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Research Article

Remote Sensing and Research Aspects in Technological Development of Computer Science

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Abstract: Earth observation is the field of science concerned with the problem of monitoring and modelling the processes on the Earth surface and their interaction with the atmosphere. The Earth is continuously monitored with advanced optical and radar sensors. The images are analyzed and processed to deliver useful products to individual users, agencies and public administrations. To deal with these problems, remote sensing image processing is nowadays a mature research area, and the techniques developed in the field allow many real-life applications with great societal value. This paper discusses the integrated use of Remote Sensing technologies in research areas for sustainable development in the field of computer science as well as the key elements like spectral and temporal data using some classification techniques for further implementations.

Keywords*:* Spectral, Temporal, Modeling, Remote Sensing**.**

INTRODUCTION

Remote Sensing (RS) technologies can be used to acquire spatially variable data for several applications. A number of these technologies can supply data to help to solve problems, and can often be accomplished at a lower relative cost than many other traditional methods Remote sensing (RS) technologies was utilized to extract some of the important spatially variable parameters, such as land cover and land use Without direct contact, some means of transferring information through space must be utilized. In remote sensing, information transfer is accomplished by use of electromagnetic radiation (EMR). EMR is a form of energy that reveals its presence by the observable effects it produces when it strikes the matter.

These advantages have attracted great interest in the scientific and engineering community. It requires methods to gather spatially distributed information and this requires repeated sampling of the variables of interest to acquire information over large areas [1-4].Modeling environmental phenomena usually needs some spatial information about the distribution and the types of land cover and land uses remotely sensed data and receive data/information on a regular interval. Schultz[5] presented the importance of remote sensing in hydrological applications such as computation of historic monthly runoff for design purposes, and real-time flood forecasting using radar rainfall measurements for which LCLU is very essential. In similar concepts, Kite[6] developed a simple watershed model which uses satellite data to simulate basin runoff. Foody *et al.*[7] derived the land cover spatial information from satellite remote sensing to predict sites at risk from large peak flows associated with flash flooding in arid regions[8-10].

VARIOUS ASPECTS OF REMOTE SENSING

Remote sensing is a wide branch of science with tremendous development in the last several decades. Over two dozen optical satellites are currently in orbit doing earth imaging[4]. Following are key components to gather remotely sensed data:

Energy Source*:* Sensors can be divided into two broad groups passive and active. Passive sensors measure ambient levels of existing sources of energy, while active ones provide their own source of energy. The majority of remote sensing is done with passive sensors, for which the sun is the major energy source. The passive sensors are simply those that do not themselves supply the energy being detected.

Wavelength: most remote sensing devices make use of electromagnetic energy. However, the electromagnetic spectrum is very broad and not all wavelengths are equally effective for remote sensing purposes.

Communication Mechanism: When electromagnetic energy strikes a material, three types of interaction can follow: reflection, absorption and/or transmission? Our main concern is with the reflected portion since it is usually this which is returned to the sensor system. Exactly how much is reflected will vary and will depend upon the nature of the material and where in the electromagnetic spectrum our measurement is being taken. As a result, if we look at the nature of this reflected component over a range of wavelengths, we can characterize the result as a spectral response pattern.

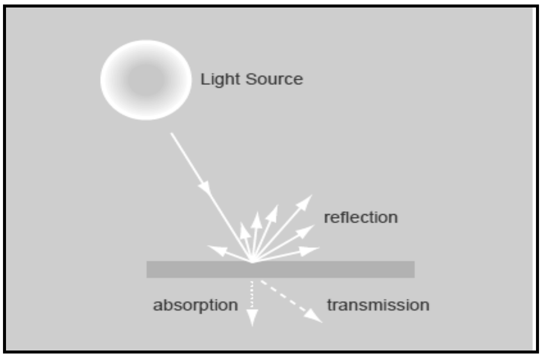

Fig.1: Process of reflectance.

Spectral Response Patterns: A spectral response pattern is sometimes called a signature. It is a description (often in the form of a graph) of the degree to which energy is reflected in different regions of the spectrum[10]. Most humans are very familiar with spectral response patterns since they are equivalent to the human concept of color.

Multispectral Remote Sensing: In the visual interpretation of remotely sensed images, a variety of image characteristics are brought into consideration: color (or tone in the case of panchromatic images), texture, size, shape, pattern, context, and the like. However, with computer-assisted interpretation, it is most often simply color (i.e., the spectral response pattern) that is used. It is for this reason that a strong emphasis is placed on the use of multispectral sensors (sensors that, like the eye, look at more than one place in the spectrum and thus are able to gauge spectral response patterns), and the number and specific placement of these spectral bands.

Hyperspectral Remote Sensing: In addition to traditional multispectral imagery, some new and experimental systems such as AVIRIS and MODIS are capable of capturing hyperspectral data. These systems cover a similar wavelength range to multispectral systems, but in much narrower bands.

RASTER IMAGE FILE FORMATS USED IN REMOTE SENSING

Band interleaved by line (BIL)[1], band interleaved by pixel (BIP), and band sequential (BSQ) are three common methods of organizing image data for multiband images. BIL, BIP, and BSQ are not in themselves image formats but are schemes for storing the actual pixel values of an image in a file. These files support the display of single and multiband images and handle black-and-white, grayscale, pseudo color, true color, and multispectral image data.

Band interleaved by line data stores pixel information band by band for each line, or row, of the image. For example, given a three-band image, all three bands of data are written for row 1, all three bands of data are written for row 2, and so on, until the total number of rows in the image is reached. The following diagram illustrates BIL data for a three-band dataset:

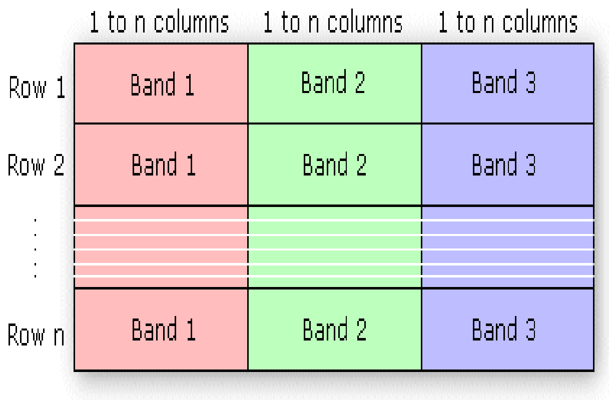

Fig. 2: General Structure of BIL Format.

Band interleaved by pixel data is similar to BIL data, except that the data for each pixel is written band by band. For example, with the same three-band image, the data for bands 1, 2, and 3 are written for the first pixel in column 1; the data for bands 1, 2, and 3 are written for the first pixel in column 2; and so on.

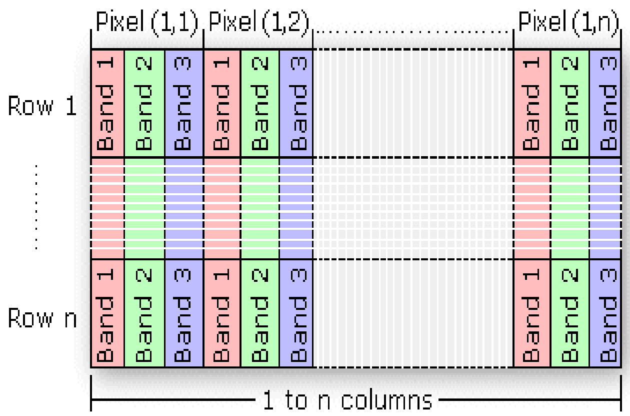

Fig. 3: General Structure of BIP Format.

Band sequential format stores information for the image one band at a time. In other words, data for all the pixels for band 1 is stored first, and then data for all pixels for band 2, and so on.

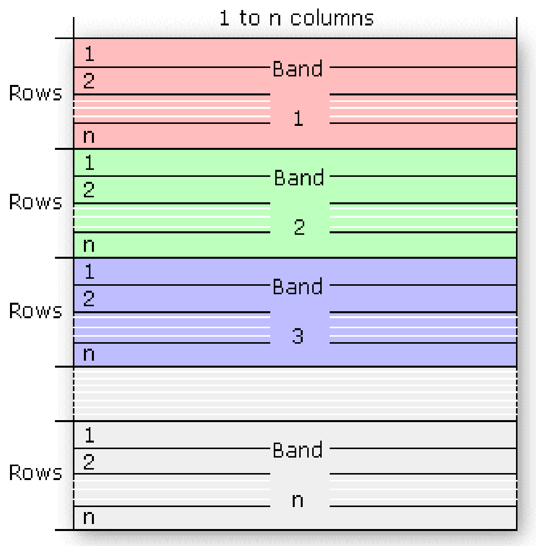

Figure 4: General Structure Of BSQ Format.

CLASSIFICATION METHODS IN REMOTE SENSING

Image classification refers to the computer-assisted interpretation of remotely sensed images. There are two general approaches to image classification: *supervised* and *unsupervised*[3]. They differ in how the classification is performed. In the case of supervised classification, the software system delineates specific land cover types based on statistical characterization data drawn from known examples in the image (known as training sites). With unsupervised classification, however, clustering software is used to uncover the commonly occurring land cover types, with the analyst providing interpretations of those cover types at a later stage.

Unsupervised classification: The computer or algorithm automatically group pixels with similar spectral characteristics into unique clusters according to some statistically determined criteria. The analyst then re-labels and combines the spectral clusters into information classes.

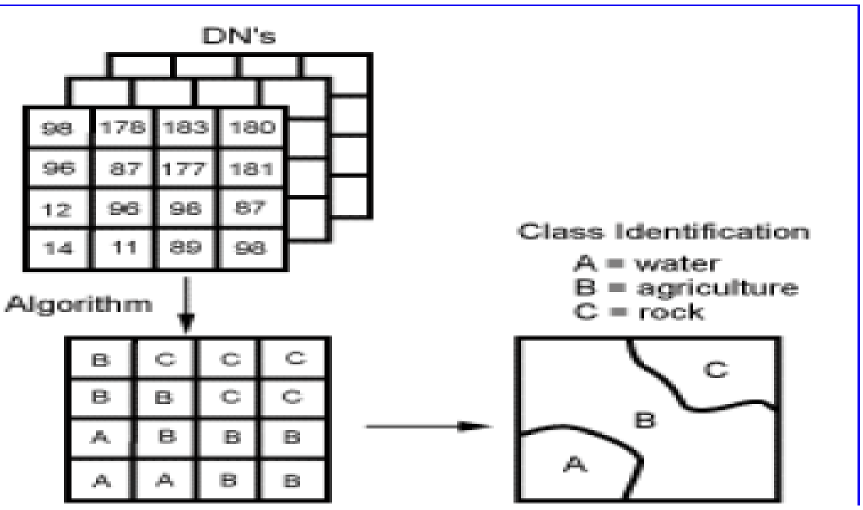

Fig. 5: Unsupervised Classification

Supervised classification: Identify known a priori through a combination of fieldwork, map analysis, and personal experience as *training sites*; the spectral characteristics of these sites are used to train the classification algorithm for eventual land-cover mapping of the remainder of the image. Every pixel both within and outside the training sites is then evaluated and assigned to the class of which it has the highest likelihood of being a member.

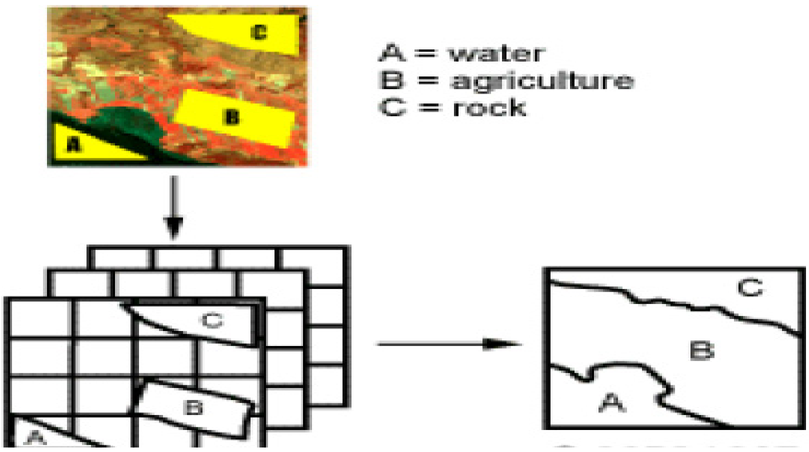

Fig. 6: Supervised Classification

Once a statistical characterization has been achieved for each information class, the image is then classified by examining the reflectance for each pixel and making a decision about which of the signatures it resembles most. There are several techniques for making these decisions, called *classifiers*.

Hard classifiers: The distinguishing characteristic of hard classifiers is that they all make a definitive decision about the land cover class to which any pixel belongs. They differ only in the manner in which they develop and use a statistical characterization of the training site data. Of the three, the Maximum Likelihood procedure is the most sophisticated, and is unquestionably the most widely used classifier in the classification of remotely sensed imagery.

Soft classifiers: Contrary to hard classifiers, soft classifiers do not make a definitive decision about the land cover class to which each pixel belongs. Rather, they develop statements of the degree to which each pixel belongs to each of the land cover classes being considered.

REMOTE SENSING BASED RESEARCH FIELDS IN COMPUTER SCIENCE ENGINEERING

Remotely sensed data is important to a broad range of disciplines. The availability of this data,coupled with the computer software necessary to analyze it, provides opportunities for environmental scholars and planners,particularly in the areas of landuse mapping and change detectionFrom a machine learning and signal/image processing point of view, all the applications are tackled under specific formalisms, such as classification and clustering, regression and function approximation, data coding,restoration and enhancement, source unmixing, data fusion or feature selection and extraction.

Various classification techniques and algorithm have been implemented.And some of them are under research,here below lies some research applications fields :

Algorithm development for Spectral Remote Sensing for Hyperspectral and Multispectral Imagery Analysis[1] Hyperspectral remote sensing is the definitive optical tool for increasing knowledge and understanding of the Earth's surface. Contiguous high-resolution spectrometry provides a new dimension in mapping capability because of the potential for quantitative measurement of surface biogeochemistry. Hyperspectral imaging systems acquire images in over one hundred contiguous spectral bands. While multispectral imagery is useful to discriminate land surface features and landscape patterns, hyperspectral imagery allows for identification and characterization of materials. In addition to mapping distribution of materials, assessment of individual pixels is often useful for detecting unique objects in the scene.

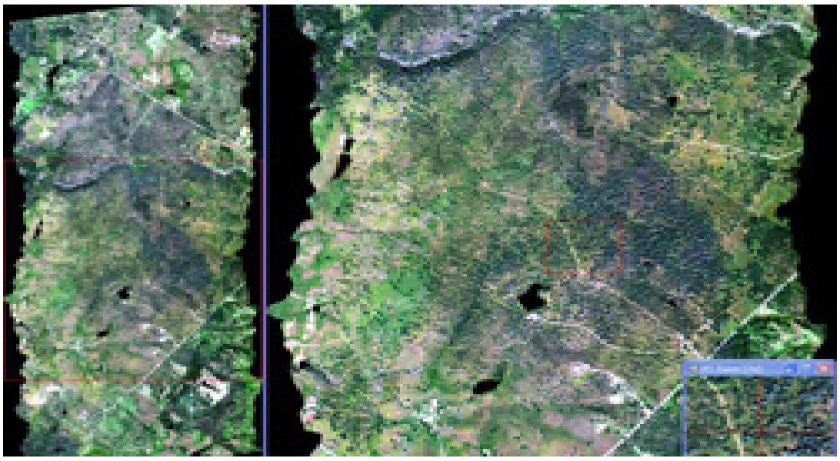

Fig. 7: Hyper spectral image sample

Study in the field of GIS and Geology: Remote sensing technology is an effective and widely established analytical method for geology and mineral exploration, and has proven extremely beneficial by providing access to dangerous or previously inaccessible sites. Aerial imagery acquired from hyperspectral and multispectral imaging sensors such as Landsat, ASTER, AVIRIS, HyMap and Hyperion is applied to geological surveys, alteration zones mapping, and geomorphology applications.

Climatic Analysis using software development: Application development involve monitoring different aspects of the Earth's system. As a result, data collected through remote sensing can be used effectively in climate change studies. As global change occurs on a daily basis, information from oceanography, plant physiology, and landscape ecolrogy research forms the basis for climate change models. Applications such as plant canopy studies, soil analysis, hydrology studies and light energy research can provide important data to these models.

Atmospheric Remote Sensing Research and Spectral Irradiance Studies: Many climate and surface energy balance studies involve monitoring the direct, diffuse and total components of solar spectral irradiance as they relate to the earth's atmosphere and surface. n order to improve these climate and ecosystem models, it is essential to measure the variation of these properties across, and within, a wide variety of ecological sites.

CONCLUSIONS

Remote sensing technology will improve by increasing spatial, spectral and temporal resolutions in upcoming years. The ability to merge soil maps with remotely sensed data to understand crop variability is a great asset to interpretation.

In Today's scenario,Remote sensing is a wide field of research and development,specifically in the area of Technology.In fact,there are numerous soft tools that has been developed to fulfill the requirement of various applications of remote sensing.

The images are analyzed and processed to deliver useful products to individual users, agencies and public administrations. To deal with these problems,remote sensing image processing is nowadays a mature research area, and the techniques developed in the field allow many real-life applications with great societal value. For instance, urban monitoring, fire detection or flood prediction can have a great impact on economical and environmental issues.

To attain such objectives, the remote sensing community has turned into a multidisciplinary field of science that embraces computer science. From a machine learning and signal/image processing point of view, all the applications are tackled under specific formalisms, such as classification and clustering, regression and function approximation, data coding,restoration and enhancement, source unmixing, data fusion or feature selection and extraction.

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