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| **Automated Georectification, Mosaicking and 3D Point Cloud Generation for Pushbroom Hyperspectral Sensors** |
| **Introduction/Aim:**  Hyperspectral sensors mounted on unmanned aerial vehicles (UAV) allow high-resolution multi-temporal spectral analysis for a range of remote sensing applications. However, although accurate onboard navigation sensors track the moment-to-moment pose of the UAV in flight, geometric distortions are introduced into the hyperspectral data cubes. Consequently, considerable time-consuming (user/manual) post-processing rectification effort is generally required to retrieve geometrically accurate mosaics of the scanned data sets. Moreover, due to the line-scan nature of many hyperspectral sensors and users are unable to exploit structure from motion (SfM) techniques, so only 2D mosaics are created.  **Methods:**  To address this, we propose a fast, automated and computationally robust georectification and mosaicking technique that also generates 3D hyperspectral point clouds. The technique first morphologically and geometrically examines (and, if possible, repairs) poorly constructed individual hyperspectral cubes before aligning these cubes into swaths. The luminance of each individual cube is estimated and normalised, prior being integrated into a swath of images. The hyperspectral swaths are co-registered to a targeted element of a luminance-normalised orthomosaic obtained using a standard red-green-blue (RGB) camera and SfM. To avoid computationally intensive image processing operations such as 2D convolutions, key elements of the orthomosaic are identified using pixel masks, pixel index manipulation and nearest neighbour searches. Maximally Stable Extremal Regions (MSER) and Speeded-Up Robust Feature (SURF) extraction are then combined with Maximum Likelihood Sample Consensus (MLESAC) feature matching to generate the best geo-metric transformation model for each swath. This geometrically transforms and merges individual push-broom scanlines into a single spatially continuous hyperspectral mosaic; and this geo-rectified 2D hyperspectral mosaic is then converted into a 3D hyperspectral point cloud by aligning the hyperspectral mosaic with the RGB point cloud used to create the orthomosaic obtained using SfM.  **Results:**  High spatial accuracy is demonstrated. Hyperspectral mosaics with 5cm spatial resolution were mosaicked with root mean square positional accuracies of 0.42 m. The technique was tested on five scenes comprising two types of landscape. The entire process, which is coded in MATLAB, takes around twenty minutes to process data sets covering around 30Ha at 5cm resolution on a laptop with 32GB RAM and an Intel® Core i7-8850H CPU running at 2.60GHz.  **Conclusion:** |