IMPACT OF THE CAMERAS RADIOMETRIC RESOLUTION ON THE ACCURACY OF DETERMINING SPECTRAL REFLECTANCE COEFFICIENTS

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KEY WORDS: Remote Sensing, Measurement, Calibration, Multispectral, Experiment,

ABSTRACT:

Nowadays remote sensing plays an enormous role in many fields, like environmental studies, hydrology, mineralogy, crop analysis and ecosystem studies. One of the key areas of remote sensing applications is water quality monitoring. Understanding and monitoring of the water quality parameters and detecting different water contaminants is an important issue in water management and protection of the whole environment and especially water ecosystems. Remote sensing techniques enable the monitoring of the state of water reservoirs, their quality and level of contamination. There are many remote sensing methods to monitor water quality and detect water pollutants. One of the most widely used methods for substance detection with remote sensing techniques is based on spectral reflectance coefficients. They are usually acquired using discrete methods such as spectrometric measurements. These however can be very time consuming, therefore image-based methods are used more and more often. According to published and ongoing studies, in order to acquire these spectral characteristics from images, it is necessary to have hyperspectral or multispectral data. The research team from the Department of Remote Sensing and Photogrammetry from the Military University of Technology in Warsaw is proposing a method of extracting precise reflectance coefficients of water contaminants and other substances from imagery data- both hyperspectral and multispectral data. This research is conducted as part of the project entitled "IRAMSWater - Innovative remote sensing system for the monitoring of pollutants in rivers, offshore waters and flooded areas" (PBS1/B9/8/2012) financed by the polish National Centre for Research and Development. The main objective of this project, is to create a remote sensing system based on hyperspectral sensors which will enable the evaluation, detection and distribution of biological, physical and chemical pollutants in the examined waters in real time. All mentioned analyses are conducted based on spectral characteristics of a wide selection of pollutants and substances. As most of these contaminants could only be measured in field conditions and can not be measured pointwise we need to determine an optimal methodology for acquiring these data in an accurate and quick way from imagery data. In order to work out the proper methodology for obtaining spectral reflectance coefficients from hyperspectral and multispectral images, it is necessary to verify the impact of a sensor's radiometric resolution on the accuracy of the final results.
The radiometric resolution can be defined as sensitivity of a sensor to incoming reflectance. As it describes the ability to discriminate very slight differences in energy on the image, the finer the radiometric resolution of a sensor, the more sensitive it is to detecting small differences in reflected or emitted energy. It leads us to the assumption that the camera radiometry can have a great impact on obtained spectral reflectance coefficients from images, what can translate into the possibility of detecting and identifying some water contaminants, which is the main aim of the IRAMSWater project.
The article presents laboratory experiments that were conducted using two monochromatic XEVA video sensors (400-1700nm spectral data registration) with two different radiometric resolutions: XEVA 4246- 12 bits and XS 4243- 14 bits. In order to determine spectral characteristics from images, the research team used prepared set of interferometric filters (i.e. 900 nm, 950 nm, 1000 nm, 1050 nm, 1100 nm and 1150 nm). All data collected with these digital video cameras were compared with spectral reflectance coefficients obtained with a FieldSpec 4 Wide-Res spectroradiometer. All research work was conducted in the same light conditions, for specially selected materials. Moreover due to possible occurrence of irregular lighting of the photographed scene, all images were equalize with two different methods of image equalization: additive, which takes into account only the difference between the image of illuminated background and illuminated scene, and a multiplicative method that considers the ratio between the background and the photographed scene.
The objective of this research is to find the impact of a camera's radiometric resolution on reflectance values in chosen wavelengths. The main topic of this study is the analysis of the accuracy of determining spectral coefficients from sensors with different radiometric resolutions. By comparing values collected from images acquired with XEVA 4246 and XS 4243 and with the curves obtained with a spectroradiometer its possible to determine the accuracy of image- based spectral reflectance coefficients and decide which sensor will be more accurate to determine them for the IRAMSWater project purposes.

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