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Monitoring of Qeshm Island Drainage Network Formic Patterns Using Fuzzy Segmentation of Processed Panchromatic Images (HR-PRS)

Heeva Elmizadeh ^{*1}, Hadi Mahdipour ²

1-Assistant Professor Department of Marine Geology, Khorramshahr Marine Science and Technology University

2-Chief Innovation Office, Sinenta Corp., La Cañada, 04120, Almeria, Spain

1-Introduction

The process of changes detection, landforms identifying and their distribution are the basic needments of geomorphology and natural resources. On the other hand, remote sensing technology is a useful tool for studying and monitoring terrestrial phenomena to produce useful and valuable data in the terms of spatial and temporal. Therefore, high spatial panchromatic remote sensing (HR-PRS) images are a useful and efficient tool for identifying and classifying landforms due to their high spatial and spectral resolution.

Restrictions such as cloud and shadow greatly affect the analysis and processing of satellite imagery, such as changes detection, classifying, and extracting accurate information from satellite imagery. Therefore, selecting the most appropriate segmentation algorithms to improve the identification and detection of landforms in these areas is of great challenge. Considering the parameters such as radiometric accuracy, atmospheric conditions, spectral, spatial, thematic, and temporal resolution, the selection and development of these algorithms provide a powerful technology for extracting information and preparing thematic maps. Providing better landforms and environmental change trends by comparing temporal images. In this regard, fuzzy clustering algorithms are one of the methods that have acceptable performance in the segmentation of HR-PRS images. The aim of this study is fuzzy segmentation using GeoEye-1 satellite imagery where proposed clustering and fusion algorithms, and the effectiveness of these techniques in anomaly detection, landforms and automatic formic patterns recognition are examined in the study area. Therefore, in this paper, a study of fuzzy zoning techniques of high spatial resolution (HR-PRS) images in order to better and more accurately detect geomorphic features in areas with obstacles of interpretation and analysis, including Cloud and shadow cover can be useful for planning, management and future sustainable development of areas.

* Corresponding Author; E-mail: elmizadeh@kmsu.ac.ir

2-Methodology

In this paper, fuzzy segmentation process and clustering algorithms are used with the aim of anomaly detecting and automatic morphic pattern recognition. For image segmentation, in addition to radiometric features, the spatial information of HR-PRS panchromatic images extracted by tissue features is also used. In addition, fuzzy clustering numbers and methods are used to improve the accuracy of study area segmentation. The study area in this study is located on Qeshm Island. In this regard, the panchromatic images of HR-PRS GeoEye-1 sensor have been used. In this regard, after radiometric and geometric preprocessing, based on fuzzy features, the input images were integrated in MATLAB software and then using FWS, MSA, IDF and CFM algorithms, segmentation was performed. In these methods, fuzzy clustering is performed several times for different numbers of clusters (from c_{min} to c_{max}) and the clustering output is evaluated and the best number of regions (\hat{c}) is selected. Also, in the processing stage, in order to reach a certain number of clusters, the image is clustered so that after defuzzification is applied on it, fuzzy segmentation is performed. Finally, the studied fuzzy clustering algorithms with fuzzy parameters are applied to the input HR-PRS images and the results are discussed.

3-Results and Discussion

In order to compare and analyze the performance of fuzzy clustering in the segmentation process, FWS, MSA, IDF and CFM algorithms were applied and processed on HR-PRS panchromatic images of the study area. The results of fuzzy segmentation and comparison of the proposed methods in the study area (Figure 4) show that the Interval-valued Data Fuzzy c-means (IDF) method has a better performance for fuzzy segmentation than other methods. The IDF method, in which the ambiguity in the HR-PRS images in the segmentation area is taken into account, has the best performance in general to find the optimal number of clusters and centers of clusters and to detect features. This algorithm also adjusts the detection capability and provides higher accuracy and detects the main boundaries well and removes the extra boundaries. The results also show that the Fuzzy Watershed Segmentation (FWS) method in the field of spatial features detection and river detection, which is a spatial criterion, has shown good performance in fuzzy clustering and in pixel fuzzy clustering. HR-PRS images examined image boundaries are well separated. However, due to its high sensitivity to noise, the FWS method faces the problem of creating additional boundaries. As a result, it has not well identified the main boundaries in the shadow and cloud cover area.

4-Conclusions

The results of applying the studied fuzzy segmentation algorithms on the study area show the use of local and global spatial relationships of pixels for fuzzy clustering of HR-PRS images and also the use of textural, structural and spectral features for segmentation and object recognition in panchromatic images have a high ability to detect geomorphic features. These results also indicate the effectiveness of fuzzy clustering algorithms for segmentation multispectral remote sensing images and confirm the efficiency of the proposed segmentation methods in terms of detecting spatial features and phenomena and accurate extraction of information from images.

Keywords: Panchromatic Image (HR-PRS), GeoEye-1 Sensor, Fuzzy Clustering Algorithms, Qeshm Island.

5- References

- Bayram. B., Demir. N., Akpınar. B., Oy. S., Erdem. F., Vögtle. T., Seker. D. Z. (2018). Effect of Different Segmentation Methods Using Optical Satellite Imagery to Estimate Fuzzy Clustering Parameters for SENTINEL-1A SAR Images, International archives of the photogrammetry, *remote sensing and spatial information sciences*, Vol.XLII-1, pp.39-43
- Chouhan, S. S., Kaul, A., & Singh, U. P. (2018). Image Segmentation Using Computational Intelligence Techniques: Review. *Archives of Computational Methods in Engineering*, 26(3), 533–596.
- Fan, J., & Wang, J. (2018). A Two-Phase Fuzzy Clustering Algorithm Based on Neurodynamic Optimization with Its Application for PolSAR Image Segmentation. *IEEE Transactions on Fuzzy Systems*, 26(1), 72–83.
- Fang, W., Liang-shu, W., Jun-jie, H., Gui-ling, L., & Xi-ping, J. (2017). Optimized fuzzy C-means clustering algorithm for the interpretation of the near-infrared spectra of rocks. *Spectroscopy Letters*, 50(5), 270–274.
- Trabelsi, M., & Frigui, H. (2019). Robust fuzzy clustering for multiple instance regression. *Pattern Recognition*, 90, 424–435.
- Wan, Y., Zhong, Y., & Ma, A. (2019). Fully Automatic Spectral–Spatial Fuzzy Clustering Using an Adaptive Multiobjective Memetic Algorithm for Multispectral Imagery. *IEEE Transactions on Geoscience and Remote Sensing*, 57(4), 2324–2340.
- Xu, Y., Chen, R., Li, Y., Zhang, P., Yang, J., Zhao, X., ... Wu, D. (2019). Multispectral Image Segmentation Based on a Fuzzy Clustering Algorithm Combined with Tsallis Entropy and a Gaussian Mixture Model. *Remote Sensing*, 11(23), 2772.
- Yu, C., Wang, L., Zhao, J., Hao, L., & Shen, Y. (2020). Remote sensing image classification based on RBF neural network based on fuzzy C-means clustering algorithm. *Journal of Intelligent & Fuzzy Systems*, 38(4), 3567–3574.

Zheng, Z.; Cao, J.; Lv, Z.; Benediktsson, J.A. (2019). Spatial–Spectral Feature Fusion Coupled with Multi-Scale Segmentation Voting Decision for Detecting Land Cover Change with VHR Remote Sensing Images. *Remote Sensing*, 11(16), 2-22.