Chapter 26
Big Data and Internet of Things for Analysing and Designing Systems Based on Hyperspectral Images

Peyakunta Bhargavi
Sri Padmavati Mahila Visvavidyalayam, India

Singaraju Jyothi
Sri Padmavati Mahila Visvavidyalayam, India

ABSTRACT

The recent development of sensors remote sensing is an important source of information for mapping and natural and man-made land covers. The increasing amounts of available hyperspectral data originates from AVIRIS, HyMap, and Hyperion for a wide range of applications in the data volume, velocity, and variety of data contributed to the term big data. Sensing is enabled by Wireless Sensor Network (WSN) technologies to infer and understand environmental indicators, from delicate ecologies and natural resources to urban environments. The communication network creates the Internet of Things (IoT) where sensors and actuators blend with the environment around us, and the information is shared across platforms in order to develop a common operating picture (COP). With RFID tags, embedded sensor and actuator nodes, the next revolutionary technology developed transforming the Internet into a fully integrated Future Internet. This chapter describes the use of Big Data and Internet of the Things for analyzing and designing various systems based on hyperspectral images.

INTRODUCTION

The advances in remote sensor and computer technology are substituting the traditional sources and collection methods of data, by revolutionizing the way remotely sensed data are acquired, managed, and analyzed. The term remote sensing (Nelson, 2012) refers to the science of measuring, analyzing, and interpreting information about a scene acquired by sensors mounted on board the different platforms for

DOI: 10.4018/978-1-5225-7033-2.ch026

Earth and planetary observation. Remote sensing instruments measure electromagnetic radiation energy at different wavelengths reflected or emitted by the Earth and its environment (Van Zyll, 2006), which can be influenced by the radiation source, interaction of the energy with surface materials, and the passage of the energy through the atmosphere. The interactions of the energy with surface materials can change the direction, intensity, wavelength content, and polarization of electromagnetic radiation. The nature of these changes is dependent on the chemical make-up and physical structure of the material, exposed to the electromagnetic radiation, and can be used to provide major clues to the characteristics of the investigated objects.

The deployment of latest-generation sensor instruments on board both terrestrial and planetary platforms provides a nearly continual stream of high-dimensional and high-resolution data. More recently, such increases in the data volume, velocity, and variety of data contributed to the term big data that stand for challenges shared with many other scientific disciplines. The importance of incorporating remote sensing into Internet of Things practice has long been recognized by the in real time applications. Recently, Internet technology is integrating more remote sensing techniques into their standard methodologies for managing global world. Furthermore, the integration of geospatial tools and techniques in Internet of Things is a growing research agenda.

HYPERSPECTRAL IMAGES

Recent advances in remote sensing and geographic information has led the way for the development of hyperspectral sensors. Hyperspectral remote sensing, also known as imaging spectroscopy, is a relatively new technology that is currently being investigated by researchers and scientists with regard to the detection and identification of minerals, terrestrial vegetation, and man-made materials and backgrounds.

Hyperspectral imaging is a combination of spectroscopy (visible light dispersed according to its wavelength by a prism) and visible imaging. Instead of just taking a picture and getting a color image, you obtain a spectral measurement for each pixel in the image in the scene. Hyperspectral imaging is used to find objects, identify material and detect processes. Imaging spectroscopy has been used in the laboratory by physicists and chemists for over 100 years for identification of materials and their composition. Spectroscopy can be used to detect individual absorption features due to specific chemical bonds in a solid, liquid, or gas. Recently, with advancing technology, imaging spectroscopy has begun to focus on the Earth. The concept of hyperspectral remote sensing began in the mid-80's and to this point has been used most widely by geologists for the mapping of minerals. Actual detection of materials is dependent on the spectral coverage, spectral resolution, and signal-to-noise of the spectrometer, the abundance of the material and the strength of absorption features for that material in the wavelength region measured.

Hyperspectral remote sensing combines imaging and spectroscopy in a single system which often includes large data sets and requires new processing methods. Hyperspectral data sets are generally composed of about 100 to 200 spectral bands of relatively narrow bandwidths (5-10 nm), whereas, multispectral data sets are usually composed of about 5 to 10 bands of relatively large bandwidths (70-400 nm). Hyperspectral imagery is typically collected (and represented) as a data cube with spatial information collected in the X-Y plane, and spectral information represented in the Z-direction. Different applications of hyperspectral images are shown in Figure 1. For finding real time solutions, developing sensors and other hyperspectral based analysis, remote sensing process is required. Figure 2, Figure 3, and Figure 4 explain the steps of hyperspectral image preprocessing to acquire digital data (Udelhoven, 2013).

Related Content