Accuracy Assessment of Bundle Adjustment with UAV Based on Images of Tropical Forest Using Sparse Control

Adilson Berveglieri, Raquel Oliveira, Alexandre Mainardi and Antonio Tommaselli (Brazil)

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SUMMARY

The conservation and recovery of native forests are global needs widely recognized, and these tasks require updated maps. Mapping techniques have evolved but there is a need for high temporal frequency, such as the case of environmental monitoring. Aerial and orbital imagery can be used for large area but the spatial resolution is limited and these techniques are not cost effective for small areas. However, for smaller areas as remaining forests, the use of images collected by Unmanned Aerial Vehicle (UAV) is feasible due to the lower costs and the possibility for acquisition of images with suitable spatial and temporal frequency. Tropical forests have dense vegetation areas being difficult to set ground control. Besides the vegetation canopy is sometimes homogeneous, making troublesome tie point generation and transfer. This work aims at performing a preliminary study on the image orientation and Digital Surface Model (DSM) generation in forest areas using images acquired with a Sony Nex camera onboard of an UAV. The coordinates of the camera Perspective Centres (PCs) were directly determined with a dual frequency receiver and the camera was stabilized with a gimbal. Ground Control Points (GCPs) can be determined only at the beginning of the first strip or end of the second one. Tie points were automatically determined and checked manually, and Bundle Block Adjustment (BBA) was performed with weighted constraints in PC positions and in GCP. Because GCPs can be located only outside the forests, it is relevant to assess the effects of such a minimum configuration in the results. A flight with an UAV was carried out to acquire 67 images at two flight strips over a dense tropical forest area. GCPs (pre-signalised targets) were only surveyed at the end of the flight strips to be used in the proposed technique. A BBA was performed considering several configurations for GCPs, initial EOPs with constraints in position, and attitude angles as unknowns. A DSM was also produced to check the resulting point clouds. A few checkpoints, available inside of the forest, were introduced into the BBA to assess the technique. Then, the analysis of results was performed on the discrepancies obtained at checkpoints. The experiments showed that the discrepancies were compatible with the expected accuracy around 20 cm in the object space, and the generated DSM can be used to estimate canopy height and other useful parameters. The detailed results will be presented and discussed, as well as the advantages and drawbacks of the proposed technique.