© 2016 IJSRST | Volume 2 | Issue 2 | Print ISSN: 2395-6011 | Online ISSN: 2395-602X
Themed Section: Science and Technology

Aggrandized Aspect Based Mosaicing Technique for Scientifically Stigmatized Airborne Synthetic Aperture Radar

D. Bhavya Lakshmi, Prof. N. Sathianandam

ABSTRACT

In the digital image processing, enhancement and removing the noise in the airborne synthetic aperture radar (SAR) image is a critical issue. We have proposed a Kaze algorithm to enhance radar image interpretation and the computational time are reduced by using the Adaptive Random Sample theory which limits the search space and work well for feature detection of synthetic aperture radar image(SAR).The performance of the proposed approach has been evaluated and compared to the existing technique, The statistics obtained from each randomly selected feature is used to update this distribution, by reducing the total required number of random trials. The re-estimation for those selected features are done within a smaller search space with a more accurate algorithm like the RANSAC fitting, thus the proposed technique show that this two-stage algorithm reduces the total computation time by limiting the search space. The entire algorithm is simple and effective. Thus the image interpretation is enhanced by invariant feature Point detector in the areas of computer vision, real time image matching and object recognition.
Keywords: Mosaicing Technique, Synthetic Aperture Radar, RANSAC, KAZE, SAR, SHIFT algorithm

I. INTRODUCTION

Unlike Passive optical sensors the active microwave sensor that transmits in microwave and detects the wave that is reflected back by the objects using Synthetic Aperture Radar. For providing the high- resolution imagery this systems take the advantage of the long-range propagation characteristics of radar signals and the complex information processing capability of modern digital electronics. Specifically Microwave pulses are transmitted by synthetic aperture antenna towards the earth surface in SAR imaging. SAR images are formed using the principal of radar and the microwave energy of the backscattered signal reflected back to the antenna. Time delay of the backscattered signals is measured.

SAR transmits a microwave beam towards the ground at right angles to the direction of flight revealing a swath which is offset from nadir. For measuring the range and range resolution from the antenna to the target this imaging system relies on or across track dimension perpendicular to the flight direction. The elapsed time between the transmission of a pulse and receiving the echo determines the range or line-of-sight, distance. Width of the receiving pulse is used to govern the range resolution of the target. Narrower the pulses, finer the resolution. This imaging system relies on another important dimension that is the azimuth or the along-track dimension parallel to the flight direction and perpendicular to range. The azimuth beam width which is inversely related to antenna size is used to govern the resolution in this direction. A smaller antenna will generate a larger beam width and its images will have poor azimuth resolution. For getting a fine azimuth resolution a physically large antenna is needed to focus the transmitted and received energy into a sharp beam.

Doppler processing is another approach which explains how the SAR imaging achieves fine azimuth resolution. Doppler frequency of the echoes from the ground determines a target's position along the flight path. If the target is in front of aircraft the offset will be positive and if it is behind the aircraft the offset will be negative. Synthetic aperture radar has the ability to penetrate clouds and darkness. Data are ideal for land surface mapping owing to their high spatial resolution. The problem of acquiring large-scale airborne SAR imaging scene in military and civilian fields, such as battlefield investigation, flood supervision and so on, need to be resolved by image mosaic. Image mosaic has several advantages like resolving the problem in multi-image matching and giving high quality results using multi-band blending. In broad remote areas like rain forest and boreal forest regions the Mosaics produced from SAR images serve as valuable base maps. These data sets are extremely valuable for scientific research. In situ observations are usually sparse and optical remote sensing technologies are often disabled due to cloud coverage. Because of the inherent compensation for the large range walk it has been presented that the SAR image formation process can be beneficially extended to the aforementioned mosaicing operations.

The strip map SAR image acquisition process, La is the length between the position of the aircraft and Ls is the length of the strip of SAR image. In general strip map SAR imaging, there will be overlap regions between two strips. And due atmosphere variations, the sensors also fail sometime and there will some geometric variations between two consecutive strips which has common area. However, to most SAR imaging algorithms, the geometric distortions, spectrum alias, and border discontinuities in the neighboring results remain as inevitable problems for high-quality mosaics Generally, the SAR image mosaicing will be performed based on location which uses latitude, longitude and movement parameters of the plane given by INS to calculate the longitude and latitude of every pixel of image.

In case of absence of the sensor information and navigation information, the SAR image cannot be mosaiced. In that situation, the gray based and feature based methods are commonly used. The gray distribution of the SAR image is not stable as that of the optical images. The feature based methods such Hough corner point can be used for SAR image mosaicing. But SURF doesn't acknowledge the geometrically distorted SAR image. In this project, a methodology to produce the continuous full image automatically is presented based on the KAZE feature with modified SHIFT algorithm that has been improved to handle the difficulties successfully. In this project, enhance feature based SAR image Mosaicing technique is explained. The performance and robustness of the proposed method are verified by the experiments. Synthetic Aperture Radar Image Features Interpretation The brightness or darkness of a SAR image pixel is dependent on corresponding 'patch' on the earth's portion of the transmitted energy that is returned back to the radar.

In contrast to most optical remote sensing and surveillance systems, where aerial photographs and satellite images must be captured during the day and generally at a time when the sun is in a favorable position, active system such as radar has the advantage of providing its own source of energy for target illumination. The radar signal interacts with ground surfaces through reflection, scattering, refraction or being absorbed. Pixels in the image represent the back-scattered radiation from an area in the imaged scene. Brighter areas are produce by stronger radar response and darker areas are from weaker radar responses. The amount of the occurrence of backscattering depends greatly on factors such as wavelength of the radar used; orientation or polarization, incidence angle of the radar wave and nature of the surroundings. The length of the wavelength determines the resolution and penetration depth.

A surface is considered smooth or flat if the height variations are smaller than the radar wavelength. For smooth surfaces, little of the radar signal will be reflected back to the radar system. This causes the area in the image to appear darker or invisible. In contrast, a surface appears rough to a shorter wavelength and a significant portion of the energy will be backscattered to the radar such that the rough surface will appear brighter in tone on an image. Longer wavelength can penetrate deeper into the canopy of trees and create multiple backscattering between the soils, leaves, branches and trunks. The large backscattering will cause the vegetation to give a brighter signature in image. Shorter wavelength will just interact with the top of the canopy causing detailed features such as small hills that are cover by the canopy to be hidden. The incidence angle refers to the angle between the incident radar beam and the direction perpendicular to the ground surface. Incidence angle can alter the appearance of the image and reduce the image distortion. Larger angles cause weaker signals and larger radar shadow but image is less susceptible to layover.

When features such as wall of a building or hedges lie in the direction of the flight-path, the radar beam can have two or double bounces occurring once on the wall surface and another off from the ground. This is known as corner reflection and most of the energy is reflected directly back to antenna resulting in a very bright appearance of the object in the image

II. METHODS AND MATERIAL

2 ARCHITECTURE FRAMEWORK

Images formed due to nonlinearities in the aircraft path and geometric changes in the images acquired, are mosaiced. The block diagram of enhanced feature based mosaicing technique consists of image enhancement, feature extraction, feature matching, warping and blending as shown in figure 1. The key problem in compututerizing the process lies in developing a better algorithm to accurately determine the features between images of neighbouring regions. Because of the distortion of the lens and other unknown natural factors, the overlapping areas of two images cannot be matched completely. In the case when there is a large overlap between the images, a new algorithm has proposed for image enhancement by directly minimizing the search space in intensities between pairs of images. The main problem to overcome in this part is to find the overlapping region between two neighbouring images. It frequently uses computer graphics knowledge to confirm overlap area.

In the vicinity of the point two dominant and different edge directions which are present in a point said to be a corner position. A corner can also be determined as the intersection of two edges. A sharp change in image brightness is referred as edges of image. They are predominantly described as interest point detection, corner detection; these methodologies used within computer vision systems to obtain certain kinds of features from a given image. To locate matching regions in different images, the initial operator concept of points of interest in an image is used. The Moravec operator is used for corner detector because it implies interest points as points where in all directions, there are large intensity variations are found.

The Kaze method is effective for images including Gaussian noise. As the statically result shows that the number of Harris corner detected for obtaining features from the original image is less to the same with the number of points detected by de-noised image using Kaze method

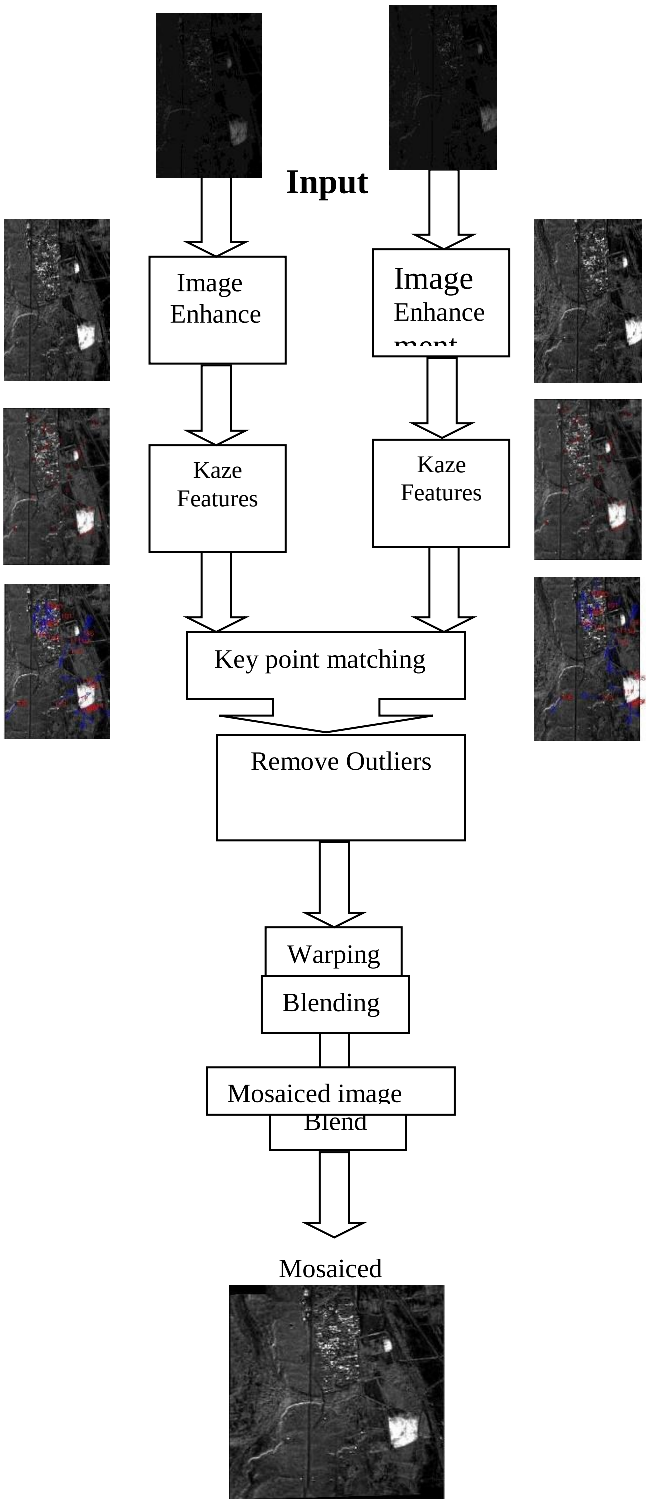

Figure 1. Different Phase Using Mosaicing Technique

III. RESULT AND DISCUSSION

3. Kaze Feature with Modified Shift

Our proposed algorithm considered the images formed due to nonlinearities of the platform and geometric changes in the images acquired. The Enhanced Feature based Mosaicing technique consists of image enhancement technique, Feature Extraction technique, matching, warping and blending, which describe the novel method for feature detection and description in nonlinear scale spaces to the given input image, then, to detect features of interest that exhibit maxima of the scale-normalized determinant of the Hessian response through the nonlinear scale space. Finally, computing the main orientation of the points and obtain a scale and rotation invariant descriptor considering first order image derivatives. Now, the procedure will describe each of the main steps in our formulation.

3.1 Enhancing the image-

1. Let the pixels of the image value A (i,j) ranges from 0 to 255.
2. Assume the threshold values, high limit and low limit. In this experiment, threshold values are 125, low limit is 22 and high limit as 223.
3. Calculate the mean adjustment value.
   Mean _adjustments=threshold-mean(mean (A));

4. Calculate the value of pixels
   A (i,j) = A(i,j)+ mean_adjustments*(1-A(i,j));
5. Calculate the minimum value and maximum values corresponding to high limit and low limit values.
a. Sort the pixel values of the image A(i,j).
b. The minimum value taken from the ordered indexed value of the low limit.
c. The maximum value is taken from the ordered indexed value of the high limit.
6. The enhanced pixel values of the image is given as A(i,j)=(A(i,j)-minimum value) / (maximum value – minimum value)).

3.2 Feature detection by KAZE- Nonlinear scale space is computed first, and then image is convolving with a Gaussian kernel of standard deviation σ to reduce noise and possible image artifacts. From that base image we compute the image gradient histogram and obtain the contrast parameter k by giving the contrast parameter and the set of evolution times, it is straightforward to build the nonlinear scale space in an frequentative way using the Additive Operator Splitting schemes depicts a comparison between the Gaussian scale space and the nonlinearity by using the g3 conductivity function. As it can be observed, Gaussian blurring smoothes for equal all the shape in the image, whereas in the nonlinear scale space strong image edges remain unaffected.

Where ($L_{xx}\, L_{yy}$) the second are order horizontal and vertical derivatives respectively, and L_{xy} is the second order cross derivative. Then w search for maxima in scale and spatial location. The search for extremes is performed in all the filtered images except i=0 and i=N. Each extrema is searched over a rectangular window of size $\sigma_i \times \sigma_i$ on the current i, upper $i+1$ and lower $i-1$ filtered images. For speeding-up the search for extrema, have to check the responses over a window of size 3×3 pixels, in order to discard quickly non-maxima responses. Finally, the position of the key point is estimated with sub-pixel accuracy.

$$L_{Hassian} = \sigma^2\,(L_{xx}\, L_{yy} - L_{xy}^2)$$

The set of first order and second order derivatives are approximated by means of 3 × 3 Scharr filters of different derivative step sizes σ_i. Second order derivatives are approximated by using consecutive Scharr filters in the desired coordinates of the derivatives. From these filters approximate rotation invariance significantly better than other popular filters. Although there is need to compute multiscale derivatives for every pixel, we save computational efforts by using this method.

3.4 Feature Matching- We use the M-SURF descriptor arrogate to our nonlinear scale space framework. For a detected feature at scale σ_i , first order derivatives L_x *and* L_y of size σi are computed over a 24σi × 24σi rectangular grid. This grid is divided into 4×4 sub regions of size $9\sigma_i$ ×9 σ_i with an overlap of 2σi. The derivative responses in each sub region are weighted with a Gaussian (σ1 = 2.5) σ_i centered on the subregion center and summed into a descriptor vector .Then, each sub region vector is weighted using a Gaussian (σ2 = 1.5σ_i) defined over a mask of 4×4 and centred on the interest key point. When considering the dominant orientation of the key point, each of the samples in the grid is rotated depending to the dominant orientation. In addition, the derivatives are also computed depending to the dominant orientation. Finally, the descriptor vector of length 64 is normalized into a unit vector to achieve invariance to contrast, so that the same number of scales O = 4, and sublevels S = 3 for the SIFT and KAZE cases. Computing a specification and dominant orientation or few of them in the case of SIFT

3.3 RANSAC fitting - The RANSAC is an algorithm, in which is applied to delete the error matching point pairs. After correcting the matching points, the matched points between the images are merged together to form a mosaiced image. The basic algorithm is summarized as follows:

1. Choose randomly the minimum number of points required to find the model parameters.
2. To solve for the parameters of the model.
3. To find how many points from the sets of all points fit with a predefined tolerance ε.
4. If the fraction of the number of inliers over the total number points in the set exceeds a predefined threshold τ, re-estimate the model parameters using all the recognize inliers and terminate.
5. Otherwise, repeat steps 1 through 4 (maximum of N number of times).

After this RANSAC algorithm has done its processing Due to the nature of the projection models used by the method, at the minimum of four correspondences are needed between the images. Also, when there is a large numbers of outlier features present, the probability that the evaluation process will fail is relatively high. A simple technique is used to deal with the situation: the image under registration is eliminate and a new image is considered if (Matches after RANSAC technique/ Matches before RANSAC technique) $<\tau$.

3.5 Feature warping and blending -The interpretation projection model established during the foregoing stages can now be used to transform the new image into the sub-mosaic image. To achieve the final projection model between the new image and the mosaic, the projection models are integrated with an alternative. The evolution in a backward manner is realized. In this way neither holes nor overlaps can arise in the resulting mosaic image. The registered image data from the new image are intent using the synchronization of the target pixel and the inverse of the estimated projection model. The image interpolation takes place in the new image on the regular grid. Bilinear interpolation is out performed by higher-order methods in terms of exactness and visual appearance of the transformed image; it offers probably the good trade-off between accuracy and computational complexity.

Registration of new image with the current mosaic is performed. If new areas were conquered, the pixels belonging to these areas are allocated values directly from the warped new image. Due to various reasons, such as non-linearity in aircraft path, radar sensors, there may be possibility of occurrence of intensity differences in the area of overlap. This may cause visible disruption in the resulting mosaic image. Therefore, the area of overlap is taken differently from the new areas.

In order to seamlessly merge the new image into the mosaic, the blending stage is attached to the method. The blending is a process of finding the updated pixel values in the area of overlap by applying a blending method that outputs a weight between 0 and 1 for each pixel in the new images. The updated pixel values are now generated as follows:

$$I0\ (0) = b\ (i)\ I\ (i) + (1 - b\ (i))\ I0\ (i0))$$

Where I and I 0 stand for the pixel values of the new image and mosaic, respectively. A blending function that reduces near the boundary of an image will efficient block visible discontinuities from occurring .Gaussian-style blending function b(x) is used. The blending is not only used to remove the visual discontinuities, but can be identified as an best way of making the method more robust against the accumulation of small registration errors, small errors can be removed by revisiting the erroneous area.

IV. CONCLUSION

In this paper, KAZE features, a novel method for multiscale two dimensional (2D) feature detection and description in nonlinear scale spaces is described. The new method has been developed to enhance the image by KAZE with modified SHIFT. The designed new method is faster and more accurate. The reconstructed image is more sensitized; the entire algorithm is simple but effective in the areas of and real time image matching and object recognition. For future research, the computational time for feature detection can be decreased. And also the research can be focused on more geometric distortion

V. REFERENCES

[1] Ali Cafer Gurbuz "FEATURE DETECTION ALGORITHMS IN COMPUTED IMAGES," In Partial Fulfillment of the Requirements for the Degree Doctor of Philosophy in the School of Electrical and Computer Engineering Georgia Institute of Technology August 2008.

[2] Ali Cafer G¨URB¨UZ "Line detection with adaptive random samples," Department of Electric and Electronics Engineering, TOBB University of Economics and Technology, S¨og¨ut¨oz¨u Cad. No 43, Ankara-TURKEY,2013.

[3] D. I. Barnea; and H. F. Silverman,"A class of algorithms for fast digital registration," IEEE Trans. Comput, vol.C-21, pp.179-186, 1972.

[4] David Peter Capel, Doctor of Philosophy,"Super-resolution and Image Mosaicing," Balliol College Trinity Term, 2001.

[5] Liu, C., Yuen, J., Torralba, A.: "Dense scene alignment using SIFT flow for object recognition," In: IEEE Conf. on Computer Vision and Pattern Recognition, CVPR 2009.

[6] Manglesh Khandelwal Shweta, Saxena Priya Bharti, Priya Bharti, "An Efficient Algorithm for Image Enhancement," Manglesh Khandelwal et al. / Indian Journal of Computer Science and Engineering (IJCSE) India, 2005. Milindkumar V. Sarode, Prashant R. Deshmukh, "Reduction of Speckle Noise and Image Enhancement of Images Using Filtering Technique," International Journal of Advancements in Technology http://ijict.org/ ISSN 0976-4860,Jan 2011.

[7] Neeta Nain, Vijay Laxmi and Bhavitavya Bhadviya "Feature Point Detection for Real Time Applications," Proceedings of the World Congress on Engineering, London, U.K, 2008 Vol I,WCE 2008, July 2 - 4, 2008.

[8] Pablo F. Alcantarillay, Adrien Bartoliy, and Andrew J. Davisonz ,"KAZE Features,"ISIT-UMR 6284 CNRS, Universit´e d'Auvergne, Clermont Ferrand, France Imperial College London, UK,2015.

[9] Paul Viola Michael J. Jones, "Robust Real-time Object Detection,"February 2001.

[10] Satya Prakash Mallick," Feature Based Image Mosaicing", Department of Electrical and Computer Engineering,University of California, San Diego, smallick@ucsd.edu, Dec2007.

[11] Udhav Bhosle, Subhasis Chaudhuri, Sumantra Dutta Roy, "A Fast Method for Image Mosaicing using Geometric Hashing," Indian Institute of Technology,Bombay,Powai,Mumbai400706, 1994.

[12] Wolberg,G. "Digital Image Warping," IEEE.Computer Society Press,pp 169-172 ,1990.