Cherif Mihoubi

Turbine simulation, software development and aerodynamics

- Warnsweg 4, 26135 Oldenburg, Germany
- Born 26.08.1979 Batna, Algeria
- Married, one child

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Skills

Turbine simulation and aerodynamics 9+ yrs.

CFD and software dev 13+ yrs.

Aerodynamics&propulsion system 2+ yrs.

OpenFOAM and other CFD codes 12+ Jahre

HPC, MPI/OpenMP, queuing systems and schedulers (Slurm, SGE) 12+ yrs.

Multiobjective Optimization 2+ yrs.

Linux administration and IT 9+ yrs.

git and other software version control 10+ yrs.

Biography

In-depth experience in turbine simulation, software development and aerodynamics

Work experience

Research Associate (Wiss. Mitarb.) **06/2012 - today**

Fraunhofer Institute for Wind Energy and Energy System Technology, Oldenburg IWES

Focussing on wind turbine aerodynamics using CFD with a special interest in aerodynamics and turbulent flow structures on wind turbines. Different approaches to simulate wind turbine rotors are used: From high fidelity blade-resolved 3D CFD simulations (both steady and unsteady) to medium fidelity methods such as the actuator line. The latter are mainly used to investigate the aerodynamic loads, flow behavior and wake characteristics of wind turbine rotors or for validation of BEM (Blade Element Momentum) simulations. The blade-resolved CFD simulations can include the tower and nacelle geometry. Different methods can be used for solving the flow equations, these range from computationally cheap RANS to eddy-resolved ones such as IDDES (Improved Delayed Detached-Eddy Simulation) with focussing on validation with experiments. Part of my daily work also includes:

- Optimizing the parallelization of large-scale openFOAM simulations for the High-Performance Computing (HPC) cluster, using debugger, profile and performance analysis tools
- Performing software engineering and development activities including requirements analysis, design, implementation, testing, deployment and maintenance
- Meshing full 3D wind turbine rotors
- Teaching lectures on advanced coding techniques in c++ for CFD and openFOAM
- Students supervision, this includes assistance with CFD runs, debugging and developing new CFD tools, airfoil simulations, etc.
- Development and extend in-house CFD tools (flow solvers and others)
- Back-end GUI web-based tools development using open-source web frameworks e.g. python-django, R-shiny, docker, bash, python, etc.
- Development of a software framework for a wind turbine condition monitoring tool based on the dynamic power curve

Research Associate (wiss. Mitarb.) **01/11- 31/12/2011**

The Chair for System Simulation, Friedrich–Alexander University Erlangen–Nürnberg FAU, Germany

Handling 3D triangle-based geometries in the massively parallel lattice Boltzmann framework waLBerla (Widely applicable Lattice-Boltzmann solver from Erlangen) which runs up to 294912 cores with an efficiency of more than 95%.

Languages

- German (very good)
- English (fluent)
- French (fluent)
- Arabic (fluent)

Interests

- Sport
- Programming
- Biking
- Travel

Education

Baccalaureate in Electrical engineering (Abitur) — **1994-1997**
Technical College Bachir El Ibrahimi, Batna, Algeria

Mechanical Engineer, option: ThermoFluid and energetics (Ingenieur Energietechnik) — **1997-2002**
University Of Batna, Algeria

Thesis topic: "Contribution study of Direct Heat Exchanger" which deals with simulation and modeling of complex phenomena related to fluid flow and heat exchange inside Direct-contact Heat Exchangers DCHEs

MSc in fluid dynamics and energetics, aerodynamics and propulsion — **2003 to 2006**
Ecole Military Polytechnic (Ex ENITA), Algiers, Algeria

Thesis topic: "A thermodynamic optimization of a gas turbine propulsion cycle and adaptation on an aircraft model". The aim of my study was to determine the optimal aero-thermodynamic design point for an aircraft propulsion system, optimal in terms of performances required under the aircraft specifications and mission requirements (e.g. FAR25). The problem of analysis and optimization, as well the integration of a propulsion system on a given model of an aircraft is carried out by means of numerical simulations. Additionally, advanced techniques based on nonlinear programming were used to solve the multi-objectives optimization problem (SQP and GA). The results of the work were the development of an overall procedure for analyzing and an optimization tool for the aircraft jet-propulsion system, which proved to be very useful in the preliminary and earlier development stages of a new propulsion system.

Ph.D. Candidate in Computational Engineering, Thermal and Fluid Dynamics — **Today**
Friedrich-Alexander University Erlangen-Nuremberg (FAU), Erlangen, Germany

Thesis title: *"Methods for the Simulation of Complex Flows using Supercomputers"*. My ph.D work deals with the simulation of complex fluid flow using lattice-Boltzmann method "LBM". My contribution was mainly developing and incorporating a module for handling complex 3D geometries into waLBerla, in order to be able to:

- Extend the framework by complex 3D triangle-based geometries, in order to be able to support various applications like aerodynamic simulations, blood flow in vessels and fluid-structure interaction.
- Improve the accuracy of computing the fluid-dynamic forces and moments by using second order boundary conditions.
- Speed-up the data processing (dynamic simulation).
- For parallel applications, visualization of huge data set of flow-field results from simulation.
- Incorporate turbulence into waLBerla framework.

Some awesome skills I have learned during my ph.D time:

- Hardware performance counters on modern microprocessors, using external libs (e.g. PAPI) to collect low level performance metrics
- Code profiling and debugging both in serial & parallel
- Compiler optimizations C++, optimizations for MPI/OpenMP Applications and performance optimization for HPC Architectures

Publications

- 28-29/03/2006: 5th Day of Mechanics (workshop), Alger, Algeria
  "multi-objective optimization of an aircraft propulsion system"
- 27-29/10/2009: Parallel Numerics "ParNum09" workshop, Slovakia
  The title of my talk was "Handling Complex Geometries in the Massively Parallel Lattice Boltzmann Framework waLBerla"
- SOWE 2015, Towards an Implementation of the Overlapping Grid Method in OpenFOAM
- SOWE 2015, Implementation of Lower and Upper Symmetric Gauss Seidel (LU-SGS) Solver in OpenFOAM
- Renewable Energy2018, Noise reduction of a horizontal wind turbine using different blade shapes
- 07/2017 Journal of Applied Fluid Mechanics, Reducing Noise Generated from a Wind Turbine Blade by Pitch Angle Control using CFD and Acoustic Analogy

Seminars and Workshops

- 23/06/2008: 4th Erlangen High-End-Computing Symposium
- Programming of High Performance Computing Systems from March 2-6, 2009 at the LRZ in Garching near Munich
- 18-20/02/2009, ASIM(Arbeitsgemeinschaft Simulation)-Workshop in Stuttgart
- 8-9/12/2009: at Leibniz Supercomputing Center in Garching near Munich. High Performance Computing in Science and Engineering, HLRB and KONWIHR Review, Results and Future Projects Workshop: Preparing for Petascale Systems
- 11/01/2010: Seminar on Didactics. The course is organized by the Bavarian Graduate School for Computational Engineering. The course is intended for students who do the "Supervised Teaching" course, i.e. on giving exercise lessons
- 10-13/10/2010 Erlangen, International Workshop on Multi-scale Modeling, Simulation and Optimization

Posters

- 3-5/03/2010: ASIM (Arbeitsgemeinschaft Simulation) Workshop, Research Center Jülich. The title of the poster was "Handling 3D triangle-based geometries in the massively parallel lattice Boltzmann framework waLBerla"
- 10-13/10/2010 Erlangen, International Workshop on Multi-Scale Modeling, Simulation and Optimization
- 24-25/02/2010 NIC (John von Neumann Institute for Computing) Symposium 2010, Forschungszentrum Jülich, “Particulate Flows with a Widely Applicable Lattice Boltzmann Solver" as co-author

Talks

- Symposium on OpenFOAM in Wind Energy (SOWE) Oldenburg , talk topic: "*Automatic block-structured hexahedral meshing Tool for a complete wind turbine rotor*"
- iTi Conference on Turbulence 2014, *Higher-order statistical analysis of DES simulation of fractal-generated turbulence flow*

- Deutsche Physikalische Gesellschaft (DPG) 2015, *The intermittent behavior of DDES simulation of fractal-generated turbulence*

Teaching and supervising

- Advanced computational fluid dynamics and wind turbine aerodynamics: Introduction to different CFD models, such as OpenFOAM. Application of these CFD models to define problems from rotor aerodynamics and the atmospheric boundary layer
- Supervising an MSc student (2015), topic: Implementing faster methods for solutions like LUSGS in OpenFOAM
- Supervising an Internship MSc student (2014), topic: Numerical simulations to study the effects of tower shadow on a downwind turbine configuration and flow field simulations over flat back airfoils using OpenFOAM
- Block Structured Mesh generation tools (complex terrain, building, rotating Wind turbine blades, ...)

Fellowships and Awards

- 2007-2011 Ph.D scholarship, Deutscher Akademischer Austausch Dienst (DAAD)
- 2003-2006 Post-graduating (master) scholarship given by the ministry of higher and scientific research, Algeria

Oldenburg, 8th March 2022

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