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The Journal covers the entire field of infrared physics and technology: theory, experiment, devices and instrumentation.

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Infrared techniques occur in many different fields, notably spectroscopy and interferometry; material characterization and processing; atmospheric physics, astronomy and space research. Scientific aspects include lasers, quantum optics, quantum electronics and semiconductor physics. Some important applications are medical diagnostics and treatment, industrial inspection and environmental monitoring.

A fuller though not exhaustive list of topics would include:

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- Atmospheric transmission, turbulence and scattering
- Environmental applications: pollution and combustion monitoring
- Detectors: quantum and thermal
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- Solid-state physics
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- Thermal imaging: device design, testing and applications
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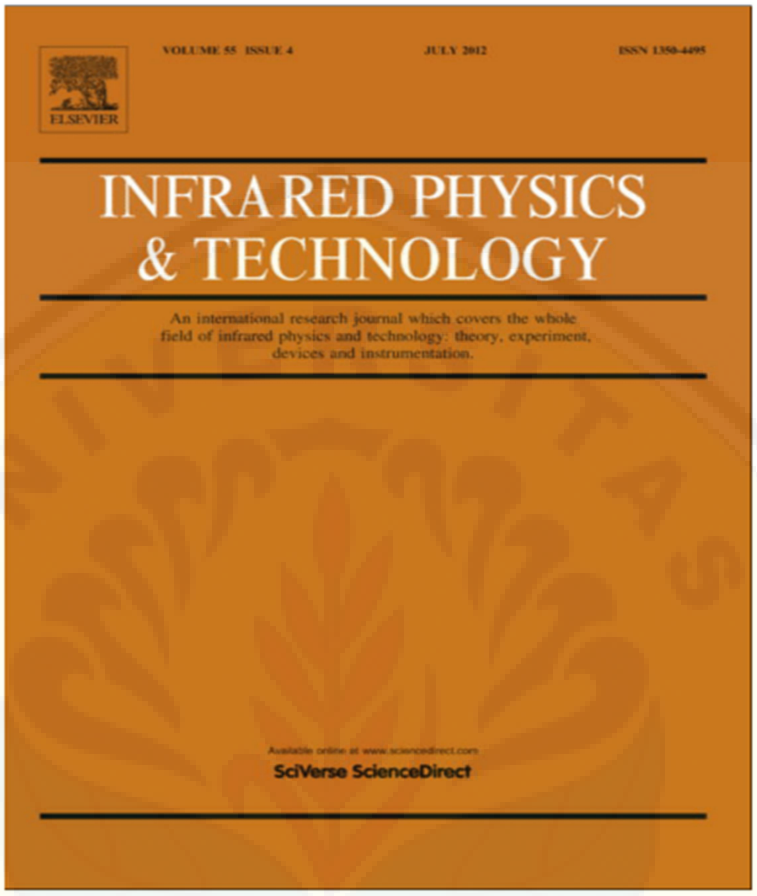

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Regular article

Evaluating NIR-Red and NIR-Red edge external filters with digital cameras for assessing vegetation indices under different illumination

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HIGHLIGHTS

- Low-cost external filter for CCD camera in assessing biophysical properties.
- Newly proposed range of RE_{high} and RE_{low} could be used for estimating Chlorophyll content using broadband indices.
- Characterization of NIR-R camera and NIR-RE camera for handheld application for chlorophyll measurement.
- Potential use of NIR-RE camera for environmental monitoring.

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ABSTRACT

Consumer-grade digital cameras with or without external filters are recognized as a cost-effective method of vegetation monitoring. These cameras could produce time series information related to biophysical properties of vegetation. This paper evaluates the use of low-cost external filters with digital cameras for assessing vegetation indices (VIs). The system was implemented for ground-based (handheld) remote sensing in assessing biophysical properties of vegetation like plant phenology and Chlorophyll content. It also has high potential for above-canopy measurement using low-altitude remote sensing (LARS). In this study the modified cameras were used to capture near-infrared (NIR), red-edge (RE), and red (R) bands using proposed external filters. We use the low-cost NIR-R and NIR-RE external filters with modified cameras and tested the cameras performance using custom chamber under different illumination. Based on our findings, a method was proposed for enhancing the value of VI, which comprised the extracted DN of two broadbands like NIR and R. New ranges of broadband in red edge area (RE_{high} and RE_{low}) are proposed as alternative bands in estimating Chlorophyll content. In addition, evaluation and implementation for assessing VIs are detailed in this study.

1. Introduction

Imaging sensors quality are estimated to continue increasing, and RGB will continue to dominate spectra component of digital cameras in near-future. Advanced technologies in Charge Coupled Device (CCD) sensors for system development of digital camera for large consumer will increasingly prevail in the coming years [1]. Nowadays, common users can easily use consumer-grade cameras in assessing biophysical properties like phenology, Chlorophyll, nitrogen critical level, biomass, leaf area index (LAI), pest and diseases, Photosynthetically active radiation (PAR), and many others related to the precision farming.

Precision farming technologies, especially incorporating remote sensing, have been growing notably in the recent years. However adoption of these technologies is difficult to reach by smallholders in developing countries due to their low investment capacity farms. In addition to those challenges, the pest and diseases, uncertain climate, drought, and soil erosions add further to the problem of ensuring food security.

Remote sensing technology uses spectral indices in narrowband and broadband; with the former providing more detailed spectral information. This narrow spectral band is supported by radiometric tools like Spectrometer, satellite and some multispectral imaging sensors; while broadband indices can be obtained by cameras. Several researches have shown that the use of broadband indices from digital camera provides comparable results in assessing plant properties.

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