CONCLUSION

It can be from the experimental results that a high-quality image source is needed for identify and extract the features information from the remote sensing images. The remote information obtain from a single sensor is extremely limited, the amount of information from image sources can be effectively increase by using image data fusion method. This article is based on this idea, make a fusion on TM multispectral remote sensing images and QuickBird panchromatic remote sensing images, and the fusion is based on HIS transform and wavelet transform fusion algorithm, then get a better image source, and then apply this image source to extraction of road information, we can extract most of the road information accurately and get a good effect as a result. However, the road information extracted in this experiment is not quite perfect, believe that with the increase in resolution of remote sensing images, and extract the road in different regions and different materials respectively to improve the adaptability of extraction algorithm, then we can identify and extract road information accurately and obtain a more comprehensive road layers.

VII.FUTURE SCOPE

Despite its ability to handle occlusions and noise, sparse tracking may be inadequate to describe complex noise corruption, for instance, in urban road tracking, where road surfaces are often significantly disrupted by the existence of occlusions and noise in high-resolution (HR) satellite imagery. To address this issue, this letter presents a semiautomatic approach for road extraction from HR satellite images. Firstly, a multifeature sparse model is introduced to represent the road target appearance. Next, a novel sparse constraint regularized mean-shift algorithm is used to support the road tracking. Furthermore, multiple features are combined by weighting their contributions using a novel reliability measure derived to distinguish target from background. The experiments confirm that the proposed method performs better than the current state-of-the-art methods for the extraction of roads from HR imagery, in terms of reliability, robustness, and accuracy.

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