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Determination of continuous discharge time series based on the optical Particle Tracking Velocity (PTV)

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The importance of optical measurement methods in hydrology is increasing in the last years. In contrast to conventional gauging techniques, they can be applied remotely, making the measurement safe for humans and equipment, even under difficult measurement conditions. One important hydrological parameter to measure is discharge. Deriving discharge with remote sensing can be done by applying particle tracking velocimetry (PTV) in combination with the velocity area method (VAM). VAM is a standardized and established method in hydrology. For reliable discharge results with the VAM, surface flow velocity measurements and thus trackable particles in the case of PTV usage are required across the entire width of the river cross section, which is not always the case in natural observation conditions. To fill these data gaps several statistical methods were investigated that incorporate information provided at different measurement times but with similar discharge conditions.

In this study, data were collected over longer time periods with different cameras at a gauging station of a medium scale river in Saxony, Germany. Stationary cameras recorded short videos, which are used to estimate the velocity distribution at the water surface using PTV incorporated in the FlowVelo tool (Eltner, 2020), and afterwards, to estimate the discharge using VAM. The obtained discharge time series from different cameras and camera positions were used to analyse the performance of different gap filling approaches. The results were compared to discharge and water level measurements of the official gauging station maintained by the federal measuring agency. They show, that the adjustment to the data of the reference measurements increases significantly by application of the gap filling methods. Next steps are to enhance the presented methods by using targeted data filtering and deep learning.

Keywords: *velocity area method, particle tracking velocimetry, camera based discharge estimation*