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Change Detection in Ottawa City Synthetic Aperture Radar Remote Sensing Images Based on SWT with Fuzzy C Means Clustering by Contrast Management

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Abstract: The collection of techniques involved in monitoring objects on the Earth's surface without any physical contact is called remote sensing. The change detection in remote sensing images is the process of detecting changes that take place between two SAR (Synthetic Aperture Radar) images gathered at dissimilar periods of the instance from same geographical area. The two or more SAR images obtained from the identical region at diverse time points are detected in terms of changes in accordance with the ground. Thus, the change detection mechanism is being widely employed in the field of military reconnaissance, natural calamity evaluation, and observing on marine oil spill, forest fire and urban expansion. A very often fusion s the merging of two images based on pixel level where it reduces the contrast of the fused image. In this paper Stationary Wavelet Transform (SWT) is employed for the fusion process and the fused image is segmented. Fuzzy C – Means clustering is used for segmentation and the segmented image is compared with the ground truth image. The performance of this method is measured in terms of measuring parameters accuracy, FDR, sensitivity etc.,

Keywords: SAR, Remote Sensing, DCT, FCM, Accuracy and FDR

1. Introduction

SAR images are quite varied from those attained from Infrared or Optical sensors [1-2]. Molecular resonances are accountable for optical sensors for object reflectivity. In the microwave region, geometric and dielectric properties are accountable for backscattering [3]. Dielectric features include sensitivity, which highlights on the morphological configuration of the considered domain and it also emphasizes the ground conductivity that could offer the data on vegetation, which is significant in forestry and agricultural applications.

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A significant feature of SAR information [4-5] results from the propagating nature of the microwave. Owing to their extensive wavelength, they are capable of penetrating the vegetation and even the earth up to a particular depth. The resolution is computed in a SAR [6-11] system by exploiting the width and pulse length of the beam that originates from the antenna. Pulse length portrays the range resolution while propagating the energy (the greater the wavelength, the shorter is the resolution) and the azimuth resolution is determined by the beam width. The azimuth, as well as the range resolutions, are almost proportional to distance of the antenna.

2. Methodology

2.1 Stationary Wavelet Transform (SWT):

The discrete cosine transform (DCT) is used to separate the image in to 8×8 blocks. The discrete cosine transform is used to decompose the spatial frequency of image in terms of various cosines.

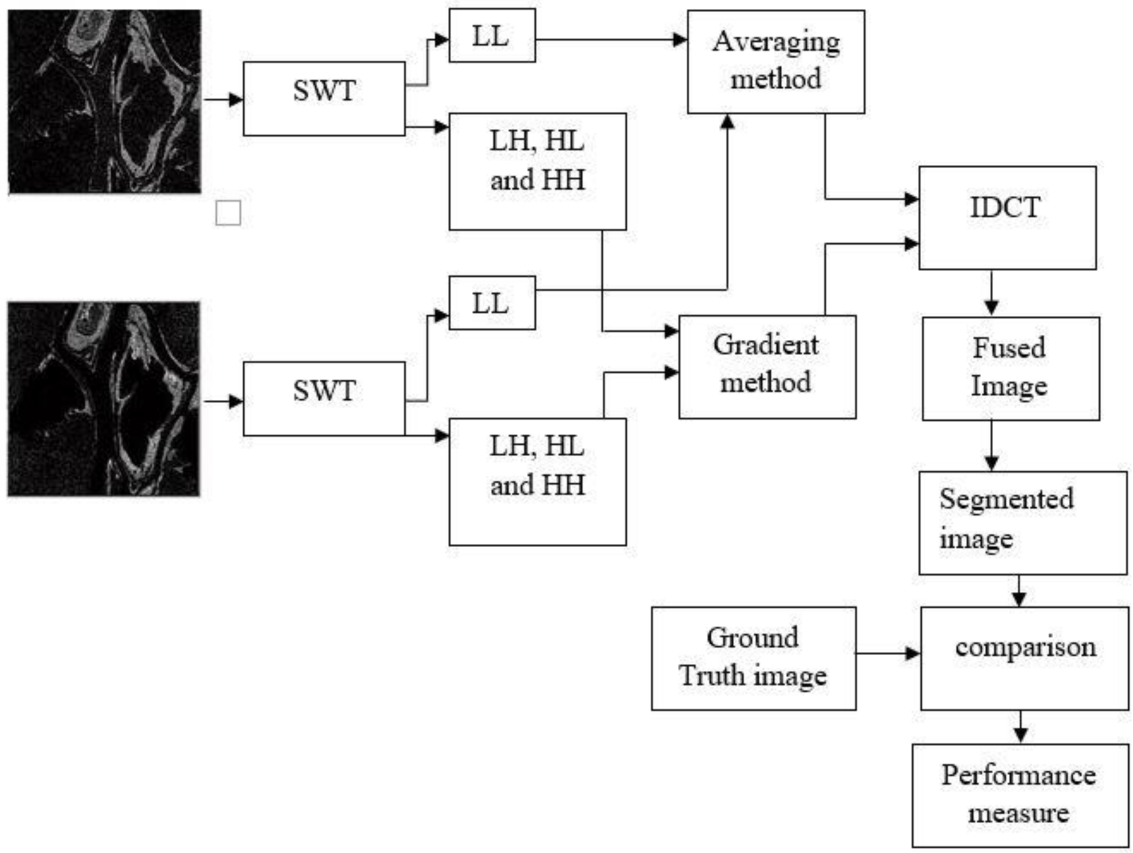

Fig 1.SWT based image fusion

As illustrated in fig.1 SWT is applied to two images i.e., image 1 and image 2. After processing ISWT the fused image will be segmented. Fuzzy C-Means clustering technique

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has been implemented for segmenting the changed regions and unchanged regions.The image fusion technique based on SWT is to perform a decomposition on each input image and the coefficients are separately fused by using certain fusion rule. Finally, the fused image is obtained by performing the inverse discrete cosine transform (ISWT) for the combined high and low frequency coefficients.

3. Results and Discussions

Two multi temporal images have been taken for this fusion process .These two images are applied as input to DCT process and multiple wavelts have been used for image fusion. Satellite images with SAR, sensors have been taken into account. Ottawa data set is taken as data set to validate the proposed methodology. As illustrated in fig.2 two images are processed for fusion, fig 2. (a) represents the image before flood occurs and fig 2 (b) represents the image after the flood is occurred and red colour shows the affected areas. Here the need of fusion is for further processing of these images such as clustering and change detection applications.

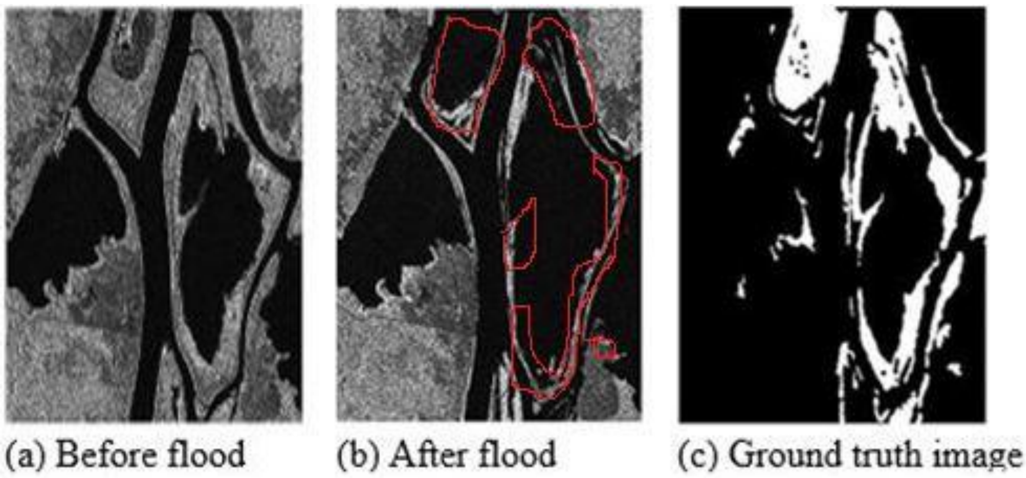

Fig .2. Input data images (a) Before flood (b) After flood (c) Ground truth image

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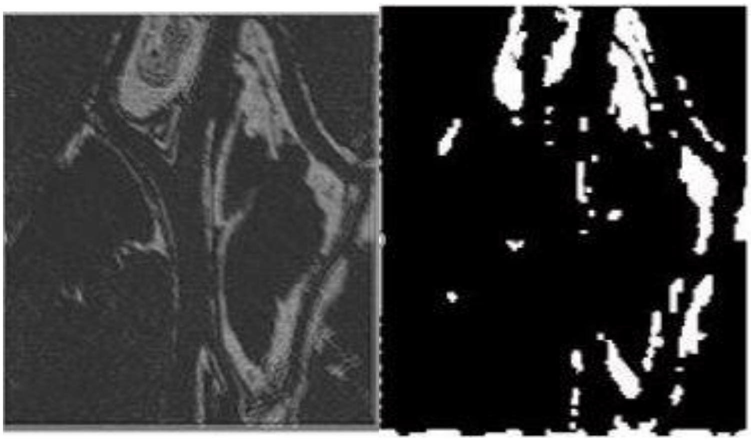

(a) **(b)**

Fig .3. a) Fused image b) Segmented image

The fusion process using SWT is implemented by using discrete cosine transform (DCT) from and the resulting fused images is shown in fig 3. (a). After fusion image is segmented by using fuzzy c- means clustering which is shown in fig 3. (b). The Segmented image is compared with the ground truth image and the performance of SWT_FCM is measured in terms of accuracy, sensitivity, precision and False Detection Rate (FDR).

Measure	**SWT_FCM**
accuracy	0.9746
sensitivity	0.8887
specificity	0.9761
precision	0.0511
FPR	0.0123
FNR	0.1012
FDR	0.9271
NPV	0.9758
MCC	0.2502
F1-score	0.1012

Table 1: Performance analysis of the SWT_FCM

4. Conclusion

In this paper change detection in SAR images has been implemented through image fusion based SWT and FCM clustering. DCT has been employed for fusion of two SAR images to extract the spatial information and spectral information from the two remote sensing images. Clustering has been performed based on soft fuzzy FCM clustering technique. The segmented image is compared with the ground truth image to compare the performance of SWT_FCM. The implemented method is given good accuracy and small FDR.

References

[1] X. Zhang, Y. Zheng, J. Feng and S. Gou, "SAR image change detection based on low rank matrix decomposition," IEEE International Geoscience and Remote Sensing Symposium, Munich, pp. 6271-6274, 2012.

[2] Fei GAO, Aidong LIU, Kai LIU, Erfu YANG, Amir HUSSAIN, "A novel visual attention method for target detection from SAR images", Chinese Journal of Aeronautics, In press, corrected proof, Available online 25 April 2019.

[3] Devi Devapal, N. Hashna, V. P. Aparna, C. Bhavyasree, K. Sangeetha Soman, "Object Detection from SAR Images based on Curvelet Despeckling", Materials Today: Proceedings, vol.11, Part 3, pp.1102-1116, 2019.

[4] Y. Zhang, C. Wang, S. Wang, H. Zhang and M. Liu, "Sar image change detection method based on visual attention," 2017 IEEE International Geoscience and Remote Sensing Symposium (IGARSS), Fort Worth, TX, pp. 3078-3081, 2017.

[5] J. Lin, Y. Huang, J. Pei, H. Yang and J. Yang, "A multi-pass coherent change detection method for SAR images in weak change circumstance," CIE International Conference on Radar (RADAR), Guangzhou, pp. 1-5, 2016.

[6] Liqin Zhu, Peng Zhang, Dongmei Li, Xiuquan Zhu, Chao Wang, "A novel change detection method based on high-resolution SAR images for river course", Optik, vol.126, no. 23, pp. 3659-3668, December 2015.

[7] H. Agha babaee, J. Amini, Y. C. Tzeng, “Improving change detection methods of SAR images using fractals”, Scientia Iranica, vol. 20, no. 1, pp. 15-22, February 2013.

[8] Thu Trang Lê, Abdourrahmane M. Atto, Emmanuel Trouvé, AkhmadSolikhin, Virginie Pinel, “Change detection matrix for multitemporal filtering and change analysis of SAR and PolSAR image time series”, ISPRS Journal of Photogrammetry and Remote Sensing, vol. 107, pp. 64-76, September 2015.

[9] Ronghua Shang, Liping Qi, Licheng Jiao, Rustam Stolkin, Yangyang Li, “Change detection in SAR images by artificial immune multi-objective clustering”, Engineering Applications of Artificial Intelligence, vol. 31, pp. 53-67, May 2014.

[10] Yu Li, Sandro Martinis, Simon Plank, Ralf Ludwig, "An automatic change detection approach for rapid flood mapping in Sentinel-1 SAR data", International Journal of Applied Earth Observation and Geoinformation, vol. 73, pp. 123-135, December 2018.

[11] Maoguo Gong, Yu Li, Licheng Jiao, Meng Jia, LinzhiSu, "SAR change detection based on intensity and texture changes", ISPRS Journal of Photogrammetry and Remote Sensing, vol. 93, pp. 123-135, July 2014.

[12] Thrisul Kumar Jakka, Y. Mallikarjuna Reddy , B. Prabhakara Rao "GWDWT-FCM: Change Detection in SAR Images Using Adaptive Discrete Wavelet Transform with Fuzzy C-Mean Clustering" Journal of the Indian Society of Remote Sensing (March 2019) 47(3):379–390.

[13] J. Thrisul Kumar, Y. Mallikarjuna Reddy, B. Prabhakara Rao "Image Fusion of Remote Sensing Images using ADWT with ABC Optimization Algorithm", International Journal of Innovative Technology and Exploring Engineering (IJITEE) ISSN: 2278-3075, Volume-8 Issue-11, September 2019

[14] J. Thrisul Kumar, Y. Mallikarjuna Reddy, B. Prabhakara Rao "Change Detection in Sarimages Based on Artificial Bee Colony Optimization With fuzzy C - Means Clustering" International Journal

[15] J. Thrisul Kumar, Y. Mallikarjuna Reddy, B. Prabhakara Rao "WHDA-FCM: Wolf Hunting-Based Dragonfly With Fuzzy C-Mean Clustering For Change Detection In SAR Images" Section B: Computer and Communications Networks and Systems

[16] J. Thrisul Kumar, Y. Mallikarjuna Reddy, B. Prabhakara Rao "Change Detection in Sar images Based on Artificial Bee Colony Optimization with Fuzzy C - Means Clustering", International Journal of Recent Technology and Engineering (IJRTE), ISSN: 2277-3878, Vol -7 Issue-4, Nov 2018, pp- (156- 160)

[17] .J.Thrisul Kumar, N.Durgarao, E.T.Praveen, M.Kranthi Kumar " Modified Image Fusion TechniqueFor Dual-Tree Complex Wavelet Transform" International Journal Of Advanced Science And Technology , Vol. 29, No. 5s, (2020), pp. 895-901