Integrating methods for sub-canopy RPAS structure from motion (SfM) mapping of geomorphic habitat in dense understorey riparian forests

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ABSTRACT

The use of remotely piloted aircraft systems (RPAS, colloquially "drones") for mapping and collecting scientific data has exploded in the last decade, but is now well-represented in the literature (e.g. Flener et al. 2013; Koci et al. 2017; Meinen and Robinson 2020; Rivas Casado et al. 2017; Rusnak et al. 2018). RPAS have been used within the context of geomorphological investigations for riparian corridor mapping (Grau et al. 2021), riverscape mapping (Dietrich 2017), representing alluvial debris fans (Westoby et al. 2012), measuring channel bank erosion, and flood monitoring (Smith et al. 2014; Tamminga et al. 2015). A key limitation cited in these studies is the obstacle that dense vegetation poses in imagery capture and development of an accurate digital terrain model (DTM), particularly in forested areas and riparian zones (Meng et al. 2017). This study advances the methods of Krisanski et al. (2020) and Koci et al. (2017) by combining hand-held and airborne photogrammetry in densely vegetated river reaches with high sub-canopy structural diversity and biomass. This application of sub-canopy structure from motion with multi-view stereo (SfM-MVS) photogrammetry is then used to develop a 3D model of the selected study reaches with the potential for using this in reach-scale geomorphic habitat mapping, or streamflow modelling. The study also addresses issues related to RPAS flight planning when automation is not possible, options for ground surveys in densely vegetated river reaches, and the use of the 180° and 360° panorama function for image capture available on the DJI Phantom 4 drone. The mapping strategy developed in this pilot study is applied along a reach of the Barlee Brook in the southwest of Western Australia. This reach has undergone a shift from perennial to non-perennial flow since the early-2000s, and so presents the opportunity to monitor geomorphic change using the SfM-MVS method in future studies. This research is at the cutting-edge of progressing technological advancements within this field in using RPAS and structure from motion (SfM) techniques for three-dimensional geomorphic habitat mapping and analysis in sub-canopy environments with a dense understory.

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