Automatic Digital Photogrammetry In Gravel Bed Rivers: A Low-Cost Tool To Study Channel Morphodynamics

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Episodic erosion, transport and deposition of sediments produce changes in river's channel morphology. These changes are directly related to flow hydraulics and bed material availability, supply and transport. The study of channel morphodynamics involves measurements of flow hydraulics, sediment transport and channel deformation. Some of these measurements are limited to the acquisition of field data and, consequently, require the integration of modelling approaches for a better quantification of processes. Field data acquisition is also limited by the time needed to obtain reliable and representative measurements, and by the spatial and temporal resolution of these.

Recent advances in topography are offering the opportunity to obtain topographic models at unprecedented resolutions. Automatic digital photogrammetry or Structure from Motion possesses an unprecedented trilogy: speed, cost and resolution. The application of this technique allows acquiring repeat high resolution topographic models that may improve our understanding in how channel morphology changes and which are the main drivers and interactions.

In this paper we present how automatic digital photogrammetry can be used to rapidly acquire high resolution topography at large scales, and how these data sets may help in the quantification of channel morphodynamics. Specifically, we present field examples in the background of the research project MorphSed (www.morphsed.es). First, we describe a simple workflow to rapidly extract bed topography and roughness of a 13-km wandering river. Secondly, we use this data to run a 2d hydraulic model and simulate the hydraulic conditions during a flood event. Finally, we model rapid topographic changes associated to channel disturbances due to: (i) in-channel gravel extractions and (ii) flood events. The examples provided in this paper show the broader space-time perspective high resolution topography data is now offering to address basic questions about how fluvial systems work.