

Multiscale material modelling through interaction forces in an LBM for solids



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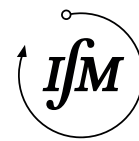
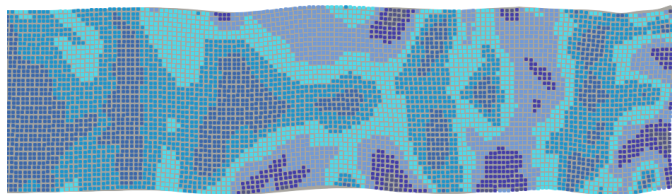
SOLIDLBM: A novel approach for computational solid and fracture mechanics

Master-Thesis: Mechanics / CE / Mechanical Engineering / Civil Engineering

8. Juni 2025

Lattice Boltzmann methods (LBMs) stem from the computation of fluid flows. They work on the mesoscale with a statistical formulation based in kinetic theory. These methods promise great gains in the computational performance with good scaling for large systems. In recent years, an effort has been undertaken to develop LBMs for the simulation of solid mechanics as well.

For solids, long-range interactions are crucial. These are incorporated through force terms, which accounts for an important part of the constitutive model. The latest advancement handles non-linear solids with typical macroscopic stress-strain-relations.



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SolidLBM

[https://git.rwth-aachen.de/
SolidLBM/pyLBM](https://git.rwth-aachen.de/SolidLBM/pyLBM)

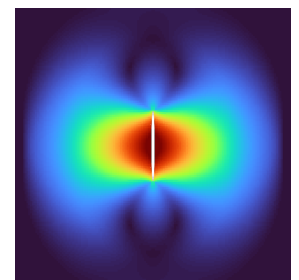
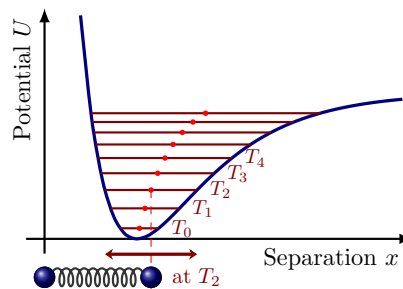
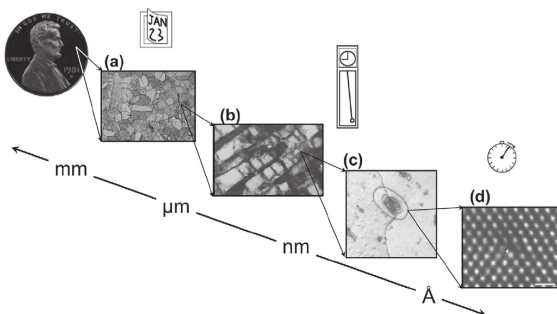


Scope of the thesis

Interaction forces are important in *molecular dynamics* (MD) simulations. Through coarse-graining, this could be used to model solids based on microscopic information, extending the capabilities of the LBM for solids.

The following tasks could be investigated in a master's thesis:

- definition a coarse-graining procedure
- evaluation of molecular interaction forces
- implementation of the algorithm in the software
- validation through benchmarks and comparison with MD simulations



Requirements

continuum mechanics
(elastodynamics);
basics in programming
(object-orientation & Python)

The specific tasks will be discussed and assigned individually.

