

HYPERSPECTRAL IMAGING APPLICATIONS WITH BIG DATA- A REVIEW

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Abstract : The spectral sensing technique which takes hundreds of closest narrow waveband images in the visible and infrared regions of the electro-magnetic spectrum is known as Hyper Spectral Imaging (HSI). Although HSI was originally developed for mining and geology applications, its usage has quickly spread into other civilian sectors and more recently into the different sectors due to the ability to discriminate between materials . The capability of multispectral imaging by identifying materials that could not be resolved previously can be improved by hyper spectral imaging. Due to the technological advancements and need of different sectors, the traditional methods are obsolete and are not cost effective. It is therefore to address the cost effective ,real time and reliable, hyperspectral imaging is one of the latest technique that introduces new sensing facilities that enable improved inspection. HSI with Big data analytics is the new emerging research area giving the solutions for different research areas that includes agriculture, biomedical imaging, geosciences, physics, and surveillance.. The present paper reviews different research ideas using HSI in the field of agriculture, healthcare, and military defense areas.

IndexTerms - Hyperspectral images, Big Data, Machine learning

I. INTRODUCTION

In general a human eye can able to recognize the color of visible light in three bands of electromagnetic spectrum (long wavelengths – red; medium wavelengths – green ; and short wavelengths - blue). The spectral imaging divides the spectrum into many more bands. This technique of dividing images into bands can be extended beyond the visible range. In hyper spectral imaging, the recorded spectra have wide range of wavelengths with fine wavelength resolution. Hyper Spectral Imaging measures adjoining spectral bands, as opposed to multispectral imaging which measures spaced spectral bands [3]. The term *big data* was first used to refer to increasing data volumes in the mid-1990s . Later on big data includes increases in the variety of data being generated by organizations and the velocity at which that data was being created and updated. The techniques of HIS and it's data are becoming mostly combination of variety with large data used by the researchers for different analytical techniques for meaningful predictions,. The combination of Big data analytics with hyperspectral images using different machine learning techniques can predict different dimensions in research. Few of the researchers findings on hyper spectral imaging techniques used in different fields is being discussed in this paper.

1.1 Hyper Spectral images applications in agriculture:

Spectral analyses techniques have been developed for plant and soil conditions through determination of crop water status, effectiveness of pre-harvest defoliant applications, and soil characterizations [4]. The study found out that spectroscopic absorption and narrow band index techniques are most promising and their application to airborne hyperspectral imagery in mapping the variability in crops and soils are helpful in adoption of crop management practices on time. Hyper Spectral imaging

applications in agriculture and agro-food product quality and safety control is being reviewed [5]. They concluded that the hyper spectral images are very beneficial in mapping of vegetation, identification of crop diseases, stress and yield prediction. There is a growing interest in HSI for safety and quality assessments of agro-food products. The applications have been classified from the level of satellite images to the macroscopic or molecular level [6]. Although the cost of acquiring hyperspectral images is typically high, for specific crops and in specific climates, hyperspectral remote sensing use is increasing for monitoring the growth and health of crops. In Australia, work is under way to use imaging spectrometers to detect grape variety and develop an early warning system for disease outbreaks [7]. Furthermore, work is underway to use hyperspectral data to detect the chemical composition of plants [8], as well as to detect the nutrient and water status of wheat in irrigated systems [9]. On a smaller scale, Near Infra Red hyper spectral imaging can be used to rapidly monitor the application of pesticides to individual seeds for quality control of the optimum dose and homogeneous coverage [10].

1.2 Hyperspectral Imaging applications in healthcare system:

During the last two decades, HSI technology with Big Data Analytics has found numerous applications in medical domain due to faster development of hardware and software's in identifying the abnormalities. Hyper spectral image classification methods applied in the field of medicine includes pixel and sub pixel classification based on the information received from different pixels. Pixel-wise classification either it can be parametric or nonparametric. Parametric classifiers often violated in practice is generally assumes normal distribution for the data[12]. Artificial Neural Networks (ANN) and Support Vector Machines (SVMs) are widely used in medical hyper spectral image processing under non-parametric methods.

1.3 Hyperspectral imaging applications in security:

In the field of forensic and defense the reliability and fast extraction of the information is very important. Investigating agencies are using hyperspectral technologies for separating forensic details [11]. The cameras used in the study could separately identify four types of human and animal bloods which were mixed in the same stain and absorbed into a fabric. The big advantage of hyperspectral imaging is in the detail it can provide. An infrared sensor or multispectral sensor, for example, might indicate the presence of a target of interest. A hyperspectral sensor, however, might indicate not only the presence of a target, but also the kind of metal it's made from, the color and type of paint it has, or the amount of moisture it contains.

II. CONCLUSION

Big data analytics applications enable data scientists, predictive modelers, statisticians and other analytics professionals to analyze growing volumes of structured transaction data .Hyper spectral imaging technique sees beyond the natural limitations of human eye with large volumes of data. It is therefore by analyzing different hyperspectral images with big data analytics we can detect disease early in the human body and crop growth cycle for timely interventions. Use of such techniques would not only be cheaper as compared to human scouting but also facilitates in immediate preventive actions. The present day applications of hyper spectral imaging techniques are limited to few fields as well as concentrated to few areas. It is therefore, the future work in hyper spectral imaging should focus on issues use of higher sensitivity cameras with higher resolution, improvements in data processing methods, increasing detection accuracy, and expanding the range with more data analytical algorithms. On a broad scale, data analytics technologies and techniques provide a means of analyzing hyperspectral data sets and drawing conclusions about them to help organizations make important research decisions. Big data analytics with hyperspectral images queries answer questions about research operations and performance. Big data analytics is a form of advanced analytics, which involves complex applications with elements such as predictive models, statistical algorithms and what-if analyses powered by high-performance analytics systems.

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