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

Bachelor/Master Thesis

Monitoring and predicting river sediment dynamics from photogrammetric data

Understanding sediment dynamics is essential for interpreting how riverbeds respond to hydrological events and for managing rivers under changing environmental conditions. High-resolution UAV and photogrammetric surveys now allow detailed grain-scale reconstruction of riverbed surfaces. Recent advances enable the automatic segmentation and sizing of surface gravels. Building on this progress, this thesis focuses on the next frontier in gravel-bed characterization: the 3D structural organization of grains within the riverbed surface.

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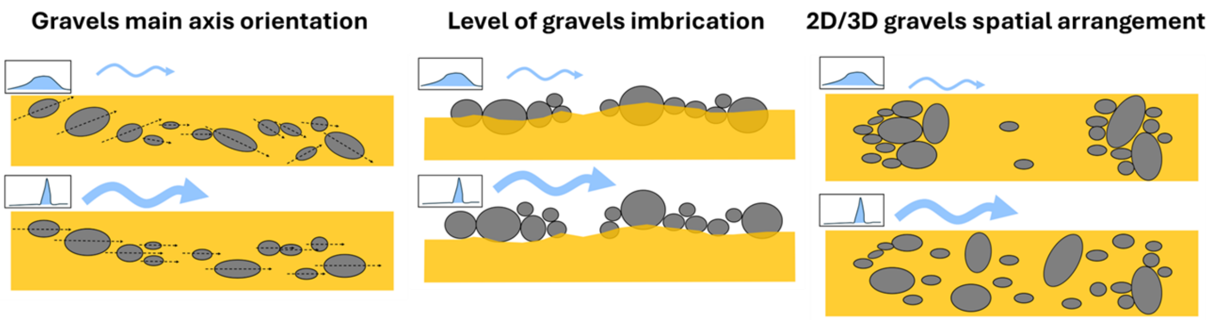
The objectives of the thesis are to develop and test methods to quantify:

- Gravel imbrication: the relative vertical positioning, nesting, and exposure of individual grains with respect to a local reference surface.
- Gravel clustering and spatial arrangement: the degree to which grains align, group, or organize around larger particles, and how this structure reflects preceding hydrological conditions.



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These metrics are key to describing the status of the riverbed, its stability, packing structure, and susceptibility to sediment mobilization, thereby offering new insights into the nonlinear relationship between flow conditions and sediment transport.

High-resolution multi-temporal photogrammetric datasets are available from different field sites in Bavaria, Germany, and the Pyrenees, Spain. Possible methodological approaches include 3D spatial analysis, point cloud geometry, surface modelling, and machine/deep learning techniques for pattern recognition.

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.

Supervision: Prof. Dr. Katharina Anders (TUM), Dr. Carmelo Juez (IPE)

Collaborators: Instituto Pirenaico de Ecología – Spanish National Research Council (IPE-CSIC)

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