Professorship of Remote Sensing Applications
TUM School of Engineering and Design
Technische Universität München

Master Thesis

Monitoring and predicting river sediment dynamics using UAV photogrammetry and deep learning

In the context of global change, including climate change and other alterations driven by human and natural causes, monitoring and predicting sediment dynamics are crucial role for understanding river systems and their evolution. These efforts have applications in fields such as flood control, lotic system management, river restoration, and hydropower production.

To support river monitoring, Uncrewed Aerial Vehicles (UAVs) serve as powerful tools, enabling the study of large areas (e.g., several hundred hectares) with high spatio-temporal resolution (sub-cm). UAVs can capture bedload sediment transport and deposition at the scale of individual hydrological events. However, the aerial imagery (e.g., RGB, infrared) and derived datasets from photogrammetric reconstruction (e.g., 3D point clouds) produced by UAV technology require an additional layer of manual interpretation.

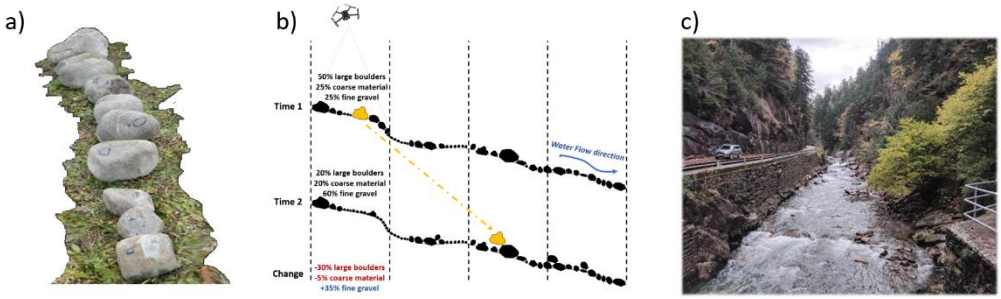

Figure 1. a) 3D point cloud model of a group of boulders released in the Aragón river. b) Graphical example of the proposed approach consisting on automatic granulometry change detection and tracking of individual boulders with UAV imagery. c) Photo of one of the study sites in the Aragón river located in the Hecho valley (Spain).

In this context, to reduce human labour and interpretation uncertainties, the objectives of this thesis are: a) To develop deep learning-based models (i.e., convolutional neural networks) applied to UAV imagery and reconstructed 3D models to facilitate wall-to-wall granulometric analysis (Fig.1b) of a riverbed section in the Hecho Valley (Spanish Pyrenees) (Fig.1c); and b) To explore deep learning techniques for recognizing individual boulders released into the river flow, which were previously 3D-reconstructed in the laboratory (Fig.1a,b).

The student requires experience with photogrammetric data processing and point cloud analysis, basic programming skills (preferably Python) and interest in machine learning/deep learning algorithms/techniques.

Location: TUM Professorship of Remote Sensing Applications

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