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Image Processing Techniques for Remote Sensing Applications

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Abstract— *The government of India has been launching many satellites for last few years intended for different purposes. The data sent by satellites are captured, processed and analyzed by National remote sensing centre (NRSC) located at various places. The satellite data is huge and carry enormous information. This information is related to land description, crop assessment, cultivation monitoring, weather forecasting, regional description, underwater analysis, sea water interpretation and so on. The images, particularly sent by satellites suffer with noise signals contributed by several factors such as atmospheric disturbance, addition of unwanted rays, radiometric noise, speckle etc. If the signal quality is not good then the analysis and subsequent applications would not have appropriate impact to the concerned areas of implementation. Therefore, image de-noising becomes essential technique for improving the image quality that could greatly help in further processing of the remotely sensed data. There are many other image processing techniques, which are required for better interpretation for getting useful information. This paper presents a set of image processing tools that could be used in remote sensing applications with basic principles.*

Keywords— *Image processing, remote sensing, de-noising, segmentation, analysis etc.*

1. INTRODUCTION

One of the most emerging areas of digital image processing is in the field of remote sensing applications [1, 2]. Recently, Indian Space Research Organization (ISRO) launched 104 satellites together wherein, 04 satellites were indigenously designed. The point to be noted is that the number of satellites launched for different purposes are increasing with advancement of time and therefore huge amount of data is being captured and analysed by remote sensing centres. So, the application of digital image processing and appropriate set of tools becomes pertinent with regard to better visualization and information retrieval from the remotely sensed data or images. There are research contributions in the field of digital image de-noising and segmentation techniques for acoustical, ultrasound, medical images; and few research papers have also attempted for remote sensing applications [3-12].

The main aim of using image processing tools for analysis of remotely sensed images is to better extraction of information and noise removal. When CHANDRAYAAN sent the image of moon then researchers started their research works on the data. Now, number of satellites has been increased that have been moving around for different purposes. There are many examples where remotely sensed images play very important role such as: Impact study of soil moisture content and guiding the farmers; Predicting retail earnings and market share by counting cars in parking lot; Searching for aircrafts and saving lives after fatal crashes; Doing the detective work for fraudulent crop insurance claims; Detecting oil spills for marine life and environmental preservation; and Identifying forest stands and tallying their area to estimate forest supplies etc.

With basic research contribution in the field of image processing and image de-noising in particular inspired to take up task of improved analysis of agriculture, forest and other lands using remotely sensed data. Research contributions have been made in this direction but robust and efficient analysis and description of the images remain major challenges [1, 2].

2. RELATED RESEARCH

Remotely sensed images carry huge amount of information. If the quality of the images are not good or the analysis of images does not use optimum set of features then the impact of study based the images would be adversely affected. So, the image processing tools especially image enhancement has been extensively studied and few important contributions at international level have been highlighted here with their findings and limitations.

Ho et al. (2013) presented an alternative effective sonar image enhancement algorithm which was composed of two steps, including noise reduction and image sharpening. The sonar image is de-noised using Wiener, median filters and enhanced using un-sharp masking and histogram equalization. The method was tested on many sonar images of different underwater structures. The results were better in terms of noise reduction, and sharpening sonar images in comparison with existing

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research works [3]. Kojima et al. (2016) concerned with the image enhancement technique for the mixed illumination variant images by applying the stochastic resonance (SR) using the auto-tuning process. The method aimed at working on the images with the mixture of darkness and brightness. The previous work was faster but this work is effective and worthy also [4]. Shen et al. (2010) discussed that the performance of remote sensing images in some applications is often affected by the existence of noise, blurring, stripes and corrupted pixels, as well as the hardware limits of the sensor with respect to spatial resolution. So, the method is used to improve the image quality by performing image de-noising, de-convolution, de-striping, in-painting, interpolation and super-resolution reconstruction. The results are presented to illustrate the effectiveness of the proposed method [5].

Fu et al. (2015) suggested an effective enhancement method for remote sensing images to improve the global contrast and the local details. The method uses an empirical approach by using the regularized-histogram equalization (HE) and the discrete cosine transform (DCT) to improve the image quality. It can generate enhanced remote sensing images with higher contrast and richer details without introducing saturation artifacts. Moreover, the proposed method has satisfactory computation time, suitable for enhancement of both remote sensing and ordinary images. However, this method does not consider the noise issue, which would become noticeable after enhancement process [6]. Hnatushenko et al. (2016) proposed a remote sensing image fusion method which combines the Independent Component Analysis (ICA) and optimization wavelet transform; and based on selection of multi-scale components obtained after the ICA of images. The information capacity of multispectral images is increased with the use of the method, the contrast and the number of gradations of brightness increase, the correlation decreases, which indicates the increase of the information entropy of the images [5]. Zhang (2014) discussed enhancing the spatial resolution of the multi-angle remote sensing images by the super-resolution reconstruction technique. Adaptive weighted super-resolution reconstruction is used to alleviate the limitations of the different resolutions. In imaging process, different angle images are degraded by different levels of blurring and noise [7].

Buddhiraju et al. (2006) presented an image processing tutor specifically for remote sensing applications and along with it a framework for a collection of tools to make it self-contained, catering to the needs of working professionals [9]. Somvanshi (2011) studied that forest plays an important role in amelioration of climate, soil and water conservation, biodiversity conservation, habitat for variety of fauna, tourism and recreation etc. And hence better management of forest it is essential to know the present status of forest in terms of its area, type of forest, growing stock and spatial distribution. Remote Sensing and Geographical Information System (GIS) technology provide essential tool for the required assessment and systematic observation on forest resource. In the Spatial filtering, sharpening filter gives the best result [10]. Kumar (2015) implemented enhancement to remote sensing Indian remote sensing satellite P6 Liss IV remotely sensed data like Near-Infrared band. Four filtering techniques were used for image enhancement based on spatial domain filters and frequency domain filters such as median filter, wiener filter, bilateral filter and Gaussian homomorphic filter and salt and pepper noise and Gaussian noise were considered. Gaussian homomorphic filtering technique is suitable for image enhancement of the Liss IV remotely sensed Near-Infrared band. It was found that a filtering strategy based on spatial domain tool and frequency domain tool allows the enhancement of near infrared band. An important task for the future is the development of smarter and more detailed enhancement schemes for remote sensing IRS P6 Liss IV near-infrared band list [11]. Lal et al. (2016) presented an enhanced dictionary-based sparse representation (EDSR) for multi-temporal image fusion. Multi-temporal remote satellite images acquired on the same geographical area at different acquisition dates are merged to obtain a fused image for further analysis. The method utilizes the regularization parameter adaptively and effectively and takes advantage of the adaptive regularization parameter and chooses the maximum absolute fused vectors for fusion. The proposed remote sensing image fusion technique can be applied to other remotely sensed images [12].

3. METHOD

This paper suggests Image processing techniques that could be used in analysis and better information extraction from remotely sensed images and data. The method includes following major steps.

Step 1— Acquisition and Pre-processing the data: Remotely sensed images are available as open source data. The images once acquired would be subjected to pre-processing so that images are ready to be used for further analysis and applications. There are different types of noises sources that corrupt the images that need to be removed. The flow diagram for implementing the method is shown in Fig. 1, where Image processing tools for Remote Sensing applications has been highlighted with all necessary steps.

Step 2— Development of Optimal and Fuzzy based Image De-noising Methods: This step includes developing novel and optimal image enhancement method for almost robust image processing tool for image de-noising. There are a number of methods available in literature on image enhancement methods and the biggest challenge among all is robustness. In [3], the most prominent author of

image processing has admitted that there is no general theory in image processing and image enhancement is in particular purely subjective matter. Therefore, an attempt would be made to:

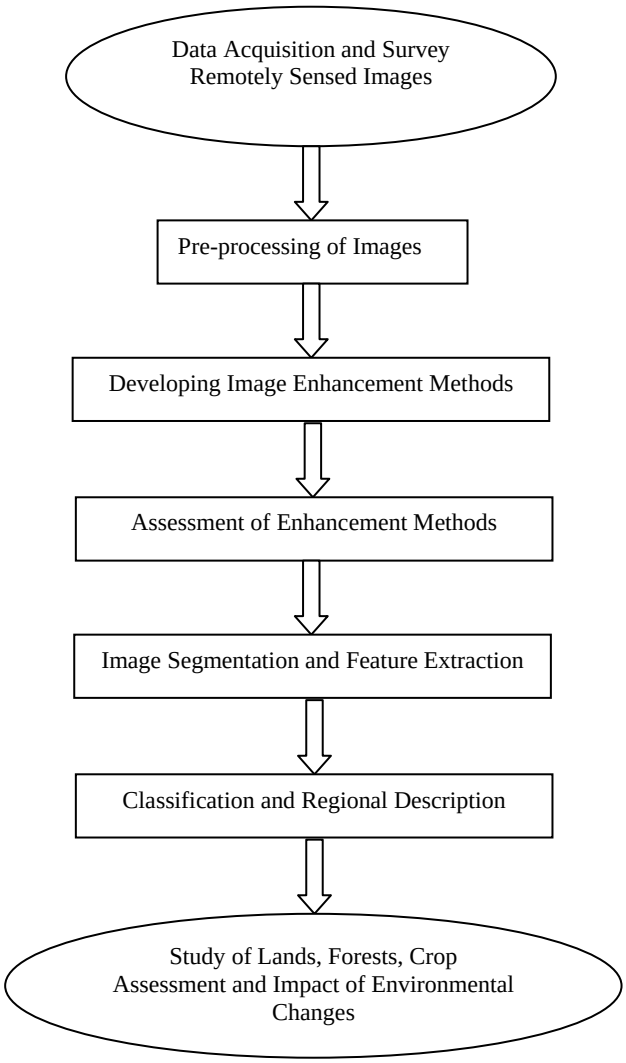

Fig. 1: Flow diagram

- Selecting optimum performance filter or enhancement method available in literature; and
- Optimizing the method using optimization tools and fuzzy based approach so as to maximize the performance measures.

Step 3— Performance Evaluation of Image Enhancement: The robustness will be evaluated in terms of suitable set of performance measures such as PSNR (peak signal to noise ratio), MSE (mean square error), CC (correlation coefficient) etc. The evaluation will also be optimized. There are other set of measures available such as CNR (contrast to noise ratio) and hence this process would also be considered seriously while selecting the appropriate set of perforate evaluation parameters. Extensive study of the papers will certainly help in devising some new parameter or metrics.

Step 4— Segmentation**:** The different regions of different parts of the country will be segmented for classification and description. Fuzzy c-means or similar method will be used so that the detailed information could be brought out from the digital images.

The information and the images are very much diverse in nature and therefore, few important segmentation methods will be tested and the one with optimal results will be chosen and recommended. The segmentation methods that would be tested are:

- Region based approaches;
- K-means method; and
- Watershed based method.

Finally, fuzzy based approaches such as application of fuzzy in k-means, fuzzy c-means will be experimented and the evaluation of segmentation results will be made using classification.

Step 5— Feature Extraction and Classification**:** A number of image features such as contrast and brightness values; shape and size; region based dimensions; textures etc. will be extracted and on the basis of these features, classification would be made among the different regions. The features will be of different types such as:

- Region based features;
- Area, shape and others; and
- Image based features such as contrast, brightness and intensity values.

Step 6— Study of agricultural, forest, weather, climate, earthquake impact in different regions.

Step 7— Study of habitats, plants and forests in different regions based on the classification of data.

4. CONCLUSIONS AND RECOMMENDATIONS

This paper has attempted to provide an exposure of how important is the image processing with regard to remote sensing applications. Though, practical results have not been included but a clear roadmap based on good study of related research activities in the relevant area, has been set aiming at viable implementation of the suggested steps so that better regional descriptions could help in devising and implementing socio-economic initiatives more vibrantly and in efficient manner. The future work aims at applying the suggested method to practical remotely sensed data of certain region.

REFERENCES

[1] G. R. Sinha and Bhagwati C. Patel, “Medical Image Processing: Concepts and Applications”, ISBN: 978-81-203-4902-5, Prentice Hall of India, 2014.

[2] G. R. Sinha and Sandeep Patil, "Biometrics: Concepts and Applications", Wiley India Publications, a subsidiary of John Wiley, March, 2013.

[3] Hoai-Nam Ho, Jong-Jae Lee, Chul Park and Byung-Wan Jo, "An efficient Image Enhancement algorithm for Sonar data", International Journal of Latest Research in Science and Technology, 02(2013) 38-43.

[4] Noriko Kojima, Bikash Lamsal and Naofumi Matsumoto, "A robust image enhancement system for illumination variant image based on auto-tuning stochastic resonance", Proceedings of the 4th IIAE International Conference on Intelligent Systems and Image Processing 2016, 199-206, DOI: 10.12792/icisip2016.036.

[5] Huanfeng Shen, Yaolin Liu, Tinghua Ai, Yi Wang and BoWu, "Universal reconstruction method for radiometric quality improvement of remote sensing images", International Journal of Applied Earth Observation and Geoinformation, 12 (2010) 278–286.

[6] Xueyang Fu, Jiye Wang, Delu Zeng, Yue Huang and Xinghao Ding, "Remote Sensing Image Enhancement Using Regularized-Histogram Equalization and DCT", IEEE Geoscince and Remote Sesning Letters, 12 (2015) 2301-2305.

[7] V.V. Hnatushenko, " Remote Sensing image fusion using ICA and Optimized Wavelet transform", The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, Volume XLI-B7, XXIII ISPRS Congress, 653-659, 12–19 July 2016, Prague, Czech Republic.

[8] Hongyan Zhang, Zeyu Yang, Liangpei Zhang and Huanfeng Shen, "Super-Resolution Reconstruction for Multi-Angle Remote Sensing Images Considering Resolution Differences", Remote Sens., 6 (2014) 637-657. doi: 10.3390/rs6010637.

[9] Krishna Mohan Buddhiraju, S. Karthik, Vijendra Nayak and G. Anu, "A multimedia tutor for digital Image Processing for remote sensing", International Archives of the Photogrammetry, Remote Sensing and Spatial Information Science, Volume XXXVI, Part 6, Tokyo Japan, 279-284, 2006.

[10] Shivangi Somvanshi, "Evaluation of Image Processing Techniques using Remote Sensing for Assessment of Forest", ESRI India User Conference, (2011) 01-06.

[11] Ganesh Kumar, "Image enhancement and performance evaluation using various filters for IRS-P6 Satellite Liss IV remotely sensed data", GEoFIZIKa, 32(2015) 179-189.

[12] Anisha M. Lal and S. Margret Anouncia, "Enhanced Dictionary based Sparse Representation Fusion for Multi-temporal Remote Sensing Images", European Journal of Remote Sensing, 49 (2016) 317-336.