MSc internship offer at Inria, Montpellier for 4 to 6 months in 2021

November 2020

This research topic is part of the core research activity of the Inria LEMON team. It lies at the intersection between physically-based and statistical modelling. The team is recognized at the national and international levels in the field of porosity models and statistical approaches. Applicants should have a strong interest in the simulation of natural processes and in bridging methodological gaps such as those between physics and statistics.

1 Scientific context

A sound assessment of urban flood hazard requires that a number of hydrodynamic variables (water depth, free surface elevation, flow velocity) be known at a high resolution (typically 1 m). High resolution hazard maps are usually determined from refined two-dimensional (2D) shallow water models (Figure 1, left-hand column). However, High Resolution (HR) 2D modelling of a complete urban area (or even an urban sub-catchment) is extremely time-consuming. In most cases, simulating 1 second requires several CPU seconds. This is incompatible with real-time flood crisis management and/or scenario extensive appraisal.
For this reason, a new generation of 2D models has been under development over the past 20 years: porosity-based shallow water models (see overview here). These models run 10^3 times as fast as conventional 2D models because they use a Low Resolution (LR) description of the urban geometry. Consequently they provide only LR flow fields.

2 Objective

The purpose is to achieve the building of HR hazard maps using only LR (upscaled) hydraulic models (block arrow in Figure 1). To do so, it is necessary to train a learning algorithm to reconstruct HR hazard maps from LR porosity model simulations. The basis for the training are HR hazard maps derived from HR simulations. The purpose is to bypass the HR simulation in the operational phase by using only the LR simulation results and the trained learning approach.
The feasibility of the approach has been proved in the context of a perfect upscaling (see here the preprint of a recently accepted publication). In this work, the upscaled LR flow fields were taken as the exact averages of the HR flow simulations over the coarse

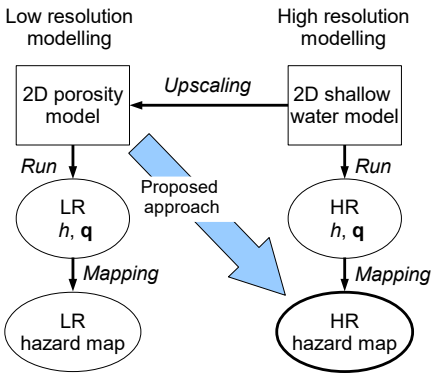

Figure 1: The current state of research and tools. HR: High Resolution. LR: Low Resolution. The target object is the bold ellipse (high resolution risk maps). The solid arrows indicate the readily available processes in the current state of research and technology. The block arrow indicates the intended research path.

grid. The objective of this MSc research topic is to extend the approach to an imperfect upscaling, where the porosity model does not give the exact solution on the LR scale.

3 Additional information

The internship duration is 4 to 6 months, with a regular "gratification" (around 550€/month). It is also worth mentioning that the internship may be followed by a PhD.

Applications should be sent by email to Antoine Rousseau, antoine.rousseau@inria.fr

Required documents

- Master 1 results
- Master 2 results (first semester)
- CV + cover letter
- Name of one reference person for recommendation