Suggested Master of Science project for 1-2 students at the Centre for Mathematical Sciences:

**Calibration of a new PDE-based simulation model of reactive settling in wastewater treatment plants**

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A major challenge for the future is to manage the water cycle more efficiently. This involves many researchers in biology, chemistry, mathematics, control theory, water and environmental science. We analyze, model and simulate the most important part of a sewage treatment plant, namely the active sludge process (see the figure) where bacteria consume nutrients and thereby remove nitrogen and phosphorus from the wastewater. The process consists basically of a biological reactor and a sedimentation tank. The biological reactions is modelled by a system of ordinary differential equations (ODEs) and the processes in the sedimentation tank by nonlinear partial differential equations (PDEs). The supervisors research on nonlinear conservation law PDEs modelling the sedimentation process, where discontinuities (shock waves) in the concentration profiles arise. A new aspect is that some biological reactions take place also in the sedimentation tank. We have access to real data from a pilot plant at Université Laval in Canada. The main tasks of the MSc project work is to implement a new numerical method for a new PDE model of reactive settling and perform calibration of the model to the real data.

**Prerequisites:** Good grades in courses in mathematics (e.g., LTH courses including “Kontinuerliga system”) and numerical analysis.