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Multispectral data processing from unmanned aerial vehicles: application in precision agriculture using different sensors and platforms

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Unmanned aerial vehicles (UAVs) in combination with consumer grade cameras have become standard tools for photogrammetric applications and surveying. The recent generation of multispectral, cost-efficient and lightweight cameras has fostered a breakthrough in the practical application of UAVs for precision agriculture. For this application, multispectral cameras typically use Green, Red, Red-Edge (RE) and Near Infrared (NIR) wavebands to capture both visible and invisible images of crops and vegetation. These bands are very effective for deriving characteristics like soil productivity, plant health and overall growth. However, the quality of results is affected by the sensor architecture, the spatial and spectral resolutions, the pattern of image collection, and the processing of the multispectral images. In particular, collecting data with multiple sensors requires an accurate spatial co-registration of the various UAV image datasets. Multispectral processed data in precision agriculture are mainly presented as orthorectified mosaics used to export information maps and vegetation indices. This work aims to investigate the acquisition parameters and processing approaches of this new type of image data in order to generate orthoimages using different sensors and UAV platforms. Within our experimental area we placed a grid of artificial targets, whose position was determined with differential global positioning system (dGPS) measurements. Targets were used as ground control points to georeference the images and as checkpoints to verify the accuracy of the georeferenced mosaics.

The primary aim is to present a method for the spatial co-registration of visible, Red-Edge, and NIR image sets. To demonstrate the applicability and accuracy of our methodology, multi-sensor datasets were collected over the same area and approximately at the same time using the fixed-wing UAV senseFly “eBee”. The images were acquired with the camera Canon S110 RGB, the multispectral cameras Canon S110 NIR and S110 RE and with the multi-camera system Parrot Sequoia, which is composed of single-band cameras (Green, Red, Red Edge, NIR and RGB). Imagery from each sensor was georeferenced and mosaicked with the commercial software Agisoft PhotoScan Pro and different approaches for image orientation were compared. To assess the overall spatial accuracy of each dataset the root mean square error was computed between check point coordinates measured with dGPS and coordinates retrieved from georeferenced image mosaics. Additionally, image datasets from different UAV platforms (i.e. DJI Phantom 4Pro, DJI Phantom 3 professional, and DJI Inspire 1 Pro) were acquired over the same area and the spatial accuracy of the orthoimages was evaluated.