“Separation of crop and vegetation based on Digital Image Processing”

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Abstract:
This study aims to separate land use classes i.e. vegetation and non-vegetation areas based on some specific concept NDVI Digital Image. Study-area is taken from Rajasthan INDIA. Main focus of work is to differentiate class of vegetation in to different categories like fallow-land, crop, trees, forest etc. For this over all work we have taken LISS III and Landsat 8 sensor’s image for the same area for same time (same month and year i.e. September, 2014). This spectral image classification comprises of certain indices among which our main focus is “NORMALISED DIFFERENCE VEGETATION INDEX” (NDVI). Here different range of index shows different categorization of vegetation and other feature. Hence studying on these ranges and analysis we get some results and conclusion which are given in this report. Apart from NDVI certain other parameter can also be used for this type of study but as per our aspect we want to derive this topic under analysis of indexes only. For cross checking or precision purpose we have also calculated some other indexes also like NDWI and NDBI (water and built up index respectively). This all calculation of index and performing algorithm according to need expected results obtained. For this type of study and work to be more precision ground truth is needed or any other instrument like reflectance meter can be used so that proper algorithm can be run on digital image for acquiring output. All the result and analysis part is shown in report conclusion and future scope is also illustrated.

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Introduction
In today's world, remote sensing is emerging in the research agenda on global and local environment. It is treated as local action for global mission, hence many areas of study are served by this technology, it is a technique in which knowledge and information of any object or body is collected without coming in contact of that object. This technology serves us by both quality and quantity of information. It consists of two data analysis typology named as 1. Visual interpretation and 2. Digital techniques here, visual interpretation tends to be qualitative rather than quantitative while digital techniques facilitate quantitative analysis. In our objective of study we are using digital techniques as a processing technique. This is named as “digital image processing” in this image processing concept enhancement of satellite image is done by observer and data is gathered for generation of specific output. Our study requires core of this DIP (Digital Image Processing).
Digital image processing requires three type of enhancement like spectral radiometric and spatial enhancement. We are taking “spectral enhancement” as a datum here to carry out our required work. It is referred as like spectral enhancement means anything to do with bands of satellite image to carry out our work according to need.

FLOW OF WORK DONE

Study area
The study area is taken from a part of Rajasthan around Pali district. The study area is lies between $73^\circ 30' E$ to $74^\circ 0' E$ & $26^\circ 0' N$ to $26^\circ 30' N$
Methodology

For the study, IRS LISS III satellite images of study area were acquired. The IRS LISS III data for 19th September 2014 were given from CompuSense Automation. Another image of landsat 8 is taken/downloaded from http://earthexplorer.usgs.gov/ website. The process of mosaicing, geo-referencing and rectification using photogrammetric techniques were carried on.

Data Pre-Processing:
The raw satellite image is full of errors and will not be directly utilized for features identification and any applications. It needs some correction. Pre-processing is done before the main data analysis and extraction of information. Pre – processing has involved by layer stacking and mosaicking the images in ArcGIS software. Processing has involved application of various GIS function and advanced digital image processing technique including contrast manipulation, edge enhancement, and image registered. The images were geometrically rectified and registered to the same projection namely.
Pre-processing aims to correct distorted data in order to create more faithful representation of the original scene, this typically involves the initial processing of raw image data to correct for geometric distortions, to calibrate the data radio metrically, and to eliminate noise present in the data.

Band reflectance calculation
For calculation of any index in digital image processing it is essential to calculate band reflectance according to index. the reason behind it is like that, when we download and pre-process satellite data at that instant we only acquired digital number data like ranging on gray scale level but for calculations of any such indices (like normalized difference vegetation index or normalized difference water index or built-up index) it is required to convert this digital number (DN) to reflectance number so that scientifically standard range of index could approach.
For this purpose of reflectance calculation we have used certain “identity” rule on band image. This identity is derived from meta data file attached with data which is based on sun angle and correction parameter mathematically it is written as under →

\[
\text{Reflectance} = \frac{((\text{reflectance \_mult \_band}) \times \text{band DN number} + (\text{reflectance \_add \_band}))}{\sin(\text{Sun elevation})}
\]

(This formula have been used on LANDSAT 8 Image)

For calculation of reflectance on LISS III image processing software was used in which sun angle and band has use as input parameter.

**Calculation of NDVI (NORMALISED DIFFERENCE VEGETATION INDEX)**

After calculation of different band reflectance value the next step is to calculate index

Identity used for different indexes are as under →

\[
\text{NDVI} = \frac{\text{NIR} - \text{RED}}{\text{NIR} + \text{RED}}
\]

\[
\text{NDWI} = \frac{\text{GREEN} - \text{NIR}}{\text{GREEN} + \text{NIR}}
\]

\[
\text{NDBI} = \frac{\text{SWIR} - \text{NIR}}{\text{SWIR} + \text{NIR}}
\]

For our interest of study we have worked more on NDVI only. Other two indexes are calculated only for cross evaluation purpose for precise work. All this identity has band reflectance as input parameter.

- This identity is performed on raster image by taking function as a float in raster calculator.
- Index ranging from minimum (-1 to +1) maximum value.
- Range of index shows the category of land use or cover like waterbody, urban, effective vegetation, crop field, or dense vegetation etc.
- Any feature based on their range can be extract using raster calculator or image calculator in ArcGIS by using condition statement.
Analysis

**Figure 2** Representation of study area

**Representation of band reflectance**

**Figure 3** Green band reflectance from Landsat8

**Figure 4** NIR band reflectance from Landsat8
Normalised difference vegetation index

Figure 6 RED band reflectance

Figure 7 SWIR2 band reflectance from landsat8

Figure 8 NDVI results on Landsat8 image. It shows that range of overall vegetation index is minimum (-0.564795) to maximum (0.736902). Here, minimum value of ranges shows settlement and water body whereas transition range shows fallow land and open patches while higher range shows effect of vegetation.

Figure 9 NDVI results on LISS III. It shows that range of overall vegetation index is minimum (-0.173077) to maximum (0.765458). Here, minimum value of ranges shows settlement and water body. And transition range shows fallow land and open patches while higher range shows effect of vegetation.
Overall vegetation over Landsat 8 image

Figure 10 Map is representing overall range of vegetation from NDVI calculation of Landsat 8 image. This overall vegetation has been extracted from figure 8 by using of conditional statement from raster calculator (ArcGIS software). It shows that total vegetation of study area comes under range of 0.3 to 0.689905.

Figure 11 Map representing range of conifer leaves form study

- Extraction of conifer leaf was based on an algorithm i.e conifer leaf lies between range like – NIR < 0.4
- This shows the approximate solution to extract tree form NDVI.
- For precise measurement ground truth information needed which can be achieved by reflectance meter or flux meter?
- This could be a solution to extract trees (babool trees) from overall vegetation since Babool tree have conifer leaves.
Overall process of separating crop from other vegetation over LISS-III image

Figure 12: separation of crop from other vegetation has been completed
- First part of map shows satellite imagery for liss 3 data and second part shows the range of normalised difference vegetation index over image (i.e. from -0.173077 to 0.765458). Third part of map shows a selected patch of image to extract crop field while the last part of this map shows the extraction of crop value from NDVI which shows that crop pattern falls under range of 0.4 to 0.77.

Other spectral enhancement index

Figure 13 Shows the NDBI calculation for landsat 8 image which is calculated by taking reflectance of SWIR and NIR band of image where higher range values show built-up feature.
Conclusion
The present study shows that “Separation of crop and other Vegetation based on Digital image processing” is very effective. This study has been carried out for understanding use of digital techniques for achieving desired goal. For this work/study we have taken normalised difference vegetation index as principle concept which is very effective but this can be more précised if ground truth data also have been collected. For cross evaluation purpose normalised built-up and water index has also been calculated but result which comes are not accurate, they are approximate. If we use other instrument like reflectance meter for surveying than condition algorithms can be made more optimised. Our main goal of understanding concept of digital image processing is achieved. The support from internship advisor - Mr Chandrashekhar Vaidya and his team (CompuSense Automation) was very excellent and helpful. Main objective of this internship was to understand practical environment of firm and it has been achieved.

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