Volume XXXIX-B1

Int. Arch. Photogramm. Remote Sens. Spatial Inf. Sci., XXXIX-B1, 485-490, 2012
www.int-arch-photogramm-remote-sens-spatial-inf-sci.net/XXXIX-B1/485/2012/
doi:10.5194/isprsarchives-XXXIX-B1-485-2012

MAPPING CROP STATUS FROM AN UNMANNED AERIAL VEHICLE FOR PRECISION AGRICULTURE APPLICATIONS

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Keywords: Agriculture, Mapping, Mosaic, Spectral, Satellite, Image

Abstract. Remote sensing system mounted on unmanned aerial vehicle (UAV) could provide a complementary means to the conventional satellite and aerial remote sensing solutions especially for the applications of precision agriculture. UAV remote sensing offers a great flexibility to quickly acquire field data in sufficient spatial and spectral resolution at low cost. However a major problem of UAV is the high instability due to the low-end equipments and difficult environment situation, and this leads to image sensor being mostly operated under a highly uncertain configuration. Thus UAV images exhibit considerable derivation in spatial orientation, large geometric and spectral distortion, and low signal-to-noise ratio (SNR). To achieve the objectives of agricultural mapping from UAV, we apply a micro-helicopter UAV with a multiple spectral camera mounted and develop a framework to process UAV images. A very important processing is to generate mosaic image which can be aligned with maps for later GIS integration. With appropriate geometric calibration applied, we first decompose a homography of consecutive image pairs into a rotational component and a simple perspective component, and apply a linear interpolation to the angle of the rotational component, followed by a linear matrix interpolation operator to the perspective component, and this results in an equivalent transformation but ensures a smooth evolution between two images. Lastly to demonstrate the potential of UAV images to precision agriculture application, we perform spectral processing to derive vegetation indices (VIs) maps of crop, and also show the comparison with satellite imagery. Through this paper, we demonstrate that it is highly feasible to generate quantitative mapping products such as crop stress maps from UAV images, and suggest that UAV remote sensing is very valuable for the applications of precision agriculture.

Conference Paper (PDF, 460 KB)

Citation: Guo, T., Kujirai, T., and Watanabe, T.: MAPPING CROP STATUS FROM AN UNMANNED AERIAL VEHICLE FOR PRECISION AGRICULTURE APPLICATIONS, Int. Arch. Photogramm. Remote Sens. Spatial Inf. Sci., XXXIX-B1, 485-490, doi:10.5194/isprsarchives-XXXIX-B1-485-2012, 2012.

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