

Domain decomposition and intelligent parallelization for flood modeling

Executive summary:

Apply FIFO management of parallel data access to real world flood modeling based on effective domain decompositions.

Key skills required:

good familiarity with C or C++ programming and/or numerical methods and models, some knowledge parallel computing and algorithms

Research teams: ICPS & MecaFlu

Research Unit: ICube Laboratory

Intern tutors: [Jens Gustedt](#)¹, Isabelle Charpentier, Sylvain Weill

Intern level: Master or Engineering student

Internship location: Strasbourg/Illkirch, France

Internship duration: 4 to 6 months

Followed by a PhD: possible

Context

In the framework of the Prim'Eau project of the University of Strasbourg, we study surface runoff for hydrological periods of several days. We use an efficient domain decomposition method that we apply to a real world example of Mutterbach (Moselle) with geological and flood data from the years 1920, 1940 and 2017. As the time and memory usage for these computations is important, we aim to parallelize them.

With our work on *ordered read-write locks*, we proposed a framework for a large set of applications, so-called iterative computations, that has interesting properties, namely equity of all compute tasks and deadlock freeness. To ease the parallelization, this framework will be applied to the efficient domain decomposition. Thereby we aim to treat real world examples faster (speed up) and to increase the data range and precision (size up).

Description

Our goal is to integrate parallelism into the already existing application.

1. The data model of the application has to be refined such that we are able to handle the communication at the boundary of the decomposed domains.
2. A first parallelization that uses only shared memory and our new framework `EiLck` will be undertaken.

¹http://icube-icps.unistra.fr/index.php/Jens_Gustedt

3. The parallel application will be verified for correctness.
4. Rigorous benchmarking will be used to assess possible improvements experimentally.
5. If time permits, a next stage of parallelization may be initiated that uses our framework ORWL that also allows to generalize the approach to distributed platforms such as clusters.

Framework

The internship will start as soon as convenient for a period of 4 to 6 months.

It will take place on the Illkirch university campus, which has a direct tram connection to downtown Strasbourg.

We will establish an internship convention with the student and their home university.

The internship will be paid at the level of the French legal gratuity for interships of about 550 € / month.

Applications

Applications should comprise a short CV and a specific motivation letter, but may additionally contain other information that you think useful for us to appreciate your skills, e.g your grades in relevant courses, work that you have written or letters from actual or former teachers. They should be mailed to Jens Gustedt².

²jens dot gustedt at inria dot fr