Airborne Velocimetry experiments at Thur River

Figure 1: Quadrocopter with mounted 4K camera facing plum vertical to ground

Heart of the project is the monitoring of a complex flow situation along a 110° river bend at Eggrankkurve, Thur River, in the framework of revitalization works. Therefore, we are developing and testing a low-cost airborne velocimetry system to measure large scale surface velocity fields. The measurement equipment consists of an ultra-light actioncam and a ready-to-fly lowcost quadrocopter (Fig. 1).

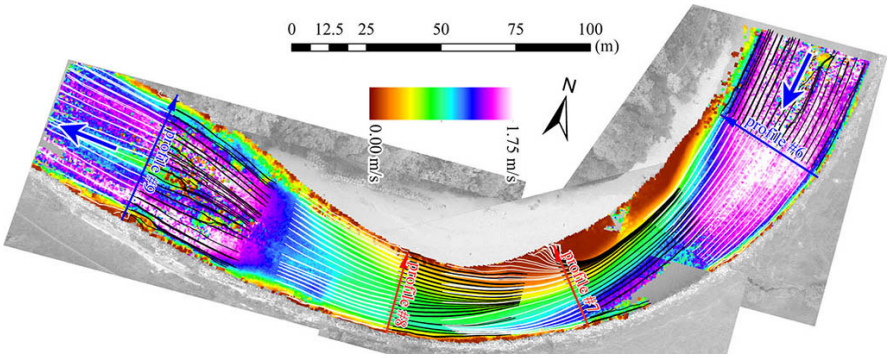

Figure 2: Time- averaged surface velocity field and streamlines

Video recordings are performed from heights between 40 to 90 m covering a total reach length of 300 m, while spruce chips with an edge length of 60 mm are added as tracer particles. Challenging for the image analysis are unsteady camera shakes due to the inevitable non-stable position of the Unmanned Aerial Vehicle (UAV). Each lens-corrected frame is therefore automatically orthorectified to riparian ground reference points as detected by computer vision techniques. The positional error of each point is computed to 0.15–0.40 m, so that the magnitude of the related descaling error is below ±2%, and the error of apparent ground velocity is approximately 0.03 m s^{-1} (maxima typically at 0.05–0.10 m s^{-1}). These values describe the uncertainty added to the subsequently calculated particle image velocity field (Fig. 2). Over the entire reach length the final raster resolution is 1.0×1.0 m^2 with 50% overlap. A comparison to velocity profiles measured simultaneously by a 3D acoustic Doppler current profiler indicates that our new type of velocimetry system is capable to describe time-averaged surface flow fields with high accuracy.

Keywords:	Computer vision, flow visualization and imaging, field studies, PIV, streams and rivers, Unmanned Aerial Vehicle (UAV), velocity measurements
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