The lattice Boltzmann method for complex flow simulation

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The lattice Boltzmann method (LBM), is an on-lattice Lagrangian solver for the phase-space discretized Boltzmann equation. Over the past couple of decades it has grown into a rather popular alternative to classical numerical solvers for low Mach number flows.
In its most basic form, the scheme solves Boltzmann's equation (up to the Navier-Stokes scale) for a single species isothermal low Mach number flow. To go towards applications involving more complex physics, i.e. thermal multi-species flows, the scheme has to be extended accordingly.

During this talk, the classical LBM (derivation, algorithmic advantages, limitations) will be reviewed. Then major obstacles associated with thermal multi-species flow simulations with the LBM will discussed, and finally possible solutions to these issues will be enumerated and illustrated with numerical examples.

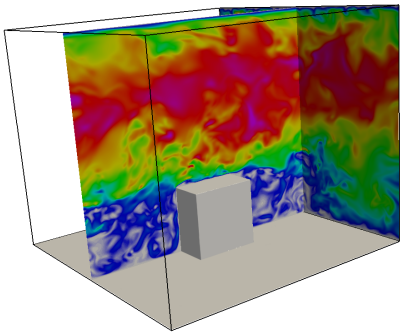

Figure 1: Instantaneous velocity field for channel flow with heated obstacle at a Reynolds number of 13100

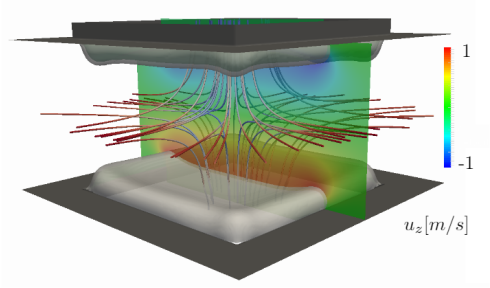

Figure 2: Propane/Air 3-D counter-flow flame steady-state velocity field, streamlines and reaction rate iso-surfaces