**Masterthesis / HiWi**

# Cutting Edge High-Performance Computing:
# Towards Exascale CFD simulations

**TECHNISCHE UNIVERSITÄT DARMSTADT**

**JÜLICH** Forschungszentrum · **STFS**

## Motivation & Background

To achieve current climate goals, rapid technological changes are necessary. High-performance computing will be a crucial pillar for future engineers, enabling a swift transition of the energy system through innovative technical solutions.

The Institute for Simulation of Reactive Thermo-Fluid Systems (STFS) aims to lead this journey by performing groundbreaking simulations. This includes leveraging Europe's first Exascale supercomputer, currently being built at our partner, Jülich Supercomputing Centre.

**Your contributions are highly welcome in this exciting endeavor!**

Are you an exceptional engineer with a passion for high-performance computing (HPC) and large-scale simulations? Do you thrive in the fast-paced world of HPC and have a knack for optimizing complex simulations on diverse hardware platforms? Do you have a strong programming background (preferably in C/C++), and proficiency in Unix-based systems? If so, we encourage you to contact us for more information!

## Tasks

- Familiarize with the GPU code NekCRF (https://github.com/Nek5000/nekRS)
- Setup and execute large-scale simulations that leverage the full potential of diverse HPC systems
- Conduct performance analysis, profiling, and tuning to identify bottlenecks and optimize code performance across different hardware architectures
- Evaluation and profiling of code performance and efficiency on different HPC clusters in Europe including europes first exascale computer Jupiter
- Possible research stays at JSC

## Focus areas

Simulation ● ● ●

Modeling ● ○ ○

Implementation ● ○ ○

Data analysis ● ● ○

## Date

**Start date**

Immediately

## Contact

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**Masterthesis / HiWi**

# Accelerate Innovations: High-Performance Computing Software Development for Heterogenous Architectures

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STFS

## Motivation & Background

To achieve current climate goals, rapid technological changes are necessary. High-performance computing will be a crucial pillar for future engineers, enabling a swift transition of the energy system through innovative technical solutions.

The Institute for Simulation of Reactive Thermo-Fluid Systems (STFS) aims to lead this journey by developing new generation of algorithms to enable simulations of reactive multiphase flows targeting the next generation of super computers. This includes Europe's first Exascale supercomputer, currently being built at our partner, Jülich Supercomputing Centre.

### Your contributions to this exciting undertaking are very welcome!

Are you a visionary engineer passionate about pushing the boundaries of computational science? Do you thrive on solving complex problems and developing cutting-edge solutions? Do you have a strong programming background (preferably in C/C++), and proficiency in Unix-based systems? If so, we encourage you to contact us for more information!

## Tasks

- Familiarize with the GPU code NekCRF (https://github.com/Nek5000/nekRS)
- Design, implement, and refine high-performance algorithms tailored for heterogeneous platforms, including multi-core CPUs and GPUs.
- Stay at the forefront of advancements in HPC: Research and implement cutting-edge methodologies.
- Work closely with computational scientists and software developers: Contribute to projects that push the frontiers of computational science.
- Possible research stays at JSC

## Focus Areas

Simulation ● ○ ○

Modellierung ● ● ○

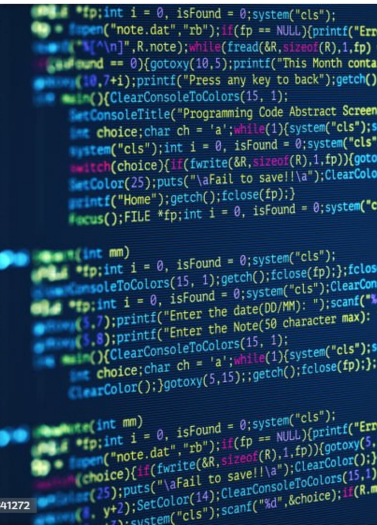Implementierung ● ● ●

Datenanalyse ● ○ ○

## Date

**Start date**

Immediately

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# Bachelorthesis / Masterthesis / HiWi

# Data science and model development for designing future clean energy systems

## Motivation & Background

To achieve current climate goals, rapid technological changes are necessary. Data driven model development from large-scale simulations will be a crucial pillar for future engineers, enabling a swift transition of the energy system through innovative technical solutions.

The Institute for Simulation of Reactive Thermo-Fluid Systems (STFS) is at the forefront of pioneering advancements in large-scale simulations and AI-driven model development. Our mission is to lead groundbreaking research and development efforts, leveraging cutting-edge AI and HPC resources to solve complex problems and drive technological innovation. **Your contributions to this exciting venture are most welcome!**

Are you a visionary engineer with a passion for large-scale data sets and cutting-edge artificial intelligence (AI) technologies? Do you thrive on transforming complex data into next-generation models that drive innovation? Do you have a strong programming background (preferably in python/C++), and proficiency in Unix-based systems? If so, we encourage you to contact us for more information!

## Tasks

- Conduct in-depth data analysis and integrate diverse datasets to inform and improve simulation models. Utilize state-of-the-art data processing and analysis techniques to extract valuable insights.
- Design, implement, and refine advanced AI models to enhance the accuracy and efficiency of simulations.
- Employ advanced performance tuning techniques to maximize the efficiency and speed of AI-driven models. Conduct detailed performance analysis and optimization to ensure optimal resource utilization.
- Possible research stays at JSC

## Focus Areas

| | | | |
|---|---|---|---|
| Simulation | ● | ○ | ○ |
| Modellierung | ● | ○ | ○ |
| Implementierung | ● | ● | ○ |
| Datenanalyse | ● | ● | ● |

## Date

**Start date**

Immediately

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