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Remote sensing of vegetation from UAS platforms using RGB camera, lightweight multispectral and thermal imaging sensors

Parivash Paridad (1), Luciana Giuzio (2), Silvano Fortunato Dal Sasso (1), Mauro Fiorentino (1), and Salvatore Manfreda (1)

(1) University of Basilicata, DiCEM, Potenza, Italy (parivash.paridad@unibas.it), (2) Spin-off Wat-tube S.r.l. University of Basilicata, Potenza, Italy

Understanding the spatial and temporal dynamics of vegetation monitoring and water stress in crops is essential for water resources management in agricultural fields and inferring land–atmosphere interactions. The characterization of vegetation biophysical variables in heterogeneous fields is limited by high spatial resolution satellite sensors, which lack the spectral resolution required for vegetation monitoring; and, by the physical constraints of ground point measurements. Unmanned Aerial Systems (UASs) represent an option to fill the gap in precision agriculture between satellite imagery and ground point measurements, and managed to compete successfully with these traditional remote sensing acquisition platforms by providing fast and low-cost high spatial resolution products with high revisit frequency. The present research gives a description on generating high-resolution remote sensing products using a rotary wing UAS equipped with thermal and multispectral imaging sensors in a vineyard. It also focuses on generating different vegetation indices such as: Excess Green Index (ExG), Normalized Green-Red Difference Index (NGRDI), Normalized Difference Vegetation Index (NDVI), and Crop Water Stress Index (CWSI) derived from different cameras. The use of such indices is explored in order to evaluate the potential of low cost technologies for precision viticulture. We carried out three surveys with a DJI Phantom 4 Pro on 22 May, 23 June and 28 July 2017, over the vineyards of Maschito located in Basilicata region in the south of Italy. The UAS is equipped with an RGB camera and in addition, we have mounted a Thermal and a Multispectral camera on board. The thermal camera applied was a FLIR Tau2 operating in the wavelengths of 7.5 – 13.5 μm. We calculated Vegetation Indices (VI) such as CWSI based on canopy temperature in heterogeneous vineyards. The multispectral images were obtained using a TETRACAM- ADC SNAP camera in a wavelength range of 700 - 1000 nm, and later processed to extract some Vegetation Indices (VI) such as NDVI. The vegetation indices obtained with the different sensors have been compared with the aim to identify the ability of each one to capture and describe properly the spatial characteristics of vegetation. This study demonstrates the great potential of high-resolution UAS data and photogrammetric techniques applied in the agriculture framework suggesting that these instruments represent a fast, reliable, and cost-effective resource in crop assessment for precision farming applications.

Keywords: Multispectral, remote sensing, thermal, Unmanned Aerial Systems (UASs), vineyard, water stress detection