M.Sc. Topic
The infiltration of fine sediments into interstices of riverbeds has an immense impact on riverine ecology and has been investigated intensively in both laboratory and field experiments. So far, most laboratory investigations measured infiltrated sediment masses using destructive methods. They only allow assessing infiltrated fine-sediment masses at the end of experiments, and cannot monitor the dynamic behavior of clogging processes over time.

The Gamma Ray Attenuation (GRA) method can provide undisturbed measurements of infiltration masses, and therefore is a unique opportunity to monitor infiltration dynamics. However, the experimental design for GRA measurements has numerous parameters that need to be optimized to obtain high-resolution, precise and accurate measurements.

The aim of this thesis is to optimize the experimental setup of GRA setups for sediment infiltration. We will use a statistical approach called model-based optimal design of experiments (MODE). MODE uses simulation tools to predict the prospective experiment. All relevant but unknown system parameters and system dynamics are treated as random variables and random time series in Monte-Carlo simulations of the experiment. By statistical analysis of the simulation results, MODE can estimate the success of an experiment for any given set of design parameters (e.g., shutter duration of the GRA). The success of the experiment, here defined as the accuracy of monitoring sediment dynamics, is used as objective function for optimizing the experiment. The used optimization algorithm (e.g., enumeration, gradient methods, simulated annealing) will depend on the resulting type of optimization problem. At all stages of the work, the system parameters, system uncertainties and the resulting optimal experimental designs need to be reflected with experimental experts.

Prospective Tasks
- Literature review of model-based optimal design of experiments
- Develop a model in Matlab to optimize the experimental setup of GRA
- Estimate the success of an experiment for any given set of design parameters
- Visualization of results and discussion

General Information
- Supervisors: Dr. Ana Gonzales + Dr. Markus Noack
- Theoretic study

Desirable Skills
- Matlab, computer programming
- Enthusiasm in (geo)statistics and optimization

Apply now!
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