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Generating videos of synthetic river flow for the evaluation of image-based techniques for surface velocity determination

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Several studies have been carried out to evaluate image-based solutions for velocity measurement and discharge determination in river. However, these studies are limited because it is difficult to know the reference surface velocity field accurately. These data are usually extrapolated from measurement within the water column or integrated over a cross-section to determine the discharge to be compared with a reference, which is uncertain itself. Measurement uncertainties are difficult to quantify and cannot be neglected usually.

The only solution that arises to get a flow with a known surface velocity reference is synthetic imaging: we generate artificial images on which particles movements are known everywhere. However, these generators must allow a comparison between simulations and measurements for a wide range of conditions representative of the situations observed in the natural environment. Several Synthetic Image Generators have been designed for laboratory PIV but the generated images are made of white particles moving on a dark background. Such images are not representative of river applications with turbulence figures, foam, debris, sunlight effects but also some homogeneous areas with poor contrast where we can sometimes see the river bed through.

We propose a novel method to generate images from a synthetic river scene with accurate surface velocity references. It is based on the 3D computer graphics tool Blender which integrates a dedicated fluid simulation tool, Mantaflow. Blender allows many different configurations by playing on the modeling of the river, the surrounding objects, the textures and optical properties of the materials but also on the lighting and the camera settings and position. Mantaflow is then used to model and extract the characteristics (velocities, positions in time) of a flow that looks similar to real-life situations. The first synthetic videos obtained were used to study the sensitivity of the velocity results to the image-based velocimetry algorithm, its parameters and user choices.