

Application of UAV-based RGB Images for the Growth Estimation of Vegetable Crops

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Abstract

On-site monitoring of vegetable growth parameters, such as leaf length, leaf area, and fresh weight, in an agricultural field can provide useful information for farmers to establish farm management strategies suitable for optimum production of vegetables. Unmanned Aerial Vehicles (UAVs) are currently gaining a growing interest for agricultural applications. This study reports on validation testing of previously developed vegetable growth estimation models based on UAV-based RGB images for white radish and Chinese cabbage. Specific objective was to investigate the potential of the UAV-based RGB camera system for effectively quantifying temporal and spatial variability in the growth status of white radish and Chinese cabbage in a field. RGB images were acquired based on an automated flight mission with a multi-rotor UAV equipped with a low-cost RGB camera while automatically tracking on a predefined path. The acquired images were initially geo-located based on the log data of flight information saved into the UAV, and then mosaicked using a commercial image processing software. Otsu threshold-based crop coverage and DSM-based crop height were used as two predictor variables of the previously developed multiple linear regression models to estimate growth parameters of vegetables. The predictive capabilities of the UAV sensing system for estimating the growth parameters of the two vegetables were evaluated quantitatively by comparing to ground truth data. There were highly linear relationships between the actual and estimated leaf lengths, widths, and fresh weights, showing coefficients of determination up to 0.7. However, there were differences in slope between the ground truth and estimated values lower than 0.5, thereby requiring the use of a site-specific normalization method.

Keywords

UAV, Growth model, Crop coverage, Crop height, Otsu threshold

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