OBTAINING SPECTRAL INFORMATION USING COMMERCIAL CAMERAS AND CTIS ADAPTIVE OPTICS BASED ALGORITHMS

Carlos A. Iturrino García[1,2], Emmanuel Arzuaga[1,2,3] and Heidy Sierra[1,3]
Laboratory for Applied Remote Sensing and Image Processing[1]
Department of Electrical and Computer Engineering, University of Puerto Rico Mayaguez[2]
Department of Electrical and Computer Engineering, University of Puerto Rico[3]

The human eye is capable of capturing a limited range of the electromagnetic spectrum which we call visible light. Different materials react to wavelengths in a different form, making them distinguishable if we capture enough spectral information about them. Fortunately, hyperspectral cameras are able to capture a wider range in the electromagnetic spectrum, providing information at a level of detail in an image that we cannot observe with our own vision. A hyperspectral camera provides three- dimensional data cubes, for which two dimensions are spatial information about the scene of interest and a third dimension being the respective wavelength captured by the sensor.

In this work, we present a methodology to extract spectral information using a regular commercial camera. The approach consists of using a relay telescope to optically separate the spectral information, following by imaging at the Fourier plane of the object of interest. A spectral cube is computationally constructed by using computed-tomography concepts based algorithms.

We have implemented an algorithm in MATLAB for the generation of a spectral data cube with three spectral bands. For this to be successful we made all the necessary calibration using 632nm laser and capturing an image with white light. The calibration consists in capturing an image with a 632nm laser to identify the location of the 632nm spectral band within the image. Other spectral bands are determined by interpolation and using the white light as a reference index. In order to accomplish this task, an H matrix is constructed, which is used as a transformation matrix to reconstruct our imaged object. We implement an expectation maximization (EM) algorithm to find the solution of the linear equation to generate the image. Finally, we obtain an output with 3 spectral bands that can be visualized as an RGB composite image.

This system is lightweight and can be mounted on a drone for coastal and earth topography, crop field monitoring and/or soil analysis. This device does not need scanning of the image plane but instead, it can capture the spectral content with a single snapshot which makes it more efficient than other techniques.