CARL VON OSSIETZKY universität OLDENBURG

ForWind Center for Wind Energy Research

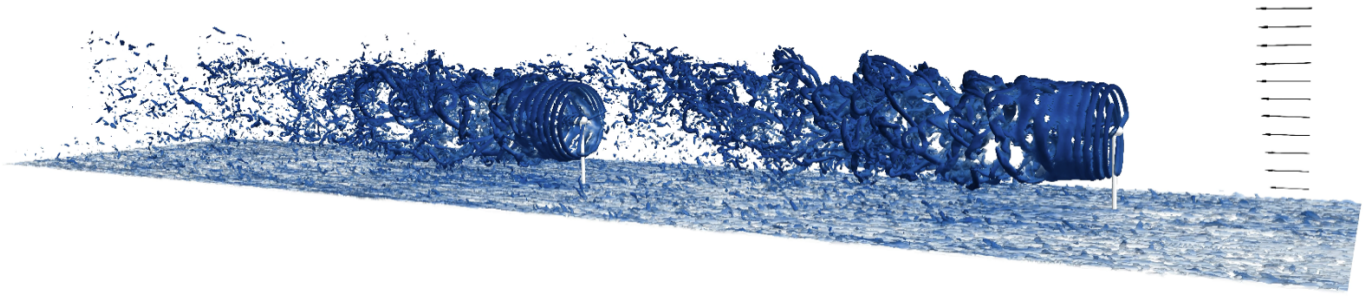
Bachelor or Master Theses:

Ultra-efficient High-fidelity Wind Farm Simulations Using GPU-resident Lattice Boltzmann Methods

AG TWiSt – Turbulence, Wind Energy and Stochastics

Modelling the interaction of wind turbines with the atmospheric boundary layer and the wakes of upstream turbines is of crucial importance for almost all engineering aspects of wind power development. Computational fluid dynamics (CFD), in particular Large-eddy simulation (LES), can provide valuable insights of the underlying flow phenomena. However, LES using classical numerical approaches typically comes at an immense computational cost that limits the use of the method significantly.

Over the past decade, modern graphics processing units (GPUs) and the development of suitable numerical approaches like the Lattice Boltzmann Method (LBM) have enabled significant performance gains for LES, and even facilitated the use of LES in the industrial practice. In the AG TWiSt, we develop and investigate a specific LBM-LES framework for various applications in wind energy. In this field, we can offer various topics for Bachelor or Master theses. Depending your interest, the thesis can revolve around the development and implementation of new model capabilities, computational optimizations of the existing solver, or the use of the framework in its current state (involving less coding) for validation studies or investigations of various wind physics.



Visualization of the flow field of two interacting wind turbines by means of vorticity iso-surfaces. Results obtained from LBM-LES using an actuator line wind turbine model.

A selection of currently available thesis topics is given in the following:

- Development of canopy models for the simulation for wind farm flows above forests
- Coupling of a structural solver and actuator line model for aeroelastic wind turbine simulations
- Comparison of LBM-LES wind farm simulations against wind tunnel experiments
- Investigation of wake mitigation strategies of wind farm power and load optimization
- Investigation of the suitability of half-precision floating point format for turbulent flow simulations

We are also always open to other suggestions. Please to hesitate to contact us for further discussions.

Your profile:

You should be at the end of your bachelor's or master's degree in physics (or comparable), highly motivated and have a great interest in numerical simulation and wind energy. Prior coding experience in C++/CUDA and Python are a merit but not mandatory.

Your next steps:

Come for a visit to our labs and get an impression of our pleasant working atmosphere and research areas. Your contact is Henrik Asmuth in the WindLab (room W33-2-226, email henrik.asmuth@uni-oldenburg.de)