ADVANCED, HARDWARE-ORIENTED SHALLOW WATER SIMULATIONS BASED ON THE LATTICE-BOLTZMANN METHOD

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Efficient and flexible fluid dynamics solvers based on Lattice-Boltzmann Methods (LBM) for Shallow Water type models and their hardware-oriented implementations are presented. In augmented versions of our previously presented solvers, the mesoscopic nature of the LBM is exploited by modifying its boundary treatment and streaming/collision operators and adapting them to the specified scenario on the particle and/or macroscopic level. This allows for the simulation of complex flows, even involving arbitrary geometry and/or moving boundaries and fluid-structure interaction. In addition, novel numerical techniques for stabilising critical flows that involve dry-states, relying on careful (local) high-pass filtering in the macroscoping quantities and/or confinement of total variations in the particle distributions are described. The hardware-oriented design and parallelisation on all levels is addressed – from vectorisation via the (multi- and many-)core level up to (heterogeneous) distributed memory clusters: The performance-critical building blocks are built on top of a collection of libraries targeting multiple fundamentally different parallel hardware architectures like commodity multicore CPUs, the Cell BE and NVIDIA GPUs.