

# Using Wavelet and Fast Discrete Curvelet Transform (FDCT) with (OTSU) Segmentation for Locating and Recognize Satellite Image Remote Sensing for Aircraft

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**ABSTRACT:** This paper proposes the application different kinds of feature extractors technique to recognize & locating the aircraft satellite image. Recognition of object (Aircraft) in an image based on the combination of feature extractors which contain of fast Fourier transform, discrete wavelet transform & discrete curvelet transform in addition to the correlation on shape analysis. Also an object can be recognized with help of texture or appearance features through Scale invariant feature transform (Wavelet Transform) and OTSU (Multi Scale segmentation), To justify the correct amount of each feature extractor, we perform per of the mentioned transforms to input images, precisely. The used classifier in this paper using Detect Fuzzy Clustering and the results of this test show, that the right recognition rate of aircraft in this recognition system, at the time of using curve let transform and all curvelet coefficients is 100%. For decreasing the dimension of feature vectors more & choosing the best features we've used of interclass variance criteria to intra class variance criteria. As a result of this performance, the size of feature vectors will be extremely decreased. Then, we perform our final impact feature vectors (the best curvelet coefficients or the best wavelet coefficients or the best Fourier coefficients) to the fuzzy and neural network.

**KEYWORDS:** Aircraft Remote Sensing, Wavelet, Curvelet Transform, OTSU Segmentation, Multi-Spectral Image.

## I. INTRODUCTION

With rapidly changing of modern environment, real-time and near real-time information and the immediate judgment of the nature and value of information are necessary. The intelligence which is delayed too long cannot effectively help combat activities, Aerial imagery Automatic Target Recognition is an important research topic in image processing and pattern recognition area and has high academic and practical value. e.g., The aircraft is an important military target and one of the main targets of reconnaissance and attack in the military field, it's important for accomplishing target strike mission to judge the type, condition and quantity of ground parked aircraft by using aviation images and identify weapons which the aircraft carried. In the research field of the identification and location of military targets, the military intelligence analysis and objective assessment methods. based on Remote sensing. Also, security system of combat aircraft and becomes further consummate with the advance of Image acquisition means analysis and processing technology and the development of computer technology. The application has proved such a system has played an important role, where the most notable feature is using diversified aerospace and aviation image data synthetically and consequently recognition system mainly by automatic identifications subsidiary by human-computer interaction identification has been put into use this not only enable the computer to process and analysis image data capacity of the pace has quickened, this paper tries to base on the exploration in the aerial imagery automatic target recognition and target detection technology, makes a detailed study on the aircraft.

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## II. EXISTING METHOD

### 1. Discrete Wavelet Transform

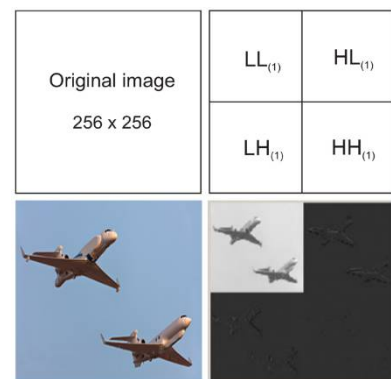
The wavelet transform (WT) has gained widespread acceptance in signal processing and image compression. Because of their inherent multi-resolution nature, wavelet-coding schemes are especially suitable for applications WHERE SCALABILITY and tolerable degradation are important. Wavelet transform decomposes a signal into a set of basic functions. These basis functions are called wavelets. Wavelets are obtained from a single prototype wavelet  $y(t)$  called

mother wavelet by dilations and shifting: 
$$\psi_{a,b}(t) = \frac{1}{\sqrt{a}} \psi\left(\frac{t-b}{a}\right)$$

Where  $a$  is the scaling parameter and  $b$  is the shifting parameter. Discrete Wavelet transform (DWT) is a mathematical tool for hierarchically decomposing an image. The DWT decomposes an input image into four components labelled as LL, HL, LH and HH. The first letter corresponds to applying either a low pass frequency operation or high pass frequency operation to the rows, and the second letter refers to the filter applied to the columns. The lowest resolution level LL consists of the approximation part of the original image. The remaining three resolution levels consist of the detail parts and give the vertical high (LH), horizontal high (HL) and high (HH) frequencies. Figure (1) shows 1D-wavelet decomposition of an image.

### 2. Image Segmentation

Image segmentation is the fundamental approach for digital image processing. In image processing, segmentation is the first step to pre-process the images to extract the objects and make it easier to analyse the segmentation process identifies the group of pixels having similar properties within the image. Segmentation is a valuable tool in many fields in our daily life like industry, health care's, Digital image processing, remote sensing, Road traffic image, content based retrieval, pattern recognition, and computer vision etc. banalization techniques for grayscale documents can be grouped into two broad categories: global binarization and local binarization. Global binarization methods like that of Otsu method try to find a single threshold value for the whole document. But all the method should be applied to all the type of images for that an algorithm like Lloyds means should be considered to classify the depth and extension region of the identified area. Figure 1: (DWT Aircraft Image)



## III. MOTIVATION

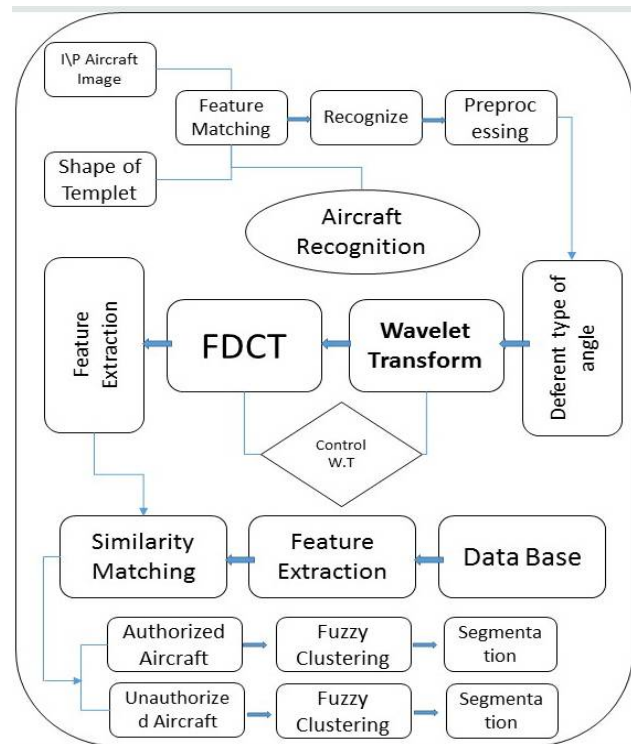
A lot of motivations and ideas thrown IN” Automatic Aircraft Recognition” It can be observed and identified by literature review and existing methods, this difference results make it difficult task, for the researcher in this field, and even if he wants to approve his results, At least must be compared with previous results, this is my point of view challenging task. Conventional methods always extract the overall shapes of aircraft at first and then represent the aircraft based on the extracted shape with different features for recognition. The major problem of these methods is that they have a high requirement on shape extraction, which is too idealistic for targets in satellite images. In this letter, we propose a new aircraft recognition approach that can recognize aircraft robustly without perfect extraction of silhouette or shape of aircraft as a precondition, and can deal with the situation of parts missing and shadow disturbance. Specifically, a direction estimation method is proposed first to align aircraft to a same direction. Then, a reconstruction based similarity measure is proposed, which transforms the type recognition problem into a reconstruction problem. Finally, a jigsaw matching pursuit algorithm is proposed to solve the reconstruction problem. We use panchromatic Quick bird imagery for evaluation, and the experimental results illuminate that the proposed method is effective and accurate.

## IV. PROPOSED METHOD

Proposed system will HAVE PRESENTED in this section depend on Wavelet transform feature mainly and we will detail that as below, in this methods we have to recognize of an aircraft in satellite image using template matching for ACCURATE AND tracking High resolution multi spectral satellite images with multi-angular look capability have tremendous potential applications. Here the system involves an object tracking algorithm with three-step processing that includes combining Discrete Wavelet Transform and fast Discrete Curvelet Transform via wrapping technique. with Detecting OTSU Segmentation, the target is modelled by extracting both spectral and spatial features. In the target matching procedure, template will be used as matching model to recognize with each frame by frame for accurate detection. Here, normalized cross correlation and spatial features are used as features model for recognition. This recognition model will be continued for all sequence of satellite images

**WAVELET TRANSFORM FEATURE BASED AIRCRAFT RECOGNITION:** The Wavelet Transform Feature Based Aircraft Recognition can be used.

- Aircraft Multi spectral Image
- Pre-processing
- Lifting Wavelet Transform
- Fast Curvelet transform
- Similarity Measurement Analysis
- Aircraft detection using Fuzzy Clustering



Block diagram 1 (Proposed Methods)

### A. PRE-PROCESSING

#### 1. Noise Removal on Median Filter:

Noise is an important factor that influences image quality which is mainly produced in the processes of image acquisition and transmission. Noise reduction is necessary for us to do image processing and image interpretation so as to acquire useful information that we want. Because the working status of image transmitter is influenced by varied factors, such as the environment of image acquired, different noises can be dealt with in different ways. Through the analysis of image spectrum, its difference can help us to choose 20 different methods to do noise reduction while the information of the image is reduced to be the most. Here in my project report paper I will illustrate in methods of noise reduction and I will show the one test result image as an example. Since this image was affected by notable striping, the noise reduction methods of this stripped image are mainly studied. Grounded on the previous studies by some experts, I have applied some algorithms to this image. The Gray Value Substitution and Wavelet Transformation are satisfactory in stripped noise reduction. Then, MSR and PSNR are calculated to evaluate the processed image.

#### 2. Low pass filter

Noise is high frequency signal usually, so we can apply low pass filter to reduce it. The trapezium low pass filter (FLPF)

$$H(u, v) = \begin{cases} 1 & D(u, v) < D_0 \\ [D(u, v) - D_1] / [D_0 - D_1] & D_0 \leq D(u, v) \leq D_1 \\ 0 & D(u, v) > D_1 \end{cases}$$

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we choose has certain advantage of ideal low pass filter and filter that has smooth transition band, which has some ringing. The pass function of TLPF is as follows:

## B. Aircraft Multi-Spectral Image

1. Multispectral Remote Sensing. 2. RGB Component Image with Plane Process. Multi spectral remote sensing applications from UAS are reported in the literature less commonly than applications using visible bands, although lightweight multi spectral sensors for UAS are being used increasingly. In this part, we describe challenges and solutions associated with efficient processing of multi spectral imagery to obtain ortho rectified, radiometrically calibrated image mosaics for the purpose of rangeland vegetation classification. We developed automated batch processing methods for file conversion, band-to-band registration, radiometric correction, and orthorectification. An object based image analysis approach was used to derive a species-level vegetation classification for the image mosaic with an overall accuracy of 87 percent. We obtained good correlations between:

1. ground and airborne spectral reflectance ( $R2 = 0.92$ ).
2. spectral reflectance derived from airborne and World View(up) satellite data for selected vegetation and soil targets.

UAS-acquired multispectral imagery provides quality high resolution information for rangeland applications with the potential for upscaling the data to larger areas using high resolution satellite imagery. Because this noise is symmetrical and regular, we try for developing one simple method to reduce this striped noise without Fourier transformation and wavelet transformation. This method firstly detects the noise value, then a value nearby is used to replace the noise value. After that, a median filter is used to do noise reduction further more. The result image can be seen in figure (3). We can see from this image, most noise line is modified and the line without noise is not affected by this method. So the image reserves much intrinsic information. However, some small stripes still exist, and the brightness after processing is larger than that before processing.

## C. Lifting Wavelet Transform

Wavelet image denoising has been well acknowledged as an important method of image denoising. This method reserves most wavelet coefficient that contains information, so it can preserve image detail.

Image denoising by wavelet usually mainly has three steps: 1- Decomposition of image signal. 2- Threshold quantification of high-frequency 3- coefficient after level decomposition.

## D. Fast Curvelet transform

Is the new member of the evolving family of multiscale geometric TRANSFORMS? It offers an effective solution to the problems associated with image denoising using wavelets. In this paper an attempt has been made to present the results of denoising of such images using both wavelet and curvelet transforms. The results obtained demonstrate that the curvelet transform based reconstructions are visually sharper than the wavelet reconstructions. The recovery of edges and of the faint linear and curvilinear

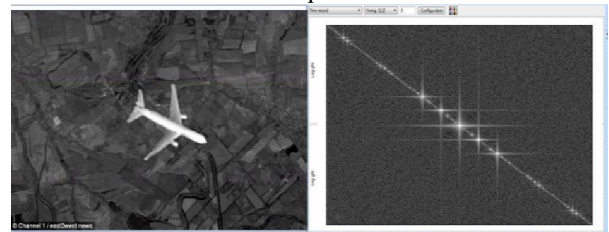


Figure2: (Test image and its Fourier spectrum)

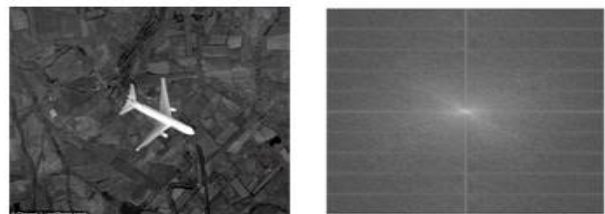


Figure3: (Image processing results of gray value substitution)

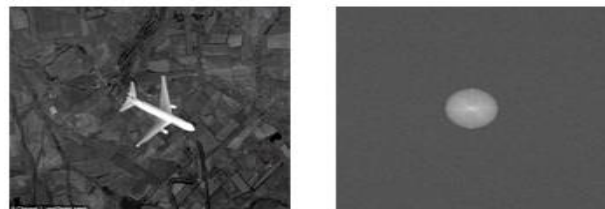
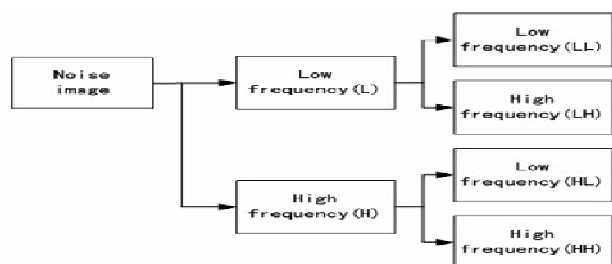


Figure4: (TLPF processed image and its Fourier spectrum)



Block diagram 2(Wavelet decomposition flow chart)

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features is of particularly superior quality. The results obtained are in accordance with the expected predictions of the existing theory of curvelet transforms. Curvelet transform was proposed in order to overcome the drawbacks of conventional two-dimensional discrete wavelet transform. In the two-dimensional (2D) case, the curvelet transform allows almost optimal sparse representation of objects with C2 singularities. To achieve higher level of efficiency, curvelet transform is usually implemented in the frequency domain. That is, both the curvelet and the image are transformed and are then multiplied in the Fourier frequency domain. The product is then inverse Fourier transformed to obtain the curvelet coefficients. The process can be described as Curvelet transform:  $=\text{IFFT} [\text{FFT} (\text{CURVELET}) \times \text{FFT}(\text{IMAGE})]$  AND the product from the multiplication is a WEDGE. The trapezoidal wedge in the spectral domain is not suitable for use with the inverse Fourier transform which is the next step in collecting the curvelet coefficients using IFFT.

$$c^D(a, b, \theta) = \sum_{\substack{0 \leq m < M \\ 0 \leq n < N}} f[m, n] \phi_{a, b, \theta}^D[m, n]$$

where:

$C^D$ : DISCRETE CURVELET COEFFICIENTS

$\phi^D$ : CURVELET FUNCTION

A: SCALE PARAMETER

B: LOCATION PARAMETER

$\theta$ : ORIENTATION PARAMETER

The advantages of using the curvelet transform include the following \*. Optimal sparse representation of curve singularities (edges). \*. In addition to parameters of scale and position (as in wavelet), curvelet also adds one more

parameter of direction. \*. Curvelets are designed to handle curves (edges) using only a small number of coefficients.

**Feature Vector:** The normalized directional energy is computed from each sub-band of the curvelet to form the feature vector. To compute the energies using L1 norm, the following expression is used. where  $E_k$ : is the energy of the kth sub-band of curvelet and is the corresponding sub-band with dimension  $M \times N$ . Hence, for each scale and direction, anisotropic features are derived and the resultant feature vector is as given by :

$$f = [f_{E1}, f_{E2}, f_{E3}, \dots]$$

### Recognition Role:

The feature vectors are derived from each of the normalized iris images during enrolment process. The test iris feature vector is compared with stored vectors using Euclidean distance (ED) given where N is the dimension of feature vector. component of test feature vector component of enrolled feature vector. The test image is verified on the basis minimum distance (Nearest Neighbour classifier). Following steps describe algorithm in detail:

1. Iris image is segmented using integral-differential operator.
2. The segmented iris image is normalized using Baughman's rubber sheet model.
3. The background subtraction method is used to enhance normalized iris image.
4. This enhanced normalized image is divided into six sub regions.
5. The 2-D FDCT via wrapping is used separately on each of these six sub-regions to extract local features (also called as curvelet coefficients).
6. Six local feature vectors are derived by estimating energies of curvelet coefficients of each sub-region.
7. These six local feature vectors are combined to create the resultant local feature vector (template).

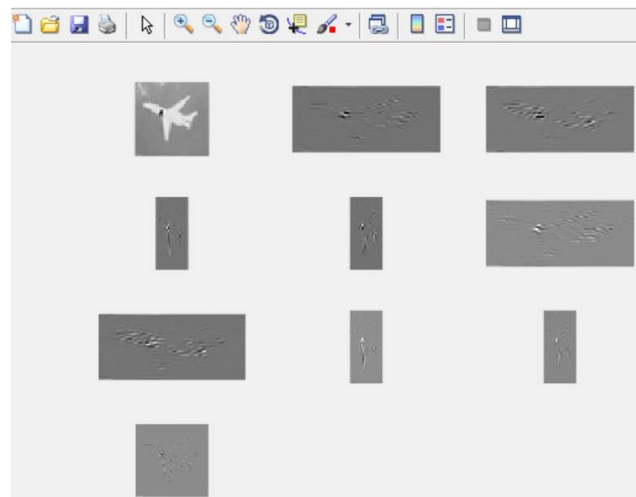


Figure 5(Fast Discrete Curvelet Transform)

$$E_k = \frac{1}{M \times N} \sum_{i=1}^M \sum_{j=1}^N |x_k(i, j)|$$

$$ED = \left( \sum_{i=1}^N (T_i - E_i)^2 \right)^{\frac{1}{2}} \quad \text{as:}$$

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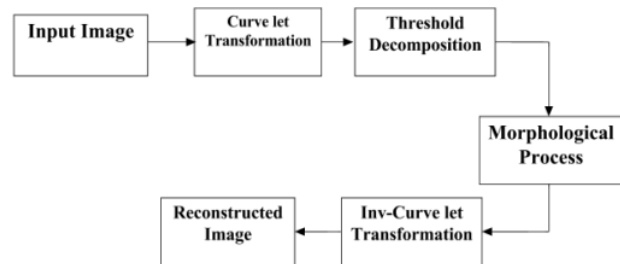
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**Image Enhancement:** Image enhancement techniques improve the quality of an image as perceived by a Satellite remote sensing. These techniques are most useful because many satellite images when examined on a colour display give inadequate information for image interpretation. There is no conscious effort to improve the fidelity of the image with regard to some ideal form of the image. There exists a wide variety of techniques for improving image quality. The contrast stretch, density slicing, edge enhancement, and spatial filtering are the more commonly used techniques. Image enhancement is attempted after the image is corrected for geometric and radiometric distortions. Image enhancement methods are applied separately to each band of a multispectral image. Contrast generally refers to the difference in luminance or grey level values in an image and is an important characteristic. It can be defined as the ratio of the maximum intensity to the minimum intensity over an image. Contrast ratio has a strong bearing on the resolving power and detectability of an image. Larger this ratio, more easy it is to interpret the image. Satellite images lack adequate contrast and require contrast improvement. However, curve lets have actually been redesigned in an effort to make them easier to use and understand. As a result, the new construction is considerably simpler and totally transparent. Moreover, this process is very time consuming, which makes it less feasible for texture features analysis in a large database. Fast discrete curve let transform based on the wrapping of Fourier samples has less computational complexity as it uses fast Fourier transform instead of complex ridge let transform. In this approach, a tight frame has been introduced as the curve let support to reduce the data redundancy in the frequency domain.

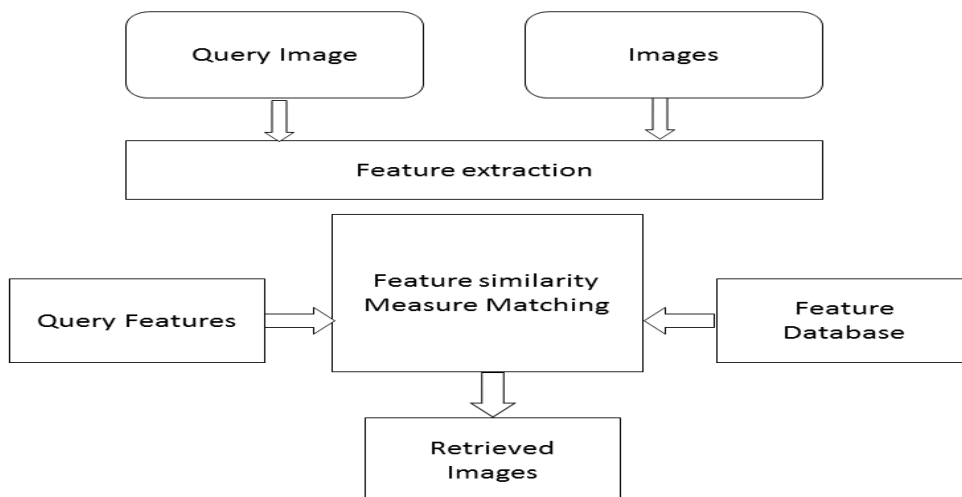
### E. Features Extraction

features such as shape, colour and texture are extracted to characterize images. Each of the features is represented using one or more feature descriptors. During the retrieval, features and descriptors of the query are compared to those of the images in the database in order to rank each indexed image according to its distance to the query. In biometrics systems images used as patterns (e.g. fingerprint, iris, hand etc.) are also represented by feature vectors. The candidates patterns are then retrieved from database by comparing the distance of their feature vectors. The feature extraction methods for this applications are discussed. the basis of features that can be automatically extracted from the images themselves. These systems called CBIR (Content Based Image Retrieval) have received intensive attention in the literature of image information retrieval since this area was started years ago, and consequently a broad range of techniques has been proposed. The algorithms used in these systems are commonly divided into three tasks:

1. Extraction ,2. Selection, 3. Classification



Block Diagram3: (Image Contrast Enhancement Using FDCT)



Block Diagram4 (Image retrieval process)

## V. EXPERIMENTAL RESULTS

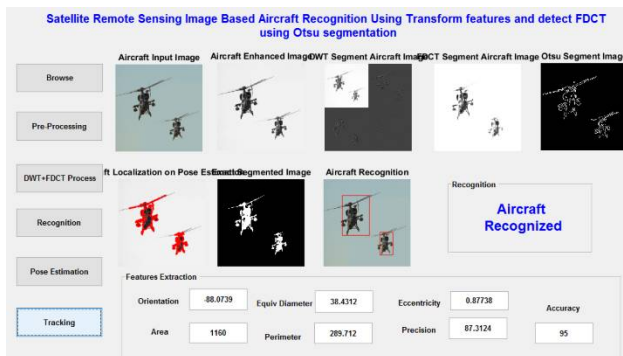


Figure6(Experiment Result -1)

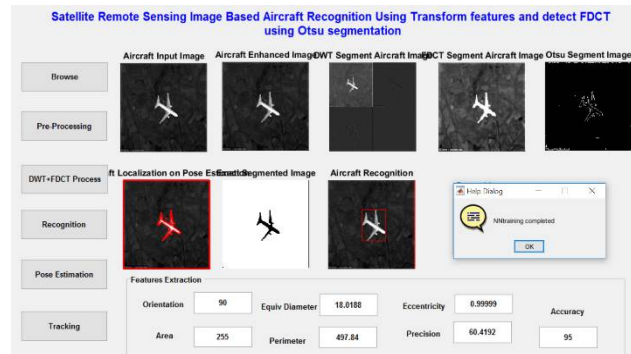


Figure7(Experiment Result -2)

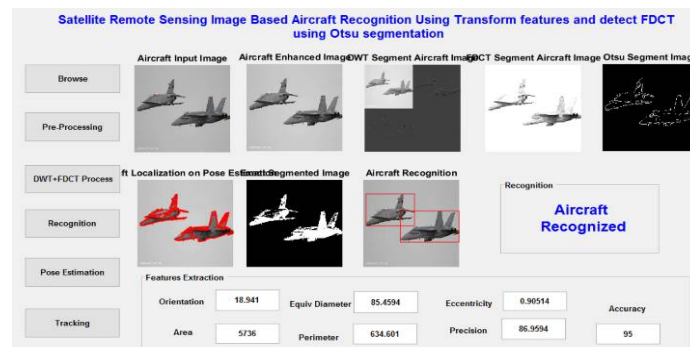


Figure8(Experiment Result -3)

Through the foregoing above results and the statement of obvious differences in each of the algorithm we will compare same image in the first algorithm and use it again with different image to showing a preview of the results and indicate the best result for the positioning, precision and to identify object and the other parameter depending on various of images. Finally, will result was good percent of recognition based on curvelet Transform and the mean square error will be decreasing in same time approving good extraction for images.

## VI. CONCLUSION

We have presented an (Satellite Remote Sensing Image based Aircraft Recognition Using Transform Features (Fourier, Wavelet transform, Curvelet Transform, Otsu Methods) and Detect Fuzzy Clustering), A new robust-type recognition method for aircraft targets in high-resolution remote sensing images has been proposed. The main advantage of the method lies in that the method can recognize aircraft robustly and excludes the target overall shape extraction phase, which is usually included in the traditional recognition methods and is not practical due to disturbing background. Each of the existing methods provided a single unique feature for Aircraft Recognition. Those features were independent and those methods did not take into account multi-level features. We have utilized all the shape characteristics for candidate selection which is very vital in order to extract accurately the aircraft candidate. Thus the Aircraft can be located even in the presence of cluttered background and other terrestrial disturbances. The work concentrates mainly on reducing the time of candidate identification eliminating other terrestrial disturbances. Finally, the simulated result with algorithm using Transform Features and Otsu Technique was shown that better efficiency achieved with chosen techniques and methodologies.

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