Bachelor Projects: Flow Simulation on Smartphones

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With compute power in mobile devices increasing, simple simulations become accessible even on these devices already. In the past, a Java/C++-based Lattice Boltzmann simulation LB2M has been developed for Android devices. In the following projects, several extensions to this simulation can be made.
Further reading for all projects: P. Neumann, M. Zellner. Lattice Boltzmann Flow Simulation on Android Devices for Interactive Mobile-Based Learning. Lecture Notes in Computer Science 10104 (Euro-Par 2016: Parallel Processing Workshops), pp. 3-15, 2017
Start time: anytime
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1 Bachelor Project: Towards more complex and flexible geometries and more usability

In this project, the currently supported modes to insert box-shaped obstacles (2D) shall be extended towards drawing and creating more complex geometrical shapes and forms. Besides, multi-touch gestures to steer and investigate the simulation easily and interactively shall be introduced into the software. The outcome of the project shall be a software LB2M in which one can easily draw new obstacles during run time, remove them if not needed anymore and so "play around" with various fluid flow scenarios.
Objectives:

- Getting familiar with the underlying simulation method (Lattice Boltzmann)
- Getting familiar with the software LB2M (Java- and C++-based)
- Implemention of drawing functionality (i.e., dynamically changing grid cells from fluid to obstacle state)
- Implementation of rubber functionality (i.e., removing obstacle cells and filling them with (more or less) valid fluid flow information (density and velocity values from neighboring cells)
- Incorporation of drawing and removal into the menus of the interactive software
- Modification of zoom and rotation of the set up via multi-touch

2 Bachelor Project: Visualisation

LB2M currently visualises the velocity field. In this project, this visualisation shall be extended towards more flexibility. This includes the visualisation of, e.g., pressure values, extraction of single values and plotting them over time in a x-y graph for statistics, or visualisation of stream lines via artificial tracer particles.
Objectives:

- Getting familiar with the underlying simulation method (Lattice Boltzmann)
- Getting familiar with the software LB2M (Java- and C++-based)
- Implementation of pressure/density field visualisation, similar to the velocity field visualisation, and incorporation of a switch and more user-friendly steering of both density and velocity visualisation into the menus of LB2M
- Implementation of cell-wise data extraction and tracking/plotting this information over time
- Incorporation of tracer particles to visualise stream lines; incorporation of this functionality including corresponding parameters into the menus of LB2M
- Optional: incorporation of check-pointing (save-option) to restart a simulation later on from a given point