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Space-time image velocimetry for remote streamflow measurement using satellite video

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Abstract: Accurate streamflow measurements are essential for developing rating curves that convert water level data into discharge time series. Often these measurements are not available across the full flow regime due to access and safety, particularly in remote areas. Surface velocity measurements achieved through video image analysis is becoming an increasingly popular method to estimate streamflow, driven by increasing availability of video from remote pilot aircraft (RPA, or drone) and camera technology (BoM, 2021). These methods are particularly well suited to estimate the visible flow during high flow events, which are typically the least measured due to the hazards involved in taking measurements during these conditions.

Video capture of high flow events from ground-based methods can be difficult, due to fast catchment response times, access difficulties, and the field of view of the camera being too narrow to capture the full extent of river flow. Remotely sensed video products are becoming more accessible and can respond quickly to unexpected flood events, with video tasking possible within short time frames (typically within one day). However, even the highest resolution products available (~1m pixels) are relatively coarse for this application to identify features on the water surface.

This work has evaluated the potential for Space Time Image Velocimetry (STIV) method (Fujita et al., 2020) to estimate discharge using video captured from the Planet SkySat constellation during a flood recession event on the Burdekin River, Queensland, in February 2025. A workflow to stabilise and orthorectify the video frames was developed, a critical requirement to apply the STIV method. With this workflow and processing using the HydroSTIV software, streamflow estimates within 10% of the rating curve were derived. Given information on river cross-section and the water level, the study has demonstrated that it is possible to obtain estimates of streamflow remotely. Future work will investigate the conditions under which this approach delivers the highest accuracy to support broader applications.

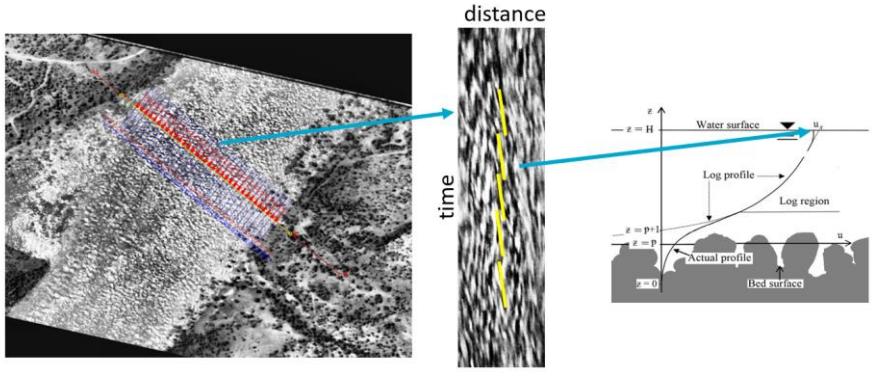

Figure 1 Workflow for estimating surface velocity, and ultimately discharge, from remotely sensed video

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