ParCFD2026
37th International Conference on Parallel Computational Fluid Dynamics
Nov 03-07, 2026, Nantes, France

ADVANCES IN QUANTUM AND QUANTUM-INSPIRED ALGORITHMS FOR COMPUTATIONAL FLUID DYNAMICS

MATTHIAS MÖLLER[*], JULIA KOWALSKI [†] NORBERT HOSTERS [♦] AND RAKESH SARMA [#]

[*] Delft University of Technology
Department of Applied Mathematics
Mekelweg 4, 2628CD Delft, The Netherlands
email: m.moller@tudelft.nl, web page: https://diamhomes.ewi.tudelft.nl/~mmoller/

[†] RWTH Aachen University
Faculty of Mechanical Engineering
Eilfschornsteinstr. 18, 52062 Aachen, Germany
email: kowalski@mbd.rwth-aachen.de, web page: https://www.mbd.rwth-aachen.de/

[♦] RWTH Aachen University
Faculty of Mechanical Engineering
Schinkelstr. 2, 52062 Aachen, Germany
email: hosters@cats.rwth-aachen.de, web page: https://www.cats.rwth-aachen.de

[#] Forschungszentrum Jülich GmbH
Jülich Supercomputing Center
Wilhelm-Johnen-Straße, 52428 Jülich, Germany
email: r.sarma@fz-juelich.de, web page: https://www.fz-juelich.de/en/ias/jsc

Abstract. Quantum computing is an emerging compute technology with the potential to become a game changer for the efficient solution of challenging CFD problems. The power of quantum computers comes from the strict exploitation of uniquely quantum mechanical effects such as superposition of states, entanglement, and quantum parallelism. Harnessing these quantum effects requires the redesign of algorithms from scratch and a fundamental rethinking of traditional workflows, as direct porting of classical methods is unlikely to yield optimal performance.

Topics of interest of this mini-symposium include, but are not limited to:

1. Quantum and quantum-inspired algorithms for solving fluid flow models, e.g., based on the Navier-Stokes or the Boltzmann equations

2. Quantum-assisted and quantum-inspired workflows for design optimization, uncertainty quantification, and other CFD-related applications

3. Software tools for developing quantum and quantum-assisted CFD applications including benchmarking

4. Data-driven and machine learning approaches with quantum enhancement

5. High-performance computing integration and software ecosystems

Matthias Möller is Associate Professor of Numerical Analysis and Scientific Director of the Institute for Computational Science and Engineering at Delft University of Technology, The Netherlands. He holds a PhD degree in Mathematics from TU Dortmund University and joined TU Delft in 2013. He is currently leading the quantum-CFD lab which is a joint research initiative between TU Delft and Fujitsu Limited, Japan. Matthias' research focusses on the development of numerical methods for fluid flow applications both on conventional and emerging compute technologies. His particular interest is in finite element and isogeometric analysis as well as lattice Boltzmann methods. He is member of the advisory council of the DLR Quantum Computing Initiative and the scientific council of CISM.

Julia Kowalski is Professor at RWTH Aachen University's Faculty of Mechanical Engineering, where she leads the Chair of Methods for Model-based Development in Computational Engineering (MBD). She holds a PhD from the Seminar of Applied Mathematics at ETH Zurich and joined RWTH in 2021. Julia's research concerns computational methods for goal-oriented prediction and decision support based on data-integrated multi-physics simulations. She is member of the board of directors of the Center for Simulation and Data Science at the Jülich Aachen Research Alliance, and serves the Steering Committee of the Helmholtz Graduate School for data science in Life, Earth and Energy.

Norbert Hosters is Senior Scientist at the Chair for Computational Analysis of Technical Systems (CATS) at RWTH Aachen University. In 2018, he defended his PhD thesis on spline-based methods for fluid-structure interaction at the same institute. While continuing this research, he is now also working on discontinuous and continuous space-time finite elements, physical-informed neural networks and quantum computational science in engineering. Furthermore, Norbert is secretary general of the German Association for Computational Mechanics.

Rakesh Sarma is a post-doctoral researcher at the Forschungszentrum Jülich, working on the development of parallel and scalable AI methods and workflows for HPC applications. He obtained his PhD from Delft University of Technology, Netherlands, in 2018. His doctoral thesis was on the development of Bayesian inference and reduced order modelling methods for prediction of instabilities in aeroelastic structures. Thereafter, he worked at the Dutch National Center for Mathematics and Computer Science in Amsterdam in the domain of ML/AI in space weather and stratified turbulence applications.