Directive-based parallelization of a GPU simulation software

**Implementation of a CUDA-based solver with OpenMP and/or OpenACC directives**

uDeviceX is an open-source software for micro rheology simulations using state-of-the-art Dissipative Particle Dynamics models. With uDeviceX we performed unprecedented simulations of blood flow and CTCs with sub-micron resolution in realistic microfluidic geometries.

uDeviceX [1] (ACM GB Prize Finalist, 2015) has been based on the hybrid MPI+CUDA programming model, targeting clusters of NVIDIA GPUs. Goal of the thesis is to enhance the portability of the code by means of a directive based approach such as OpenMP and OpenACC.

OpenACC can improve the performance portability of uDeviceX and result in a version of the code that targets a broader range of computing platforms as well as future accelerators.

The highly tuned CUDA version will also serve as a benchmark for direct performance assessment of the compiler-based implementation. This work will allow for a study of how performance and portability can be combined using a real-world open-source application code.

This project is suitable for both Master and Bachelor level.

[1] [github.com/uDeviceX/uDeviceX](https://github.com/uDeviceX/uDeviceX)

**PREREQUISITES**

Good Programming Skills  
Desire to Learn and Improvise

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In the CSE Lab, we combine computational methods, computer science tools and domain specific knowledge to solve scientific and engineering problems in areas such as Fluid Mechanics, Nanotechnology and Life Sciences. The core computational competences of our group are in particle methods and in stochastic optimization techniques. Motivated by challenges in application fields, we focus on identifying the common elements among computational techniques and on formulating common methodological, algorithmic and software structures that facilitate their further development.