A Survey Report on Normalized Difference Vegetation Index (NDVI) Processing of Satellite Images

Sayali Dnyaneshwar Nikam[1] Prof. Umakant Mandawkar[2]
[1,2]School of Computer Science & Engineering Sandip University, Maharashtra, India

Abstract— An improved method for the analysis of the satellite image based on normalized difference vegetation index NDVI is show cased in this paper. To find the spectral signature of different objects such as the vegetation index, land cover classification, concrete structure and road structure the multi-spectral remote sensing data method is used. the spatial distribution such as road, urban area, agriculture land and water resources which can be easily interpreted by computing their normalized difference vegetation index are exploited and explored for land cover classification. For generating the false color composite of the classified objects, various values of threshold of NDVI are used. According to simulation result, normalized difference vegetation index is highly useful to detect surface features of the visible area which is highly useful for management and municipal planning.

Key words: Remote Sensing, Normalized Difference Vegetation Index, Digital Image Processing, Multi-Spectral Images and Sensor

I. INTRODUCTION

Achieving information and extracting displays such as a form of spectral, spatial, and temporal about some objects, area, or phenomenon like vegetation, land cover designation, concrete structure, road structure, urban area, agriculture land and water resources without coming into sensible contact of these objects, area and fact under analysis is an art of remote sensing. Remote sensing is the method of acquiring information about the earth's land and water surfaces using images derived from an overhead aspect. In this case, information transfer is done by electromagnetic radiation, sometimes also called as EMR waves.

There are two types of generic sensors used for the collecting information, named passive remote sensor and active remote sensor. For gathering the satellite information passive remote sensing is used. An array of small sensors which record the amount of electromagnetic radiation reflected or emitted from earth surface is applied in it. The remote sensing which propagate its own electromagnetic radiation and measures the intensity of return signal is the mechanism of active remote sensing. In case of feature extraction, commonly passive remote sensing is used and active remote sensing is used applied for radar imaging system. 7-Band data is used for feature extraction in NASA of USA and in Indian Satellite INSAT image, 3-band data is used. Some specific information is consisted by each band and with the help of these features are obtained or simply extracted. Remote sensing is simply categorized into three types as thermal infrared remote sensing, visible and reflective infrared remote sensing and microwave remote sensing. These types are of different ranges and used for feature extraction from the multispectral satellite image.

To calculate the percentage of different features like vegetation, water bodies of any particular area and making it avail to public for further investigation in order to avoid any sorts of natural disasters like hurricanes, floods. There are many different techniques in literature available for examination of satellite image like artificial neural network, normalized different vegetation index and Satellite Image Contrast Enhancement Using Discrete Wavelet Transform and Singular Value Decomposition. In case of normalized difference vegetation index, at first various different bands are computed from satellite image, then NDVI method is employed according to its features such as vegetation (around 0.4), The characteristics for the barren areas of rock, sand or snow is indicated by very low value of NDVI (0.1 and below). Values between 0.2 to 0.3 (moderate values) represents shrub and grassland in 7-band satellite image. Whereas high value shows template and tropical rain forest (values from 0.6 to 0.8).

The performance parameters of feed forward neural network are the weights in the artificial neural network technique. They are different from each other so that the true output value is close to the predicted output corresponding to input values. This technique is based on supervised learning algorithm and unsupervised learning algorithm. H. Demirel, Ozcinar and AnbarJafari are the scientists who proposed another technique named Discrete Wavelet Transform and Singular Value Decomposition. A new satellite image contrast enhancement technique based on discrete wavelet transform (DWT) and singular value decomposition has been proposed in this technique. In this technique input image decomposes into the four frequency sub bands by using DWT and states the singular value matrix of the low-low sub band image and then enhanced image is reconstructed by applied inverse DWT in all those methods, feature extraction from multiband data is the main objective.

II. LITERATURE REVIEW

This segment of literature survey ultimately revels some facts based on thoughtful examination of many authors as surveys.

A. K. Bhandari [1] stated NDVI based methodology is presented for feature extraction of the multiband remote sensing image taken by the NASA LANDSAT. NDVI is a very fast and effective method for vegetation detection analysis. It is widely used for the crops classification in the world. But in this paper the NDVI technique is used specially for land cover classification because vegetation components are very dominant in the images. The percentage of vegetation in the given studied land sat image is found to be 5.2204 % by the analysis after applying NDVI threshold at 0.4 level and 15.1730% when threshold decreases at 0.2 level. By changing the value of threshold index, changing densities of vegetation coverage can be detected. The simulation results that are found through the analysis are true up to 90 to 95% in case of the vegetation, around 85 to 90 % in case of the structures but in case of the roads, free lands and water, error percentage is much higher so the results percentage are true up to 60 to 70% only. This analysis can also be used apart from study of greenery detection, agricultural needs and crop patterns, in the events of unfortunate natural disasters to provide humanitarian aid and damage assessment and also to plan new protection strategies at a large scale.

Hasan [2] proposed a new resolution enhancement technique based on the interpolation of the high-frequency sub band images obtained by discrete wavelet transform (DWT) and the input image. The proposed technique has been tested on well-known benchmark images, where their Peak signal-to-noise ratio (PSNR) and Root mean square error RMSE and visual results show the advantage of the proposed method over the predictable and state-of-art image resolution enhancement techniques. The PSNR enhancement of the proposed technique is up to 7.19 dB compared with the standard bicubic interpolation.

A. K. Bhandari [3] explains an improved method is presented for feature extraction from the multispectral remote sensing images. The normalized difference vegetation index (NDVI) technique with different threshold values has been employed for features extraction of Jabalpur region (India) as a case study. Simulation results included in this paper clearly shows that the percentage of vegetation is almost same for different threshold value. This implies that the result of vegetation and other features are accurate. The NDVI method gives superior results for vegetation changing in densities and also for scattered vegetation from a multispectral remote sensing image. By changing the value of threshold index, the changing densities of vegetation coverage can be detected. Apart from studies of agricultural needs and crop patterns, the vegetation analysis can be used in the events of unfortunate natural disasters to provide humanitarian aid and damage valuation and also to device new defense strategies.

A. Kumar [4] presented a novel technique based on SVD-DCT domain for enhancement of low contrast satellite images has been proposed for feature extraction using the technique NDVI. Because of scaling singular values of DCT coefficient the basic enhancement occurs. The performance of this technique is compared with LCS, GHE, SVD-DWT based techniques in comparison with SVD-DWT gives better performance it is highly useful to detect surface features of visible area which is the most facilitate for municipal planning and management.

Hasan Demirel [5] a new satellite image contrast enhancement technique based on DWT and SVD was projected. The projected technique decomposed the input image into the DWT sub bands, and, after updating the singular value matrix of the LL sub band, it restored the image by using IDWT. The technique was compared with the GHE, LHE, BPDHE, and SVE techniques. The visual results on the final image quality show the superiority of the proposed method over the conservative and the state-of-the-art techniques.

Ana F. Militin,[6] states the interpolation of the mean anomalies IMA technique assumes that remote sensing data can be expressed as the sum of a trend plus a random error. The trend is assumed to be constant in the locality of the target image, and it is estimated with the mean of this locality, and the residuals or anomalies are the estimates of the random error. Using repeated measurements from the same and contiguous time periods across several years provides a more robust estimation of the mean. Anomalies need to be filtered because images are not always free of altered or distorted data. Shrinking spatial resolution of the filtered anomalies is also a essential step to reduce the dimension of the equations to be solved in the thin-plate projections and to mitigate the border effect. After interpolating the averaged anomalies, the new estimations are added to the mean image.

JAHANGIR KHAN [7] suggests that VTCI is a time-conditioned and area-characterized vegetation index, which is used to obtain the desired results in the cropland area of Punjab. Furthermore, the mapped MODIS NDVI and LST products are very promising in response to soil moisture and VTCI imagery in the plain for drought monitoring as well as to identify the warm and cold edges during the winter wheat crop-growing season spanning 2003-2008. This shows that VTCI detects the soil moisture status in the region in response to the integration of LST and NDVI, an important indicator of land surface in the region to extract the drought conditions. Results from the current study show that the plain is mostly subjected to wet and slight-mild drought conditions and the recoil states of the warm and cold edges are stable and represent a substantial normality in the region in each year. VTCI illustrate that northeast areas had more surface wetness compare to the south of the plain. In the substantiation of drought, a strong relationship between the VTCI and cumulative precipitation anomaly was found in the cold months, from D-025 to D-057. Whereas, during the warm season at D-169 a negative correlation was established and present the warm/summer season; this indicates that the vegetation and temperature related drought indices might be better for agricultural drought monitoring.

Jose [8] Obtaining spectral coefficients which can be applied to global data requires a large spatial and temporal distribution of measurements, which only satellite data can provide. As long as other sources of error are comparable to the spectral adjustment differences, this becomes a difficult task. Until then we must rely on models that can simulate satellite data, and our approach of linearly combining field measurements addresses this. The regression parameters retrieved are operationally convenient and provide a significant correction of the spectral effects for coarse to moderate resolution satellite sensors. These results benefit existing cross-correlation methods by allowing a smoother transition between different sensor generations and facilitating the use of a time series using data from multiple satellites.

Michele Meroni [9] The SPOT-VGT mission provided 15 years of operational remote sensing indicators of vegetation status to the user community dealing with crop monitoring. The mission reached its end-of-life in May 2014 and was replaced by the PROVA-V mission, aiming to ensure, among other objectives, the seamless continuity of provision of VGT-like products, including NDVI. Exploiting the period of overlap when both instruments were functioning (November 2013–April 2014), this study has compared NDVI data provided by the SPOT-VGT and the PROBA-V instruments from the point of view of the user interested in functioning crop nursing and yield forecasting. The study was motivated by the requirement of three North African countries (Morocco, Algeria, and Tunisia) to assess the interoperability of the two data sources with respect to the operational crop monitoring season of 2015, when the crop monitoring institutions of these three countries would have to decide whether to continue their business-as-usual activities, which were carried out in the past with NDVI from the SPOTVGT sensor, with the new PROBA-V data. The study analyzed the impact of the data differences on the products being operationally derived and analyzed for crop monitoring and yield forecasting: anomaly maps, temporal profiles, and yield figures estimated using semiempirical regression models.

Eileen M. Perry [10] expresses evaluate the relationships between MODIS vegetation indices at the 250 m spatial resolution and 1) in situ measurements of FGrC, NDVI, and AGB, and 2) FGrC, LAI, and AGB from crop simulation models for Australian dryland wheat. The analysis was based on multiple paddocks and spanned multiple years. Results show the encouraging potential for using crop simulation models to develop a relationship between MODIS summed NDVI and AGB for Australian dryland wheat. The model fitted between MODIS summed NDVI and simulated AGB had a larger (0.92) and smaller RMSE(755kg/ha)than the model fitted between MODIS and in situ AGB (1397 kg/ha). LAI was not measured in situ, but the linear models fitting simulated LAI to MODIS NDVI had smaller RMSE in LAI at anthesis (0.30) than at peak values (0.79). In addition to the opportunity to "extrapolate" AGB across a region using MODIS NDVI, the results also indicate that AGB may provide better "feedback" to assimilate into crop simulation than LAI

III. Conclusion

As discussed earlier the requirement of the search over Normalized Difference Vegetation Index (NDVI) is to allocate the search result without compromising the accuracy and speed of the data with respective techniques. This research paper analyses all the previous works and come to conclusion, that there is still lot to achieve the perfection in this area.

So, this paper decides to deal with NDVI technique which is eventually used for low contrast satellite images for the detection of the vegetation index i.e. the green zone as we can say forest, crops etc. with the help of number of algorithms. This work of ours will be reflected in our future edition research work.

References

[1] A. K. Bhandari, A. Kumar and P. K. Padhy "Satellite Image Processing using Normalized Difference Vegetation Index: A Case Study of Paris City",

[2] Hasan Demirel and Gholamreza Anbarjafari "Discrete Wavelet Transform-Based Satellite Image Resolution Enhancement", IEEE Transactions On Geoscience And Remote Sensing, Vol. 49, No. 6, June 2011.

[3] A. K. Bhandari, A. Kumar, and G. K. Sing "Feature Extraction using Normalized Difference Vegetation Index (NDVI): a Case Study of Jabalpur City", 2nd International Conference on Communication, Computing & Security [ICCCS-2012].

[4] A. Kumar, A. K. Bhandari, P. Padhy "Improve Normalized Vegetation Index method based on discrete cosine transform and singular value decomposition for satellite image processing", Published in IET Signal Processing Received on 5th August 2011 Received on 13th May 2012.

[5] Hasan Demirel, Cagri Ozcinar, And Gholamreza Anbarjafari "Satellite Image Contrast Enhancement Using Discrete Wavelet Transform And Singular Value Decomposition", IEEE Geoscience And Remote Sensing Letters 2009.

[6] Ana F. Militin, M. Dolores Ugarte, Unai Pérez-Goya, And Marc G. Genton "Interpolation Of The Mean Anomalies For Cloud Filling In Land Surface Temperature And Normalized Difference Vegetation Index", IEEE Transactions On Geoscience And Remote Sensing 2019.

[7] Jahangir Khan, Pengxin Wang, Yi Xie, Lei Wang, And Li Li "Interpolation Of The Mean Anomalies For Cloud Filling In Land Surface Temperature And Normalized Difference Vegetation Index", 2169 -3536 2018 IEEE.

[8] Jose Luis Villaescusa-Nadal, Belen Franch, Jean-Claude Roger, Eric F. Vermote, Sergii Skakun, And Chris Justice "Spectral Adjustment Model's Analysis And Application To Remote Sensing Data", IEEE Journal Of Selected Topics In Applied Earth Observations And Remote Sensing, Vol. 12, No. 3, March 2019.

[9] Michele Meroni, Dominique Fasbender,Riad Balaghi, Mustapha Dali, Myriam Haffani, Ismael Haythem, Josh Hooker, Mouanis Lahlou, Raul Lopez-Lozano,Hamid Mahyou, Moncef Ben Moussa, Nabil Sghaier, Talhaoui Wafa, And Olivier Leo "Evaluating Ndvi Data Continuity Between Spot-Vegetation And Proba-V Missions For Operational Yield Forecasting In North African Countries", IEEE Transactionson Geoscience And Remotesensing, Vol. 54, No. 2, February 2016.

[10] Eileen M. Perry, Elizabeth M. Morse-Mcnabb, Member, IEEE, James G. Nuttall, Garry J. O'leary, And Robert Clark "Managing Wheat From Space: Linking Modis Ndvi And Crop Models For Predicting Australian Dryland Wheat Biomass", IEEE Journal Of Selected Topics In Applied Earth Observations And Remote Sensing, Vol. 7, No. 9, September 2014.

