Study and Implementation of Image Analysis of Remote Sensing Data

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ABSTRACT
This thesis focuses on the Image Analysis of Remote Sensing Data Integrating Spectral, and Spatial Features of Objects in the area of satellite image processing. We have used the multi-spectral remote sensing data to find the spectral signature of different objects of the Meerut city for the land cover classification. Some band combinations of remote sensed data are effective in the land cover classification. Spatial distributions of land cover types such as roads; urban area, agriculture land, and water resources can easily be interpreted by taking their Artificial Neural Network (ANN). We have carried out the ground survey to obtain the threshold values of ANN and on the basis of it we have trained neurons hence obtained the False Color Composite (FCC) of classified objects. The classified data could be used for municipal planning and management. The long-term objective of the thesis is to optimize the land use pattern for economically and environmentally sustainable urban development.

KEYWORDS

1. INTRODUCTION
Satellite remote sensing by virtue of its synoptic coverage, repetitivity and multispectral information becomes an important source of spatial information on agricultural resource.

1.1 PRE-PROCESSING OF SATELLITE DATA
In the solar spectrum, sensors on the meteorological or earth remote sensing satellites receive the integrated (atmosphere-Earth surface system) spectral response of the target area within the designed spectral width and the data is provided to the user in the form of digital numbers (DN), which do not correspond to physical units such as radiance, reflectance or temperature. Studies that intend to use remote sensing data to quantify ground surface characteristics such as leaf area index, biomass, phenological changes, crop discrimination and accurate yield estimation, require the digital numbers to be converted into target reflectance. To make the multi-temporal and or multi-sensor images comparable, DN values should be converted into physical units.

1.2 MOTIVATION
Satellites play a major role to provide the timely and cost effective information about the resources of the city. With the increased availability and improved quality of multi-spatial and multi-temporal remote sensing data as well as new analytical techniques, it is now possible to monitor urban land cover/land-use changes and urban sprawl in a timely and cost-effective way.

The technique that is used here is well known for the classification of the crops in the world, it is known as ANN method of classification. Here this technique is used for the land cover classification of the Meerut city. It is found that this technique is a very fast and efficient method of analysis.

1.3 AIM AND OBJECTIVES
Basic aim of our study is to analyze the Remote Sensing Data that we have received from the national remote sensing agency (space department, government of India); Integrating Spectral, Temporal and Spatial Features of the Objects in the area of satellite image processing. Here the multi-spectral remote sensing data is used to find the spectral signature of different objects of the Meerut city for the land cover classification, how the use of land changes according to time and also performed the temporal analysis to analyze the impact of climate over the surface.

During the Research following objectives were achieved:
1 General analysis of the different bands data of the multi spectral images.
2 Determination of ANN images from the multi spectral images.
3 Determination of threshold values of Pixels for classified objects from the ground survey data.
4 Creation of the False Color Composite image for the classified objects such as (vegetation, structures, roads, free land and water)
5 Other parameters analysis of the multi spectral images

1.4 SIGNIFICANCE
For efficient planning and management, we need the classified data in a timely manner, in order to get the classified data of the ground; satellites are the best resources to provide the data in a timely manner.

Another significance is that our eyes can acquire and analyze the energy of the visible band only but satellites are capable of collecting data beyond the visible band also. This additional information helps us to analyze the new things, which are not possible in visible band.

One of the significance of the analysis of the satellite data is that it is very much cost saving. If we perform the ground surveys then cost of surveys will be very much high.

Another significance of satellite data is that we can have a large view of the surface, which is not possible otherwise. We can utilize these advantages of the satellite for proper planning and management.

The long-term Significance of the thesis is to optimize the land use pattern for economically and environmentally sustainable urban development.

1.5 SCOPE AND LIMITATIONS

There is a lot of scope of the analysis that we have done in our thesis; our analysis could be used for the purpose of monitoring the unauthorized development of the colonies, protection of the trees, the agricultural planning, because in our study area a lot of agricultural land is available. Water resource planning, infrastructures planning and so many other areas where analysis could be used, in our country hyper spectral and very high resolution satellites will be available in coming years so they can provide us very useful data, now it is up to us how we process it and extract the useful information from this data.

There are also certain limitations of the satellite imaging. Atmospheric effects could be dominant and information of the object could be misinterpreted. Given bands image may not be suitable for certain objects, because objects response in one band may be good but in another band it may poor. So we are required an appropriate image for each object for right classification.

2. RESOLUTION AND SAMPLING IN REMOTELY SENSED DATA

Resolution: The maximum separating or discriminating power of a measurement. It can be divided into four types: spectral, radiometric, spatial and temporal.

2.1 SPECTRAL RESOLUTION AND SAMPLING:
The level of solar energy coming from the sun and passing through the atmosphere at a spectral region between 0.4 mm - 1.1 mm is distributed

2.2 SAMPLING FREQUENCY:
Determines how frequent are data collected. There are three types of sampling important to remote sensing: spectral, spatial and temporal. Combinations of resolutions and sampling frequencies have made it possible for us to have different types of remote sensing data.

2.3 ELECTROMAGNETIC ENERGY:
Energy is a group of particles traveling through a certain media. Electromagnetic energy is a group of particles with different frequencies traveling at the same velocity. These particles have a dual-mode nature. They are particles but they travel in a waveform.

Major Uses of Some Spectral Wavelength Regions:
- Y- ray Mineral
- X-ray Medical
- Ultraviolet (UV) Detecting oil spill
- 0.4-0.45µm Water depth, turbidity
- 0.7-1.1µm Vegetation vigor
- 1.55-1.75 µm Water content in plant or soil
- 2.04-2.34 µm Mineral, rock types
- 10.5-12.5 µm Surface temperature
- cm - 15 cm Surface relief, soil moisture
- 20 cm - 1 m Canopy penetration, woody biomass

The optical region covers 0.3 - 15 mm where energy can be collected through lenses.

Radiation Laws:
- The energy of a quantum is given by $E = h\nu$
E = \text{energy of a quantum (Joules)}

h = 6.626 \times 10^{-34} \text{ (Planck's constant)}

v = \text{frequency}, \ c = \text{Velocity of electromagnetic wave}

- Stefan-Boltzmann Law: \( E = \delta T^4 \).
- \( \delta : \text{Stefan-Boltzmann constant}, \ T = \text{absolute temperature} \)
- Wien's displacement law: \( \lambda_{\text{max}} = \frac{2897.8}{T} \)

As the temperature of a blackbody gets higher, the wavelength at which the blackbody emits its maximum energy becomes shorter.

3. ANALYSIS OF THE MULTI SPECTRAL IMAGES

We have received the color images that have the RGB components, in the given images R represents the near infrared band, G represents the red band, and B is for the green band. By using the MATLAB, we got the three different images of the different bands.

The energy response in infra red band is good enough after that we got the energy response of the green band but energy response of the red band is the lowest one in our image, it clearly shows that vegetation component is very dominant in our image.

4. RESULTS AND DISCUSSIONS

In order to create the FCC images, we found the specific ranges of ANN, NIR and RED for all the components, but in some ranges of all these parameters, multiple components were present so we have chosen the optimum values on the basis of ground surveys for minimizing the error. As a Result, we have found that our analysis is 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 result % are true up to 70 to 80% only. Accuracy

5. CONCLUSION

In this thesis we have analyzed the Remote Sensing Data that we have received from the national remote sensing agency (space department, government of India); to find the land cover classification of our city, and to know how the use of land changes. In order to analyze all these things, we have used the ANN method of classification. This is a very fast and effective method of analysis. It is widely used for the crops classification in the world. But we have used this one for land cover classification because vegetation components are very dominant in the images. And our basic aim is also to preserve the greenery of the city for the healthy environment.

We have achieved all the objectives that I have set for the study. And results that I have found through our 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 result % are true up to 70 to 80% only. All these classification errors can be reduced by using the much higher resolution and hyper spectral images from the satellites, such satellites are to be launched by the Indian government in coming years.

REFERENCES