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Experimental LSPIV configurations for flow observations

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Large Scale Particle Image Velocimetry (LSPIV) is a powerful technique to remotely monitor surface flows based on high-speed cross-correlation between pairs of images. Traditional LSPIV configurations (TLC) involve the use of mast-mounted cameras that are installed along river banks and inclined with respect to the water surface to capture large fields of view. Such experimental apparatuses require the images to be orthorectified before LSPIV processing and, therefore, imply the acquisition of ground reference points (GRPs). In a recent contribution by the authors [Tauro et al., Water Resources Research 2014], a novel experimental approach has been proposed to perform remote image calibration based on the use of laser modules. Specifically, a novel self-contained LSPIV configuration (NLC) comprising a miniature camera with its axis perpendicular to the stream surface and two green laser modules oriented orthogonally to the flow are used to develop surface flow maps. Such approach allows for circumventing image orthorectification and prevents in-the-field acquisition of GRPs.

In this contribution, we apply and compare findings obtained with the two LSPIV experimental configurations on the Rio Cordon mountainous stream in the Italian Alps. Specifically, we consider an artificial rectilinear reach of the stream that extends for approximately 10 m, is less than 1 m wide, and 9 cm deep. We perform benchmark flow measurements with an impeller flowmeter up to 3 cm below the stream surface. Further, we execute a set of 10 videos with each LSPIV configuration during the same day by using both naturally occurring and artificial tracers to enhance image visibility. Experimental findings demonstrate that both sets of data from the LSPIV apparatuses tend to underestimate the actual surface flow velocity. In particular, the methodology is severely affected by illumination issues and inhomogeneous tracer density. Further, both LSPIV configurations suffer from a number of practical criticalities that may hamper their implementation in topographically-difficult to access areas.