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ORTHO-RECTIFICATION OF NARROW BAND MULTI-SPECTRAL IMAGERY ASSISTED BY DSLR RGB IMAGERY ACQUIRED BY A FIXED-WING UAS

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Abstract. Miniature Multiple Camera Array (MiniMCA-12) is a frame-based multilens/multispectral sensor composed of 12 lenses with narrow band filters. Due to its small size and light weight, it is suitable to mount on an Unmanned Aerial System (UAS) for acquiring high spectral, spatial and temporal resolution imagery used in various remote sensing applications. However, due to its wavelength range is only 10 nm that results in low image resolution and signal-to-noise ratio which are not suitable for image matching and digital surface model (DSM) generation. In the meantime, the spectral correlation among all 12 bands of MiniMCA images are low, it is difficult to perform tie-point matching and aerial triangulation at the same time. In this study, we thus propose the use of a DSLR camera to assist automatic aerial triangulation of MiniMCA-12 imagery and to produce higher spatial resolution DSM for MiniMCA12 ortho-image generation. Depending on the maximum payload weight of the used UAS, these two kinds of sensors could be collected at the same time or individually. In this study, we adopt a fixed-wing UAS to carry a Canon EOS 5D Mark2 DSLR camera and a MiniMCA-12 multi-spectral camera. For the purpose to perform automatic aerial triangulation between a DSLR camera and the MiniMCA-12, we choose one master band from MiniMCA-12 whose spectral range has overlap with the DSLR camera. However, all lenses of MiniMCA-12 have different perspective centers and viewing angles, the original 12 channels have significant band misregistration effect. Thus, the first issue encountered is to reduce the band misregistration effect. Due to all 12 MiniMCA lenses being frame-based, their spatial offsets are smaller than 15 cm and all images are almost 98% overlapped, we thus propose a **modified projective transformation** (MPT) method together with two systematic error correction procedures to register all 12 bands of imagery on the same image space. It means that those 12 bands of images acquired at the same exposure time will have same interior orientation parameters (IOPs) and exterior orientation parameters (EOPs) after band-to-band registration (BBR). Thus, in the aerial triangulation stage, the master band of MiniMCA-12 was treated as a reference channel to link with DSLR RGB images. It means, all reference images from the master band of MiniMCA-12 and all RGB images were triangulated at the same time with same coordinate system of ground control points (GCP). Due to the spatial resolution of RGB images is higher than the MiniMCA-12, the GCP can be marked on the RGB images only even they cannot be recognized on the MiniMCA images. Furthermore, a one meter gridded digital surface model (DSM) is created by the RGB images and applied to the MiniMCA imagery for ortho-rectification. Quantitative error analyses show that the proposed BBR scheme can achieve 0.33 pixels of average misregistration residuals length and the co-registration errors among 12 MiniMCA ortho-images and between MiniMCA and Canon RGB ortho-images are all less than 0.6 pixels. The experimental results demonstrate that the proposed method is robust, reliable and accurate for future remote sensing applications.

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