Novateur Publication's
International Journal of Innovation in Engineering, Research and Technology [IJIERT]
ICITDCEME'15 Conference Proceedings
ISSN No - 2394-3696

SAR IMAGE ANALYSIS FOR MICROWAVE C-BAND FINE QUAD POLARISED RADARSAT-2 USING DECOMPOSITION AND SPECKLE FILTER TECHNIQUE

Mudassar Shaikh
Department of Electronics Science, New Arts, Commerce & Science College,
Ahmednagar, (M.S.) India

Vijay Gadkar
Department of Electronics Science, New Arts, Commerce & Science College,
Ahmednagar, (M.S.) India

Shafiyoddin Sayyad
Department of Physics, Milliya Arts, Science and Management Science College,
Beed, (M.S.) India

ABSTRACT

The Synthetic Aperture Radar (SAR) image is a type of radar image which can be acquired by satellite at any time; day or night, though there is a change in weather condition or heaviest rainfall. In the field of remote sensing SAR image analysis is the need of the World. In this paper RADARSAT-2 C-Band fully polarimetry SAR data is used. But it was in SLC (single look complex) format i.e. level 1 and was not geocoded. Hence, for image analysis, the decomposition technique is used to extract the any object on the earth. But though it is decomposed and geocoded, speckle noise is still the major problem in SAR images which degrades the quality of images. Because of speckle noise the analysis of the image is difficult. The speckle noise can be removed by using different types of filters. Hence the speckle noise reduction helps in preprocessing due to that the overall visibility of SAR image increases. In this paper experimental result demonstrates the comparative study of image analysis with and without noise filter. The objective of this paper work is to produce RGB image i.e. level 2 for analysis so that processed image is much better than selected an original SAR image.

KEYWORDS- SAR, RADARSAT-2, Decomposition, Speckle Filter.

INTRODUCTION

Remote sensing utilizes the visible, infrared and microwave region of the electromagnetic spectrum. The microwave has its own advantages of interference of the atmospheric conditions; hence it is widely used than optical remote sensing. The Synthetic Aperture Radar (SAR) is an active remote sensing system, which is used to obtain high resolution images. The SAR sensor transmitted signal information towards earth object area and measuring the scattered or reflected energy back from the target material. The SAR has the capacity to penetrate clouds, fog, smoke etc. It is also has the capability to sense the object during the day or night. It operates in all-weather conditions, though there is change in environmental changes [1]. The wave reflected from the target material consists of contributions from many independent scattering points. Hence, these coherent waves results in the granular pattern of noise known as speckle. The speckle is the multiplicative noise which is the major problem in SAR images and because of such noise the resolution or quality of the image is reduced. Therefore, it is difficult to image processing on SAR images. Usually, due to increasing the power of the signal the speckle noise is also increased by the same amount. Hence it is essential to remove such type of noise from SAR images [2-3].
The polarization characteristics of electromagnetic energy recorded by a remote sensing system represent an important variable that can be used in many earth resource investigations [4-6]. It is possible to selectively send and receive polarized energy using active remote sensing systems which can be in the form of HH, HV, VH, VV polarization. The dynamic range of the like polarized component is larger than that of the cross-polarization component in urban areas; this is in contrast to the measurement of forested areas, where the dynamic range of the cross polarized component is larger than that of the like polarized

component [7]. It is also observed that the like-polarization (HH or VV) shows higher reflection and is significantly different from the results observed for cross polarization (VH or HV). In the present study RADARSAT-2 satellite fine quad polarized dataset is used [8].

In the present work decomposition techniques used for extracting the target information from the backscatter. These techniques are aimed on separating the polarimetry measurements from a random media into independent elements which can be associated to the various physical scattering mechanism occurring on the ground. This paper will provide simulation model result of RADARSAT-2 SAR image analysis using decomposition and speckle noise reduction technique using PolSARpro 4.2.0 and NEST 5.0.16 software. The main objective of the proposed work is to analyses SAR image with and without filter decomposition RGB images.

SAR IMAGE ANALYSIS ALGORITHM

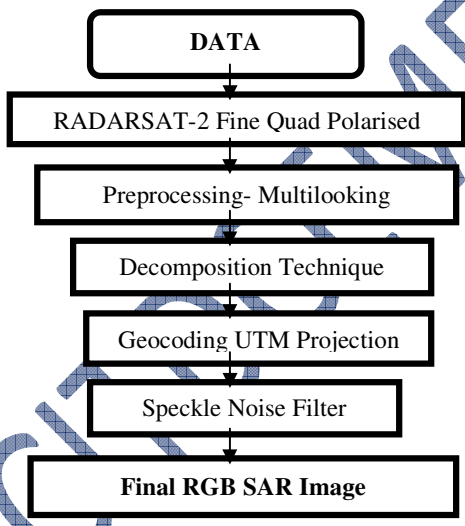


Figure 1: Flowchart SAR Image Analysis Algorithm

The algorithm used in the present study is as shown above figure. The RADARSAT-2 provides powerful new capabilities which include high resolution imaging, flexibility in selection of polarization, left and right-looking imaging options, shortened programming, processing and delivery timelines, superior data storage and more precise measurements of spacecraft position and attitude. MDA Geospatial Services operates the satellite and ground segment, and holds the worldwide distribution rights to RADARSAT-2 products. Data processing included pre-processing by multi looking process, decomposition technique, geocoding and speckle filtering.

DECOMPOSITION AND SPECKLE FILTERING TECHNIQUE

The available RADARSAT-2 C-Band fully polar metric data was in SLC (single look complex) format Level 1 which implies that the data was in the form of the scattering matrix for single polarization channel (HH, HV, VH and VV), in terms of the complex scattering coefficient. The data also had speckle noise and was not geocoded. This data was in the slant range format, due to which it was compressed. Therefore, the azimuth and the range direction were different, hence slant range to ground range conversion was performed to equalize these resolutions. This resulted in the creation of an image with square pixels due to equalization of the azimuth and range resolution using multi looking process. This process was carried out to improve the radiometric accuracy of the measurements. Then further processing is carried out using decomposition and speckle filtering techniques.

DECOMPOSITION TECHNIQUE-

One of the main advantages of polarimetric radar data analysis is the possibility of separating and identifying contributions from different types of scatteres in the imaged terrain. To do this, the received scattering matrix is analyzed using various techniques to extract information about the scattering processed. These process generally known as target decomposition. There are several types of decomposition techniques performed on the scattering matrix.

PAULI DECOMPOSITION-

This is most common decomposition techniques of the scattering matrix is often employed to represent all the polarimetric information in a single SAR image. Using the Pauli decomposition an RGB image, also called Pauli image can be constructed with the odd bounce, even bounce and 45^0 tilled even bounce components in red, blue and green colours respectively representing all the polarimetric information of matrix [9].

FREEMAN DECOMPOSITION-

The Freeman approach is based on the decomposition of the power reflection matrix of a scatterer. The scattering mechanism of a target or an ensemble of the target can be explained through a 3x3 scattering matrix in the power domain for monostatic case. The Freeman-Durden decomposition models the covariance matrix as the contribution of three scattering mechanisms-(1) Volume scattering where a canopy scatterer is modelled as a set of randomly oriented dipoles (2) Double bounce scattering modelled by dihedral corner reflector and (3) Surface or single-bounce scattering modelled by a first order Bragg Surface scatterer [10].

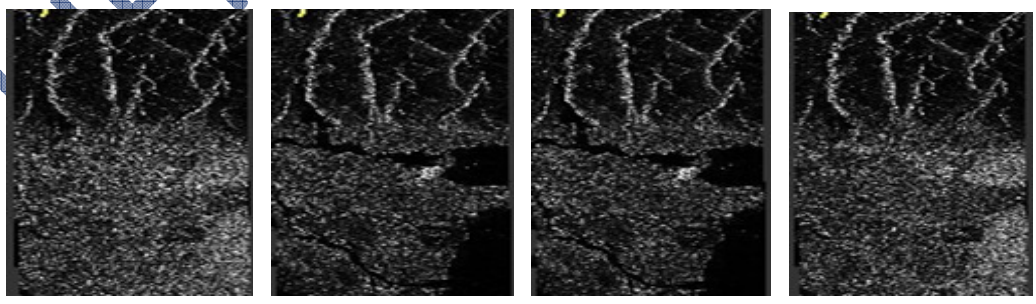
SPECKLE FILTER-

In SAR sensing the data is characterized by a typical noise called speckle, which is multiplicative in nature. This is due to inherent techniques used in acquiring the reflected back signal. SAR imaging is based on the integration of a scene coherent response of multiple scatterers from within a resolution cell. This gives rise to constructive and destructive interference of the return signal which in turn gives causes the speckle noise. Thus homogeneous regions will appear non uniform, and edges will lose their sharpness. Such data are not only visually unpleasant, but also unsuitable for image analysis such as classification, segmentation etc. Most of the noise removal techniques used in image processing field deal with additive noise which is generally present in optical data sets [11].

MEDIAN FILTER

Order-statistics filters [12-14] are nonlinear spatial filters whose response are based on ordering (ranking) the pixels contained in the image area encompassed by the filter, and then replacing the value of the centre pixel with the value determined by the ranking result. Median filter is used in the SAR filters & textures program. Sometimes, to get better image quality, it may be useful to filter the same image two or three times. The median filter not only removes the noise also the blurred effect in the SAR image.

STUDY AREA



(a) HH_Polarization (b) HV_Polarization (c) VH_Polarization (d) VV_Polarization

Figure 2: Original RADARSAT-2 SAR Image

The study area is located in the city of British Columbia by longitude 122^0 46' to 123^0 21'W & latitude 48^0 55' to 49^0 32' of Vancouver, Canada. This is a coastal seaport city on the mainland of British Columbia, Canada. The 2011 census recorded 603,502 people in the city, making it the eighth largest Canadian municipality. The Greater Vancouver area of around 2.4 million inhabitants is the third most populous metropolitan area in the country and the most populous in Western Canada. The City of Vancouver encompasses a land area of about 114 square kilometers, giving it a population density of about 5,249 people per square kilometer (13,590 per square mile). The RADARSAT-2 image with the fine quad 2 polarization obtained on 15/04/2008 is used in this study (Figure 2). The SAR image has a full polarization of HH, HV, VH, VV having 30 short pulses [15].

RESULT FINDING AND DISCUSSION

The RADARSAT-2 image with the fine quad polarization i.e. HH, HV, VH, VV initially converted into the ground range by using multi looking process. Then decomposition technique applied on pre-processed image. The following figure shows Pauli decomposition image,

Figure 3: Pauli Decomposition Image

The figure shows the natural colors composition result, which helps to analyze images in true color i.e. Red, green and blue combination. Further freeman decomposition used for analysis. In this model the covariance matrix as the contribution of three scattering mechanisms Volume scattering, Double bounce scattering and Odd bounce scattering as shown in following figure,

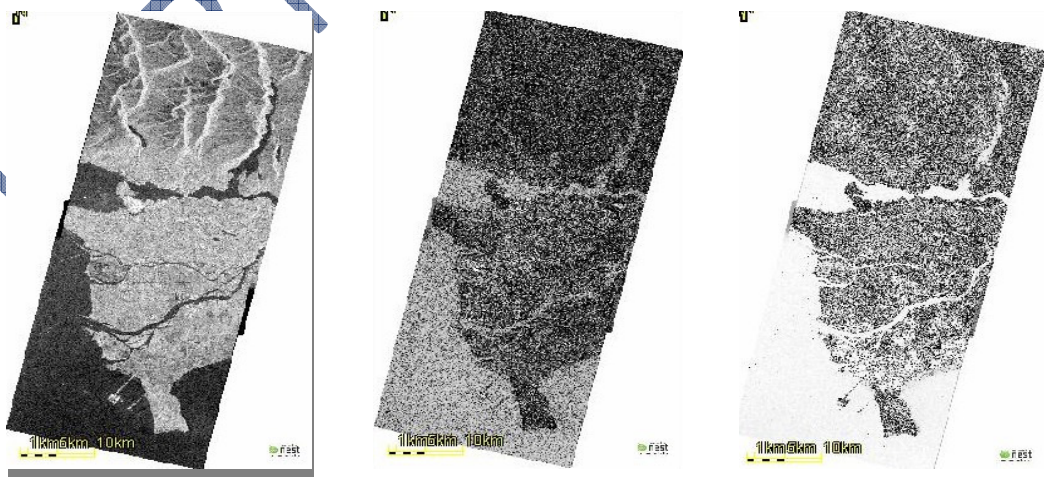
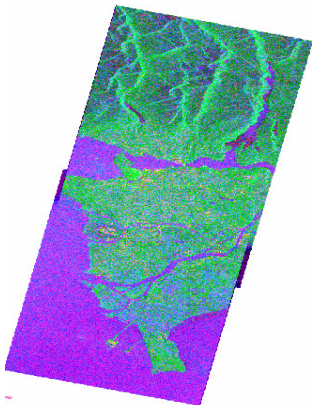


Figure: 4 (a) Volume Scattering (b) Double Bounce Scattering (c) Odd Bounce Scattering

The above scattering images results are combined as, red is volume scattering, green is double bounce scattering and blue is odd bounce scattering. Then resultant freeman RGB SAR image is formed as shown in following figure,



.

Figure 5: Freeman RGB image without filter

Since the decomposition having speckle noise which degrades the quality of SAR image, hence the speckle noise filter helps to improve the visibility of the image.

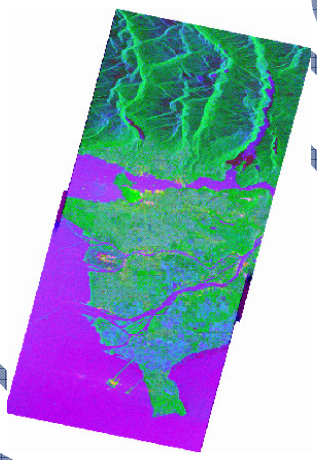


Figure 6: Freeman RGB image with Median Filter

The above figure shows the results of freeman RGB image using median filter. From the result, it shows that the filter image is good for analysis.

CONCLUSION

This paper made an attempt of SAR image analysis for microwave C-Band RADARSAT-2 fine quad polarized of Vancouver city, Canada. In this work the SAR image contains various objects like sea port area, settlement, hill area, rivers, roads etc. Hence, for analysis of all these parameter the original RADARSAT-2 image was not useful. The processing results of freeman decomposition and speckle filtering techniques helped in better visual interpretation. The freeman decomposition helps to extract the object in the SAR image and the resulting RGB image was created which was exactly like the Pauli decomposition image. Also the median filter used as a speckle filter for removing the speckle noise from the image. Therefore, from the all simulation results it is concluded that the decomposed speckle filter RADARSAT-2 SAR image having better performance than without a decomposed speckle filter for the image analysis.

REFERENCES

1. T. M. Lillesand, R. W. Kiefer. (1999). Remote Sensing and Image Interpretation. 4th Edition, John Wiley & Sons, Inc.
2. Didier Massonnet & Jean-Claude Souyris. (2008). Imaging with Synthetic Aperture Radar, First Edition, EPFL Press.
3. Arundhati Misra, B. Karikeyan, S. Garg. (2013). Noise Removal Technique for Microwave Remote Sensing Radar Data and Its Evaluation. Conference Paper CCSIT SIPP AISC PDCTA (pp.257-264).
4. James B. Campbell. (2002). Introduction to Remote Sensing. Third Edition, the Guilford Press.
5. John A. Richards. (2009). Remote Sensing With Imaging Radar", First Edition, Signals & Communication Technology Series Springer.
6. John R. Jensen. (2014). Remote Sensing of The Environment An Earth Resource Perspective, Second Edition, Pearson.
7. Dong Y., Forester B., Ticehurst C. (1997). Radar Backscatter Analysis For Urban Environment. International Journal of Remote Sensing. 18, 6, 1352-1364.
8. Xu-nan Liu, Bo Cheng. (2012). Polarimetric SAR speckle filtering for high-resolution SAR images using RADARSAT-2 POLSAR SLC data. International Conference on Computer Vision in Remote Sensing (CVRS). (pp.329 – 334).
9. Boerner W. M., Wei-Ling Yan, An-Qing, Xi and Yoshio Yamaguchi. (1991). On the Basic Principles of Radar Polarimetry: The Target Characteristics Polarization State Theory of Kennaugh, Huynen's Polarisation Fork Concept and Its Extension to the Partially Polarized Case. Proceedings of the IEEE, 79 (10), (pp.1538-1550)
10. Freeman A. and Durden, S. L. (1992). A three –Component scattering model to describe Polarimetric SAR data. Proceeding. SPIE Conference on Radar Polarimetry. 36(3), 963-973.
11. Nobuyoshi Kobayashi, Haruto Hirosawa. (1996). A Filter for Reduction Speckle in Synthetic Aperture Radar Images. Electronics and Communications in Japan. Part 1, 79, 3, 52-60.
12. A. K. Jain. (2013). Fundamental of Electronic Image Processing, Eastern Economy Edition, PHI Pvt. Ltd.
13. M. A. Shaikh, S. B. Sayyad. (2014). A Critical Review of Various Image Enhancement Technique. Journal of Advances in Applied Sciences and Technology. 1, 2, 244-247.
14. R. G. Gonzalez & R. E. Woods. (2008). Digital Image Processing. 3rd Edition, Pearson.
15. Microwave RADARSAT-2 Dataset Source- http://gs.mdacorporation.com/ SatelliteData/Radarsat2/SampleDataset.aspx //.