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A Review Article NR Image Quality Assessment of Satellite Image Enhancement

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Abstract- **Satellite image enhancement is the technique which is most widely required in the field of satellite image processing to improve the visualization of the features. Satellite images are captured from a very long distance, so they contain too much noise and distortion because of atmospheric barriers. After capturing the image, some radiometric and geometric corrections are carried out on it but they are not sufficient for all the applications. It is very important to enhance the restored image before using it. In this paper, different methods for satellite image enhancement viz. contrast enhancement, resolution enhancement, edge enhancement, density slicing, digital mosaics and synthetic stereo images are discussed in detail, as well as experimental results of two techniques viz. contrast enhancement of multispectral color composite and IHS (Intensity, Hue, Saturation) transformation are shown.**

Keywords- **Remote Sensing, Satellite Images, Satellite Image processing.**

I. INTRODUCTION

Images of different locations in earth taken by artificial satellite are called Satellite Images. Satellite Image Processing is important as they provide information about the surface. If effective processing is done the images are widely used to inform and monitor the physical conditions, Infrastructure and detection of any animals etc. [1].

Satellite Images is a type of remote sensing which is utilized to collect coherent information about earth surface. These images play and vital role in many fields like astronomy, remote sensing, GPS, Disaster management etc. These images are very complex and inculcate processing criteria is required in analysis of the images. Researchers are developing techniques to use the satellite image data and making the processing easy and timely. One of the important techniques in satellite image processing is image enhancement [2].

Image enhancement is used to make the visual perception in the image clear and easily understandable. This method emphasis on different features of image such as edges boundaries or patterns. This is important for perceiving the details in the image.

In this paper we have proposed an improved contrast enhancement technique which will improvise on the contrast of the image to certain limits by saturating 1% of the upper and lower pixel values. This process produces better quality images as compared to the conventional contrast enhancement technique and the ground truth of the original image.

II. IMAGE ENHANCEMENT

Image enhancement is the improvement of satellite image quality without knowledge about the source of degradation. If the source of degradation is known, one calls the process image restoration previously. Both are iconical processes, viz., input and output is images. Many different, often elementary and heuristic methods are used to improve images in some sense. Image restoration removes or minimizes some known degradations in an image.

In many image processing applications, geometrical transformations facilitate processing. Examples are image restoration, where one frequently wants to model the degradation process as space-invariant, or the calibration of a measurement device, or a correction in order to remove a relative movement between object and sensor [3, 4, and 5].

III. LITERATURE REVIEW

Hatem Magdy Keshk; M. Moustafa Abdel-Aziem; Ashraf S. Ali; M. A. Assal, “Performance evaluation of quality measurement for super-resolution satellite images” Super resolution (SR) image reconstruction refers to a process of generating a high resolution image from several low resolution images.

There is a high demand for highresolution satellite sensing in modern applications. SR offers an affordable solution for this high demand. The accuracy of super resolution depends on the accuracy of determining the difference between the low-resolution images. The widespread use of superresolution methods, in a variety of applications such as remote sensing has led to an increasing need for or quality assessment measures. Assessment for image quality traditionally needs its original image as a reference. The traditional method for assessment like Peak Signal to Noise Ratio (PSNR) or Mean Square Error (MSE) difficult when there is no reference.

This paper is focused on No-Reference (NR) quality measures for SR images using blur and sharpness (CPBD, LPC-SI). A non-reference objective measure is proposed, which aims to evaluate the quality of the super-resolution satellite images that are constructed without the need for a full reference condition and the result will be reliable.

This article presents an overview assessment of SR techniques and measuring the quality of the image. We illustrate shift estimation which is the first and the most critical step in super resolution process. Then several super resolution reconstruction techniques have been discussed and compared. Satellite images (SPOT-5) and other Remote Sensing (RS) data are used in the experiment. The images have sub pixel shifts 0.5 in the horizontal and vertical directions respectively.

Oscar A. Agudelo-Medina, Hernan Dario Benitez-Restrepo, Gemine Vivone and Alan Bovik, " Perceptual Quality Assessment of Pan-Sharpened Images" Pan-sharpening (PS) is a method of fusing the spatial details of a high-resolution panchromatic (PAN) image with the spectral information of a low-resolution multi-spectral (MS) image. Visual inspection is a crucial step in the evaluation of fused products whose subjectivity renders the assessment of pansharpened data a challenging problem. Most previous research on the development of PS algorithms has only superficially addressed the issue of qualitative evaluation, generally by depicting visual representations of the fused images. Hence, it is highly desirable to be able to predict pan-sharpened image quality automatically and accurately, as it would be perceived and reported by human viewers.

Such a method is indispensable for the correct evaluation of PS techniques that produce images for visual applications such as Google Earth and Microsoft Bing. Here, we propose a new image quality assessment (IQA) measure that supports the visual qualitative analysis of pansharpened outcomes by using the statistics of natural images, commonly referred to as natural scene statistics (NSS), to extract statistical regularities from PS images.

Importantly, NSS are measurably modified by the presence of distortions. We analyze six PS methods in the presence of two common distortions, blur and white noise, on PAN images. Furthermore, we conducted a human study on the subjective quality of pristine and degraded PS images and created a completely blind (opinion-unaware) fused image quality analyzer. In addition, we propose an opinion-aware fused image quality analyzer, whose predictions with respect to human perceptual evaluations of pansharpened images are highly correlated.

Damon M. Chandler, "Seven Challenges in Image Quality Assessment: Past, Present, and Future Research" Image quality assessment (IQA) has been a topic of intense research over the last several decades. With each year come an increasing number of new IQA algorithms, extensions of existing IQA algorithms, and applications of IQA to other disciplines. In this article, I first provide an up-to-date review of research in IQA, and then I highlight several open challenges in this field.

The first half of this article provides discuss key properties of visual perception, image quality databases, existing full-reference, no-reference, and reduced-reference IQA algorithms. Yet, despite the remarkable progress that has been made in IQA, many fundamental challenges remain largely unsolved.

The second half of this article highlights some of these challenges. I specifically discuss challenges related to lack of complete perceptual models for: natural images, compound and suprathreshold distortions, and multiple distortions, and the interactive effects of these distortions on the images. I also discuss challenges related to IQA of images containing nontraditional, and I discuss challenges related to the computational efficiency. The goal of this article is not only to help practitioners and researchers keep abreast of the recent advances in IQA, but to also raise awareness of the key limitations of current IQA knowledge.

KeGu; Dacheng Tao; Jun-FeiQiao; Weisi Lin, "Learning a No-Reference Quality Assessment Model of Enhanced Images with Big Data" In this paper, we investigate into the problem of image quality assessment (IQA) and enhancement via machine learning. This issue has long attracted a wide range of attention in computational intelligence and image processing communities, since, for many practical applications, e.g., object detection and recognition, raw images are usually needed to be appropriately enhanced to raise the visual quality (e.g., visibility and contrast).

In fact, proper enhancement can noticeably improve the quality of input images, even better than originally captured images, which are generally thought to be of the best quality. In this paper, we present two most important contributions. The first contribution is to develop a new no-reference (NR) IQA model. Given an image, our quality measure first extracts 17 features through analysis of contrast, sharpness, brightness and more, and then yields a measure of visual quality using a regression module, which is learned with big-data training samples that are much bigger than the size of relevant image data

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sets. The results of experiments on nine data sets validate the superiority and efficiency of our blind metric compared with typical state-of-the-art full-reference, reduced-reference and NA IQA methods. The second contribution is that a robust image enhancement framework is established based on quality optimization. For an input image, by the guidance of the proposed NR-IQA measure, we conduct histogram modification to successively rectify image brightness and contrast to a proper level. Thorough tests demonstrate that our framework can well enhance natural images, low-contrast images, low-light images, and dehazed images.

Anish Mittal, Anush Krishna Moorthy, Alan Conrad Bovik, "No-Reference Image Quality Assessment in the Spatial Domain" We propose a natural scene statistic-based distortion-generic blind/no-reference (NR) image quality assessment (IQA) model that operates in the spatial domain. The new model, dubbed blind/referenceless image spatial quality evaluator (BRISQUE) does not compute distortion-specific features, such as ringing, blur, or blocking, but instead uses scene statistics of locally normalized luminance coefficients to quantify possible losses of "naturalness" in the image due to the presence of distortions, thereby leading to a holistic measure of quality.

The underlying features used derive from the empirical distribution of locally normalized luminances and products of locally normalized luminances under a spatial natural scene statistic model. No transformation to another coordinate frame (DCT, wavelet, etc.) is required, distinguishing it from prior NR IQA approaches. Despite its simplicity, we are able to show that BRISQUE is statistically better than the full-reference peak signal-to-noise ratio and the structural similarity index, and is highly competitive with respect to all present-day distortion-generic NR IQA algorithms.

BRISQUE has very low computational complexity, making it well suited for real time applications. BRISQUE features may be used for distortion-identification as well. To illustrate a new practical application of BRISQUE, we describe how a nonblind image denoising algorithm can be augmented with BRISQUE in order to perform blind image denoising. Results show that BRISQUE augmentation leads to performance improvements over state-of-the-art methods.

J. Whittle, Swansea University, UK,M. W. Jones, "A deep learning approach to no-reference image quality assessment for Monte Carlo rendered images" In Full-Reference Image Quality Assessment (FR-IQA) images are compared with ground truth images that are known to be of high visual quality. These metrics are utilized in order to rank algorithms under test on their image quality performance. Throughout the progress of Monte Carlo rendering processes we often wish to determine whether images being rendered are of sufficient visual quality, without the availability of a ground truth image. In such cases FR-IQA metrics are not applicable and we instead must utilise No-Reference Image Quality Assessment (NR-IQA) measures to make predictions about the perceived quality of unconverged images. In this work we propose a deep learning approach to NR-IQA, trained specifically on noise from Monte Carlo rendering processes, which significantly outperforms existing NR-IQA methods and can produce quality predictions consistent with FR-IQA measures that have access to ground truth images.

Francesco Checchi, Barclay T Stewart, Jennifer J Palmer & Chris Grundy, "Validity and feasibility of a satellite imagery-based method for rapid estimation of displaced populations" Estimating the size of forcibly displaced populations is key to documenting their plight and allocating sufficient resources to their assistance, but is often not done, particularly during the acute phase of displacement, due to methodological challenges and inaccessibility. In this study, we explored the potential use of very high resolution satellite imagery to remotely estimate forcibly displaced populations.

Anil B. Gavade, Vijay Rajpurohit, "Systematic analysis of satellite image-based land cover classification techniques: literature review and challenges" As the land cover is a basic and important factor, affecting and connecting various parts of the human and physical environment, the classification of land cover plays a major role in the recent research. Hence, accurate and effective techniques are required for the classification to provide meaningful information regarding climate change, bio-diversity variation, and so on.

Remote Sensed (RS) data obtained from the remote sensors are capable of providing easily accessible data that is used in different earth observation applications. Satellite image-based land cover classification is one of the interesting research areas. In this paper, 50 research papers that are based on the land cover classification using satellite images are surveyed. The research papers are categorized based on different classification techniques, such as fuzzy, Support Vector Machine (SVM), Neural Network (NN), Bayesian model, Decision Tree (DT) and so on. Finally, review and analysis are done based on the datasets, the number of bands considered, evaluation metrics, simulation platform, sensors, and the performance attained. Furthermore, the review suggests some major future scope to the researches based on the challenges and the research gaps in the reviewed papers.

Dipl.-Geol. Eike – Marie Nolte aus Hildesheim, "The application of optical satellite imagery and census data for urban population estimation: A case study for Ahmedabad, India" In the last decades of the 20th century, the rapid growth of the world population has led to dynamic and complex urbanization. By 2050, it is predicted that 6 billion people – by then about 70% of the world population – will reside in urban areas (UN, 2008). However, this urban growth is geographically disproportionate. The rapid and often unplanned growth of urban areas in lesser developed and newly industrialized countries, with annual growth rates between 3% and 4%, directly contrasts the stagnating urban growth within industrialized countries. India is a useful example of a nation where the phenomenon of urbanization is rapid, spatially varied, and exceptionally dynamic.

By 2050, India"s population is expected to overrun China"s population (1, 4 billion) with a total population of 1,6 billion and an urban population of 0,9 billion (UN, 2008). The considerably high annual urban growth rates are expected to remain constant within the coming decades. As a consequence, many cities (today already more than 43 cities in India have more than 1 million inhabitants) will become megacities in the near future. One example for the dynamic and uncontrolled development of urban areas is the city of Ahmedabad in northwest India. India has an exceptional census history.

Since 1872, the population is enumerated every ten years by the official Indian Census Bureau. Thus, the availability of population data for Indian cities is restricted to these decennial Census data. But as most Indian cities face a dynamic population growth, a population count on a decennial basis is not sufficient to display the population development. To estimate the intercensal population for these dynamic cities, modern technology such as satellite imagery plays an important role as it provides information for large areas and can be used for identifying and classifying for example land cover like urban extent. In addition to the large area coverage with a spatial resolution depending on the imaging technology used, observations are feasible repeatedly, depending on the revisit time of the satellite, so that changes of land cover can be monitored.

In this thesis, the question of how the population in large cities can be spatially modelled is addressed. A methodology is developed to spatially model the population of the Ahmedabad Municipal Cooperation (AMC) area using satellite images and census data. The developed method allows for modeling its spatial distribution for different times of day on city, district and building level.

The developed models enable the generation of population data with different spatial resolutions and different information detail at each level, with the amount of required input data increasing with the information detail and resolution of the resulting population data. This way, the developed methodology allows for generating population information for large cities without depending on detailed survey information. At all spatial levels, the population estimation models incorporate GIS-based data and therefore an administrative map for the AMC area is essential, for example for mapping the population distribution on city and district level and for spatially analyzing the statistical data. Therefore, a methodology was developed for generating an administrative map using Google Earth images and an analog paper map. The resulting map yield an accuracy of 93, 49%. At city level (tier 1), three models were developed to estimate the population within the AMC area and within the urban extent of the AMC area.

The extent of the urban areas was extracted from moderate optical satellite images (Landsat 5 TM) and very high resolution optical satellite images (Quickbird). The city population for 2008 was projected to be 3.152.108 people, with a population density of 23.091 people/km2 in the AMC area (model I). For the urban population (model II), the population density was estimated 56.791 people/km2 for the Quickbird image and 34.446 people/km2 for the Landsat image. The density difference is due to the fact that the urban extent extracted from Landsat is larger than the urban extent extracted from Quickbird because of mixed pixels. Model III allows for population estimation and for modelling the spatial distribution of the population for different times of day.

In this study, two occupancy–based approaches were tested: A binary approach which distinguishes only residential and nonresidential occupancy (Coburn & Spence, 2002) and an approach provided by HAZUS using 4 different occupancy categories (FEMA, 2008). Tier 2 operates on district level and provides 3 different models to estimate and model the population. The first model (model IV) provides the district population as an aggregated value for the administrative boundary. The second model (model V) calculates the population in the urban areas within each district.

The results from model IV and V revealed that the district population varies considerably in the AMC area. The districts with the highest population are located in the south-eastern periphery of the AMC area. However, the districts with the highest population density are located in the central part of the AMC area due to the much smaller administrative area. This shows that the assumption of a constant population density which proved to be valid on city level cannot be readily transferred to district level.

At tier 3 – building level, two models were developed to estimate the population and model the population distribution within the districts. Model VII estimates the population on building block level, the second model VIII operates on single building level. Because of limited data availability, only the building block model was tested for the city of Ahmedabad. This dissertation thesis addresses the question how optical satellite imagery and census data can be used to develop a tiered modelling method for urban population of large cities. The developed methodology is summarised in the final chapter, where the achievements as well as scope for improving the currently proposed methodology is described.

Juan Manuel Núñez, Sandra Medina, Gerardo Ávila and Jorge Montejano,"High-Resolution Satellite Imagery Classification for Urban Form Detection"Mapping urban form at regional and local scales is a crucial task for discerning the influence of urban expansion upon the ecosystem and the surrounding environment. Remotely sensed imagery is ideally used to monitor and detect urban areas that occur frequently as a consequence of incessant urbanization.

It is a lengthy process to convert satellite imagery into urban form map using the existing methods of manual interpretation and parametric image classification digitally. In this work, classification techniques of high-resolution satellite imagery were used to map 50 selected cities of study of the National Urban System in Mexico, during 2015–2016. In order to process the information, 140 RapidEye Ortho Tile multispectral satellite imageries with a pixel size of 5 m were downloaded, divided into 5 × 5 km tiles and then 639 tiles were generated.

In each (imagery or tile), classification methods were tested, such as: artificial neural networks (RNA), support vector machines (MSV), decision trees (AD), and maximum likelihood (MV); after tests, urban and nonurban categories were obtained. The result is validated with an accuracy method that follows a stratified random sampling of 16 points for each tile. It is expected that these results can be used in the construction of spatial metrics that explain the differences in the Mexican urban areas.

P.Lakshmi Devi 1,*, S.Varadarajan 2, "Segmentation of Satellite Images for Damage Assessment::Natural Calamity Images Perspective" Image processing has been proved to be an effective tool for analysis in various fields and applications in engineering. Among the segmentation methods, image thresholding technique is one of the most well-known methods due to its simplicity, robustness, and high precision.

The primary objective of image processing is to optimize visualization of particular thematic data set. The type of image processing method and strategy is broadly influenced by the application and its objectives.

Use of satellite imagery has become an integral aspect in planning of multiple domains which include disaster management and analysis of natural calamity images. In this paper an attempt is made to develop an efficient segmentation method for satellite images of natural calamity images for damage assessment using a hybrid algorithm EGA & E-BFOA and proved to be an efficient to evaluate index parameters for damage assessment. Disaster management is one such area where the changes brought in by the disaster has to be assessed for effective rescue and rehabilitation.

IV. CONCLUSION

This article summarizes the review of Satellite image enhancement methods. Nonfusion-based enhancement method provides low spatial information with higher computational complexity. In order to improve the spatial information and reduce the computational complexity, fusion-based method is preferred.

Fusion-based enhancement results in high spectral distortion, low spatial resolution, reduced contrast and sharpness. Therefore, it is necessary to have a fusion technique to enhance the Satellite images for better visualization and classification accuracy.

This survey paper gives idea and analyses the performance of various and different resolution enhancement techniques. Resolution enhancements schemes are not based on wavelets have the drawback of losing the high frequency contents which resulting in blurring. Also, CWT technique is almost shift invariant and results in better performance. In future, Multi Wavelet Transform can be used to produce fewer artefacts when compared to other techniques for hyper spectral satellite images. Also enhance performance of a satellite image in terms of MSE and PSNR.

REFERENCES

[1] P. Suganya, N. Mohanapriya, B. Kalaavathi, "Satellite image resolution enhancement using multi wavelet transform and comparison of interpolation techniques", International Journal of Research in Engineering and Technology, eISSN: 2319-1163 | pISSN: 2321-7308, Volume: 03 Special Issue: 07 | May-2014.

[2] Vaibhav R. Pandit, R. J. Bhiwani, "Image Fusion in Remote Sensing Applications: A Review", International Journal of Computer Applications (0975 – 8887) Volume 120 – No.10, June 2015.

[3] Arya P Unni, "Satellite Image Enhancement Using 2D Level DWT", International Journal of Engineering Research & Technology (IJERT), ISSN: 2278-0181, Vol. 3 Issue 3, March 2014.

[4] Dontabhaktuni Jayakumar, D. Padmashri, D. Arunakumari, "Satellite Image Fusion in Various Domains", International Journal of Advanced Engineering, Management and Science (IJAEMS), Vol1, Issue-3, ISSN: 2454-1311, June- 2015.

[5] Yong Yang1, Shuying Huang2, Junfeng Gao3, Zhongsheng Qian, "Multi-focus Image Fusion Using an Effective Discrete Wavelet Transform Based Algorithm", measurement science review, volume 14, no. 2, 2014.

[6] Pavithra C , Dr. S. Bhargavi, "Fusion of two images based on wavelet transform", International Journal of Innovative Research in Science, Engineering and Technology, Vol. 2, Issue 5, May 2013.
[7] Wenkao Yang, Jing Wang and Jing Guo, "A Novel Algorithm for Satellite Images Fusion Based on Compressed Sensing and PCA", Hindawi Publishing Corporation, Mathematical Problems in Engineering, pp. 1 – 10, Volume 2013.
[8] Lasmika, K. Raveendra, "Improving Quality of Satellite Image by Wavelet Transforming & Morphological Filtering", International Journal of Innovative Research in Science, Engineering and Technology, ISSN: 2319- 8753,Vol. 3, Issue 7, July 2014.
[9] Vinay Sahu, Dinesh Sahu, "Image Fusion using Wavelet Transform: A Review", Global Journal of Computer Science and Technology: FGraphics& Vision, Volume 14 Issue 5 Version 1.0 Year 2014.
[10] R.Swaminathan, Dr.ManojWadhwa, "Satellite Image enhancement using Combination of Transform Techniques and Interpolation Methods", International Journal Of Engineering And Computer Science ISSN:2319-7242 Volume 3 Issue 4 April, 2014.