Journal of Basic and Applied Engineering Research
p-ISSN: 2350-0077; e-ISSN: 2350-0255; Volume 2, Number 18; July-September, 2015, pp. 1570-1573
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Anatomization of Significance of Time Series Data in Specific Crop Identification

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Abstract—*This paper stated the substance value of time series data for mapping specific crop with the objective to obtain the spectral behavior of crop/vegetation from different stages of growing season. The importance of using time series remote sensing data lying in achieving the spectral response of different crops as images acquired over a period of time provides better classification of crop and vegetation. Temporal data set while extracting single class of interest becomes necessary because of the fact that spectral overlap or low separability distance between different crops creates problem in discriminating crops from each other with the help of single date image.*

Keywords*: Remote sensing images, Temporal data set, Time series data processing.*

1. INTRODUCTION

Crop growth information represented through temporal remote sensing data is of great importance for specific agriculture crop discrimination [8]. Today technological progress has enabled to capture in an image elements of a large geographical area, without having any direct contact with them, through remote sensing for earth observation purpose. These images can be used for studies of different types based on their reliability and high accuracy once they have being processed [7].

Time series remote sensing images collectively represent characteristics of a landscape in which each class or element has particular spectral response. Low distinguishes between these elements makes it harder to extract single class with the help of only one date image.

Image is made up of pixels. A pixel value (brightness value) is result of interaction of electromagnetic waves with the ground objects and/or atmosphere. The spectral response recorded by sensor may be differ for same or similar type of classes while it may be possible that the dissimilar entities may show similar spectral response which depends on ground or atmospheric condition [7]. In such situations, it becomes more challenging to discriminate single class of interest through only single date image. Scientist have devoted significant effort to develop sensors, visual and digital image processing algorithms to extract important vegetation biophysical information from remotely sensed data [11]. A remote sensing sensor captures data of an object on the earth remotely from satellite. Time series of optical satellite image acquired at coarse to medium spatial resolution is useful source of information for monitoring agricultural crop growth and productions [8].

Temporal data set could be a good solution for situations where crop discrimination is required or where there is a need of separating different classes from each other. For crop discrimination, more positive result can be achieved by obtain images at several times during the growing cycle [7].

2. EXPLORATION OF PREVIOUS FINDINGS

Several studies have been successfully carried out in the past using temporal data for identifying single class of interest.

[10] used MODIS temporal data set to identify specific croplands with the help of three band indices which are NDWI (Normalize Difference Water Index), NDSI (Normalized Difference Soil Index) and NDVI (Normalized Difference Vegetation Index). Methods used to extract single class of interest were PCA (Principal Component Analysis), linear spectral un-mixing method and SVM (Support Vector Machine).

[4] studied the use of time series of Landsat sensor data acquired over an annual cycle for mapping semi-natural habitats and agricultural land cover in Berwyn Mountains, North Wales, United Kingdom [7]. They concluded that better discrimination of habitats and agricultural land can be obtained using rule based classification. Numerical decision rules based on fuzzy logic that coupled knowledge of ecology and the information content of single and multi-date remotely sensed data and derived products (e.g., vegetation indices) were developed to discriminate vegetation types based primarily on inferred differences in phenology, structure, wetness and productivity [7].

[1] analyzed coarse resolution multi-date time series images to find out paddy fields. The analysis highlighted the potential of moderately coarse resolution WIFS data in discriminating the crop grown in fragmented conditions [7].

Jiali Shang have worked on Multi-temporal RADARSAT-2 and Terra SAR-X SAR dat for crop mapping in Canada and they found that when multi-frequency SAR (X- and C- band) are combined, classification accuracies above 85% are achieved prior to the end of seasons [2].

[9] classified high resolution time series SPOT images into four land class viz. bare soil, trees on bare soil, herbaceous crops and trees along with herbaceous crops using NDVI band ratio which generated NDVI temporal images.

3. TIME SERIES DATA PROCESSING

Each crop has a well-defined crop calendar with specific planting times and unique seasonal growth pattern [12]. Therefore timing plays an important role while identifying specific crop from remotely sensed data. Appropriate processing of temporal data set is necessary for image interpretation because factors like crop growth cycle i.e. growing season, passing of the green up, heads of grains and mature, and soil moisture vary during the year. In addition to seasonal variations, whether can cause significant short-term changes. Because soil moisture conditions may change dramatically during the day or two immediately following a rainstorm, the timing of image acquisition for soil studies is very critical [3].

The processing of time series data for identifying specific crop is basically done according to the sequence of actions shown in Fig. (1):

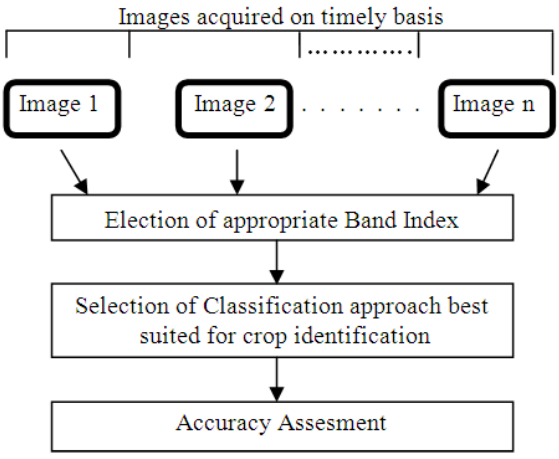


Fig. 1: Temporal data processing approach

In the first step, all the temporal data images are stacked as shown in Fig. (2):

In next step, suitable band ratio is selected to generate temporal indices data for enhancing the vegetation signal in remotely sensed data and provide an approximate measure of green vegetation. Band rationing means dividing the pixels in one band by the corresponding pixels in a second band Mather, P. (1999). Commonly used band indices are: NDVI (Normalized Difference Vegetation Index), SR (Simple Ratio), NDSI (Normalized Difference Soil Index), NDWI (Normalized Difference Water Index) and TVR (Triangular Vegetation Ratio).

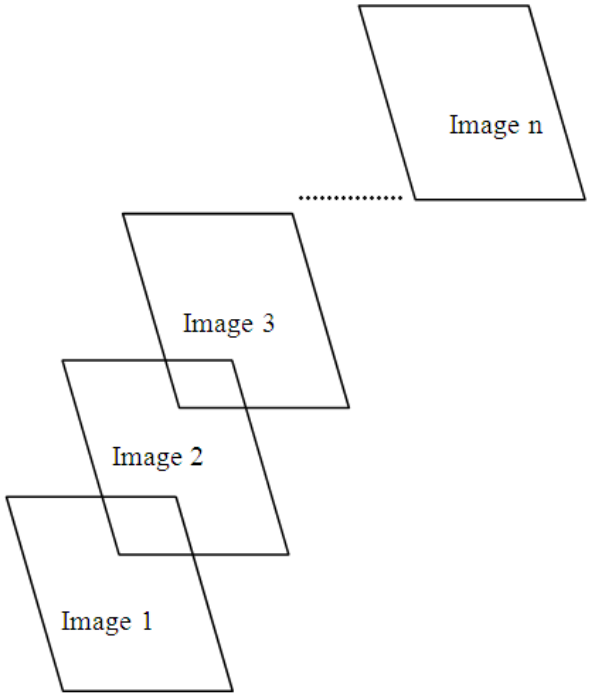


Fig. 2: Time series image processing

After that appropriate classification approach was selected. Classification is the process where we convert multilayer input image in to single layer thematic map. However, classifying remotely sensed data into a thematic map remains a challenge because many factors , such as the complexity of the landscape in a study area, selected remotely sensed data, and image-processing and classification approaches, may affect the success of a classification [5].

In the last pace, the accuracy of identified crop is measured. Accuracy upto some extend depends on the number of time series data images used to identify specific crop because non-optimum number of temporal data set implies more rigid temporal signature and specific to the pixels used for training. Hence for proper estimation of a class optimization of temporal dates need to be done [8].

4. OUTPUT GENERATION

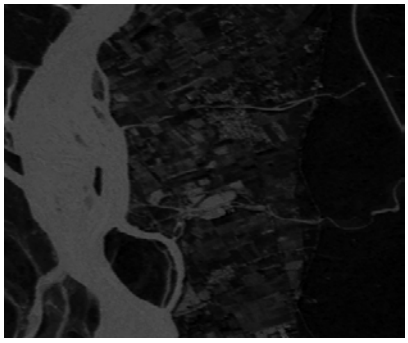
Generation of output takes place at various pace. Initially temporal signature of images is generated with the help of various band indices and then final output is obtained through processing of temporal band index images. Consider three scenes of rice crop from august to october 2014 shown in Fig. (3) for generation of output process. Circled area in the images shows growth cycle of rice crop:

August-2014

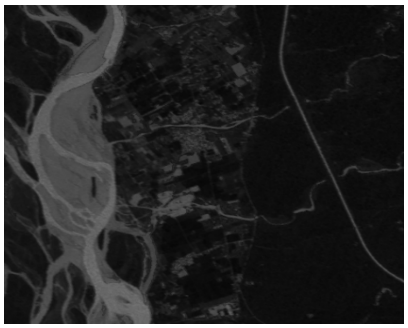
September-2014

October-2014
Fig. 3: Scenes considered for study

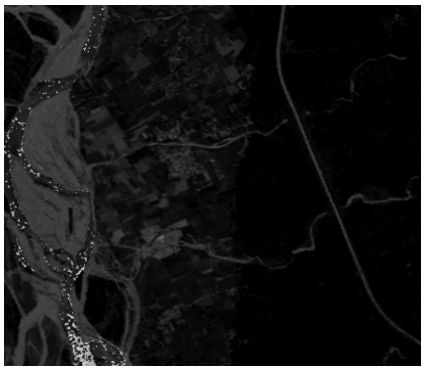
Band ratio of images was calculated using NDVI band ratio. Resultant temporal NDVI images has been shown in Fig. (4):



August NDVI image



September NDVI image



October NDVI image

Fig. 4: Temporal NDVI images

Final output shown in Fig. (5) has been obtained by processing NDVI temporal images. In output, the pixel values are represented between 0 to 1 membership values.

Fig. 5: Final output

5. CONCLUSION

Time series analysis can be a good panacea in case of discriminating single crop of interest among various crops and vegetation classes by considering spectral overlap between different classes as discriminating factor. With the help of

temporal data set, temporal changes in specific crop can be recognized in a better way and spectral response of different classes can be differentiated effectively. For discriminating single class, it is also recommended that images must be obtained within the time of crop growth cycle. However best suited number of time series images data for extracting specific crop of interest can be an another area of research.

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