Public Abstract

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Title:DEVELOPMENT OF A MULTISPECTRAL SENSOR FOR CROP CANOPY TEMPERATURE MEASUREMENT

The Multispectral System for Imaging of a Crop Canopy (MSICC) that combines a miniature long wavelength infrared (LWIR) camera with a visible camera was developed to capture a field of view and derive a plant specific temperature measurement. The overall project included the development of electronics and firmware used to integrate the two cameras into a deployable system, the calibration that converted LWIR images into thermal measurements, the post-processing techniques used on visible camera images, and the field operation of the instrument as a static and mobile device.

The electronic system used a microprocessor to control the operations of the LWIR and visible cameras and to save and display images. The LWIR camera was calibrated for thermal measurement to an accuracy of 0.65 ºC by relating pixel output to a temperature measurement. The visible camera, through processing to identify plants within an image, provided a binary mask to identify crop/non-crop components within its field of view. The mask was then used to obtain a region of interest (ROI) from the thermal image over which data were integrated to create a crop temperature measurement.

The MSICC, paired with an infrared thermometer for comparison, collected data at high temporal resolution on three different soybean plots during September and October 2016. It was capable of removing shaded areas and soil from the ROI, based upon monochrome image intensity, from thermal images to produce temperature measurements more representative of the plant canopy.

Hardware, software, and image processing improvements facilitated use of the MSICC as a mobile sensor to identify spatial variability. This instrument gathered high spatial resolution data on two different sets of corn plots during June 2017. The effectiveness of two color-based vegetative indices for defining the ROI was gauged on plots with different percent canopy cover. The MSICC was able to discern a significant difference in temperature between plants growing in shallow and deep topsoil plots on a day with high temperature and low soil moisture. Due to its ability to remove non-crop background, this instrument should be able to provide accurate crop temperature measurements earlier in the growing season than other methods.