Low-cost hyper-spectral imaging system using a linear variable bandpass filter for agritech applications

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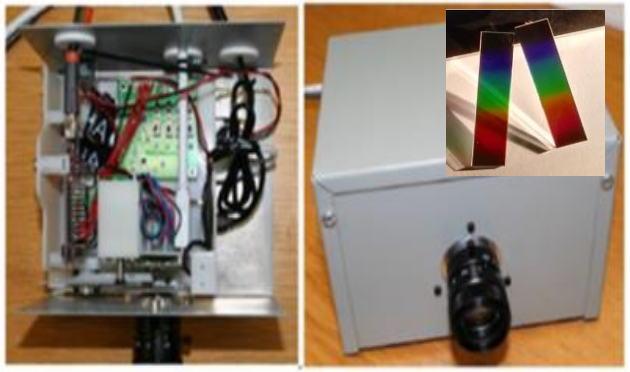
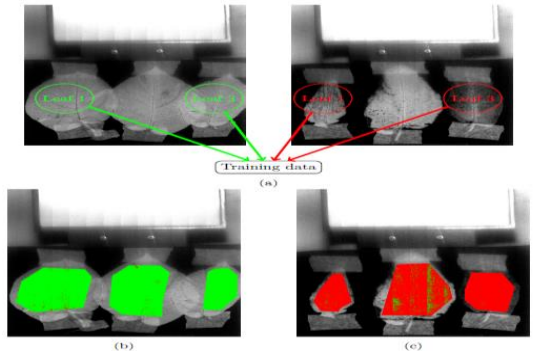
Abstract

Hyperspectral imaging for agricultural applications provides a solution for non-destructive, large-area crop monitoring. A linear variable filter (LVF) was developed and implemented into a prototype hyperspectral imaging camera that demonstrated good spectral performance between 450 and 900 nm. Results are promising for an entry-level, low-cost hyperspectral imaging solution for agriculture applications.



Prototype HCC assembly with internals exposed and as a final compact design. (Insert: LVF)



Supervised classification of the HCC image " using a trained SVM

Project Description

A linear variable filter (LVF) was developed using UWS patent protected process which enables large batch production of low-cost LVF. A prototype hyperspectral crop imaging camera (HCC) is developed using LVF to replace large volume and high cost monochromator. This prototype camera demonstrated good spectral performance between 450 and 900 nm. Equipped with a feature extraction and classification algorithm, the proposed system can be used to determine potato plant health with 88% accuracy. This algorithm was also capable of species identification and has been demonstrated capable of differentiating between rocket, lettuce, and spinach.

Key Results, Conclusions, Comments, Impact

- A cost-effective visible-to-near-infrared LVF was developed;
- This HSI prototype camera was comparable in performance to the reference commercial alternatives while only costing approximately 1/10 of the price;
- The total volume of the portable, handheld prototype is 150 mm x 120 mm x 100 mm and weighs 650 g.
- An algorithm for the HCC system shows good feature extraction and SVM classification between similar leaf varieties while also achieving 88% accuracy in discriminating healthy and late-blight-expressing classes of potato plant leaves.
- These results are promising for future applications of the low-cost HSI camera, including potential in aerial and satellite monitoring.

Refs & links: Vol. 59, No. 5 / 10 February 2020 / Applied Optics A16
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