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Non-contact flow gauging for the extension and development of rating curves

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Accurate measurement of river discharge is fundamental to understanding hydrological processes, associated hazards and ecological responses within fluvial systems. Established protocols for determining river discharge are partial, predominantly invasive and logistically difficult during high flows. There is demand for new methods for accurate quantification of flow velocity under high-flow/flood conditions to in turn enable better post-event reconstruction of peak discharge. As a consequence considerable effort has been devoted to the development of innovative technologies for the representation of flow in open channels. Remotely operated fixed and mobile systems capable of providing quantitative estimates of instantaneous and time-averaged flow characteristics using non-contact methods has been a major development. Amongst the new approaches for stand-alone continuous monitoring of surface flows is Large Scale Particle Image Velocimetry (LSPIV). Here we adapt the LSPIV concept, to provide continuous discharge measurements in non-uniform channels with complex flow conditions. High Definition videos (1080p; 30fps) of the water surface are acquired at 5 minute intervals. The image is rectified to correct for perspective distortion using a new, open source tool which minimises errors resulting from oblique image capture. Naturally occurring artefacts on the water surface (e.g. bubbles, debris, etc.) are tracked with the Kanade–Lucas–Tomasi (KLT) algorithm. The data generated is in the form of a complex surface water velocity field which can be interrogated to extract a range of hydrological information such as the streamwise velocity at a cross-section of interest, or even allow the interrogation of hydrodynamic flow structures. Here we demonstrate that this approach is capable of generating river discharge data comparable to concurrent measurements made using existing, accepted technologies (e.g. ADCP). The outcome is better constraint and extension of rating curves. The approach is suited to water management authorities throughout Europe who seek ever-increasingly cost-effective and non-invasive techniques for maximising the monitoring capabilities of their operational network.