

# Wojciech Sadowski

Ambitious, passionate and hard-working engineer focused on fluid mechanics, numerical analysis and the application of both to real-world problems. Open for new challenges and opportunities to broaden my horizons.

E-mail: [wojciech1sadowski@gmail.com](mailto:wojciech1sadowski@gmail.com)



h-index: 4  
citations: 54

## Work experience

### Researcher

since Nov. 2020

Ruhr University Bochum, Chair of Thermal Turbomachinery and Aero Engines

Working as a researcher in the project **Bulk-Reaction** (SFB/TRR 287) aiming at improving the current tools for **simulation and designing packed-bed reactors**.

Focusing on **gas flows through a packed bed**—applying **LES and DNS** to study the flow at the microscale—use of **upscaling and explicit filtering** to derive better models for macroscale description of the gaseous flow through the particle assembly. The research has resulted in 3 publications and 4 conference presentations.

Developed a **high-performance explicit filtering library** for accurate determination of macroscale properties from scale-resolving simulations.

Took part in **writing two successful proposals** (2nd funding period of the SFB 287 and computing power on the SuperMUC-NG cluster).

An active member of **Research Data Management** pilot group.

Supervising master students, conducting exercises, helping with lectures, administering of the chair Linux computers and maintenance of the cluster

### Project leader

Sept. 2019 - Sep. 2020

The Institute of Applied Research of the Warsaw University of Technology

Led a research project aimed at **improving of the accuracy of 3D printing in SLS technology**, resulting in a specialized coupled **structural/thermal code predicting deformation of printed parts**.

Coordinated modelling and development work of three researchers.

Conducted detailed simulations of **natural convection inside the printer** and the survey of accuracy requirements reported by the end users of SLS printing technology we performed.

### CFD Engineer / Developer

Dec. 2017 - Sep. 2020

QuickerSim Ltd.

Implemented **FEM solver employing geometrically exact beam elements** for non-linear structural analyses (including linear or non-linear buckling). Conducted industrial-grade **analysis of slotted pressure filters** using the solver.

Implemented **RANS turbulence models in the in-house FEM-based CFD solver**. Solver was used for several projects, including analyses of cyclone filters and HVAC flows.

Implemented **stabilization methods in Galerkin FEM** for convection dominated problems framework.

Designed and implemented the modelling and numerical core of a **toolbox for the oil & gas extraction studies**. Supervised further development of the code.

Performed the **analysis of flow-induced noise using LES and Lattice-Boltzmann method** for research and development of hearing aids.

Performed the study of **blood flow in a preliminary design of an artificial, 3D-printed pancreas**, to guide the design process.

Analysed the **flow of cellular material inside the 3D-printer**, to establish a **range of safe printing rate**, which resulted in a scientific publication.

## Education

### PhD Mechanical Engineering

Ruhr University Bochum, Chair of Thermal Turbomachinery and Aero Engines

since Nov. 2020 (planned defence Nov. 2025)

**Thesis:** "Mesoscopic modelling of porous-fluid interface: insights from particle-resolved simulations"

**Supervisor:** prof. dr. Francesca di Mare

### M. Eng. Mechanical Engineering

Warsaw University of Technology, Faculty of Power and Aeronautical Engineering

Feb. 2018 - Sept. 2019

**Thesis:** "Assessment of an algebraic intermittency model for separation-induced transition"

**Supervisor:** prof. dr. Stawomir Kubacki

### B. Eng. Robotics,

Warsaw University of Technology, Faculty of Power and Aeronautical Engineering

Sept. 2014 - Feb. 2018

**Thesis:** "Trajectory planning and obstacle avoidance in cluttered environment"

**Supervisor:** prof. dr. Marek Wojtyra

## Research interests

### Flows in porous materials

*I am studying laminar and turbulent flow behaviour at the microscale to understand how pore-level dynamics impact macro scale transport in complex systems. The behaviour of the fluid at the porous-fluid interface, including the properties of turbulence, dispersion and porous-induced drag are the main focus of my work.*

### Upscaling methods

*I am developing and applying upscaling methods, including Large Eddy Simulation and Volume Averaging Method, to improve currently used closures for flows in porous materials—in particular at the porous-fluid interface, as these two modelling strategies intersect there.*

## Student activities

### Dynamics Engineer

Oct. 2016 - Sept. 2017

Hyper Poland University Team

*Designed and constructed first Polish Hyperloop prototype, coordinated mechanical assembly and designed lateral stabilizers, implemented dynamic model of magnetic levitation suspension in Matlab & Simulink and Adams.*

### Mechanical Engineer

Oct. 2015 - Jun. 2018

Students Association of Vehicle Aerodynamics

*Constructed extremely fuel efficient vehicles Kropelka 2.0 and PAKS, coordinated mechanical team of Kropelka 2.0 and led the drive train redesign.*

## Publications

Klak, M., Kowalska, P., Dobrzański, T., Tymicki, G., Cywoniuk, P., Gomółka, M., Kosowska, K., Bryniarski, T., Berman, A., Dobrzyń, A., **Sadowski, W.**, Górecki, B., & Wszola, M. (2021). *Bionic Organs: Shear Forces Reduce Pancreatic Islet and Mammalian Cell Viability during the Process of 3D Bioprinting*. *Micromachines*, 12(3), 304. [hfillhttps://doi.org/10.3390/mi12030304](https://doi.org/10.3390/mi12030304)

**Sadowski, W.**, & di Mare, F. (2023). *Investigation of the porous drag and permeability at the porous-fluid interface: Influence of the filtering parameters on Darcy closure*. *Particuology*, 78, 122-135. <https://doi.org/10.1016/j.partic.2022.09.010>

**Sadowski, W.**, Sayyari, M., di Mare, F., & Marschall, H. (2023). *Large eddy simulation of flow in porous media: Analysis of the commutation error of the double-averaged equations*. *Physics of Fluids*, 35(5), 055121. <https://doi.org/10.1063/5.0148130>

**Sadowski, W.**, Sayyari, M., & di Mare, F. (2023). *Large-eddy simulation of a channel flow over an irregular porous matrix*. *PAMM*, e202300095. <https://doi.org/10.1002/pamm.202300095>

**Sadowski, W.**, Sayyari, M., Di Mare, F., Velten, C., & Zähringer, K. (2024). *Particle-resolved simulations and measurements of the flow through a uniform packed bed*. *Physics of Fluids*, 36(2), 023330. <https://doi.org/10.1063/5.0188247>

**Sadowski, W.**, Lo Presti, F., & di Mare, F. (2023). *Assessment of hybrid turbulence models for the simulation of ribbed channel with heat transfer*. *Proceedings of 15th European Conference on Turbomachinery Fluid Dynamics & Thermodynamics*. <https://doi.org/10.29008/ETC2023-312>

Lea, B., Presti, F. L., **Sadowski, W.**, & di Mare, F. (2025). *Detached Eddy Simulation of a Radial Turbine operated with supercritical CO<sub>2</sub>*. *Proceedings of 16th European Conference on Turbomachinery Fluid Dynamics & Thermodynamics*. (accepted for publication)

Schulze, S., Presti, F. L., **Sadowski, W.**, & di Mare, F. (2025). *Effects of Streamwise Oriented Riblets on an LPT Blade: A Numerical Study*. *Proceedings of 16th European Conference on Turbomachinery Fluid Dynamics & Thermodynamics*. (accepted for publication)

Lea, B., **Sadowski, W.**, & di Mare, F. (2025). *Evaluating differences between the computable and filtered state variables in supercritical CO<sub>2</sub>*. *Proceedings of the 5th International Seminar on Non-Ideal Compressible Fluid Dynamics for Propulsion and Power*. (accepted for publication)

## Conference presentations

**Sadowski, W.**, & di Mare, F. (2022). *Investigation of the porous drag and permeability at the porous-fluid interface: Influence of the filtering parameters on Darcy closure*. 1st International Workshop on Reactive Particle-Gas Systems, Bochum, Germany

**Sadowski, W.**, Sayyari, M., & di Mare, F. (2023). *Large-eddy simulation of a channel flow over an irregular porous matrix*. 93rd Annual Meeting of the International Association of Applied Mathematics and Mechanics (GAMM), Dresden, Germany

**Sadowski, W.**, Lo Presti, F., & di Mare, F. (2023). *Assessment of hybrid turbulence models for the simulation of ribbed channel with heat transfer*. 15th European Conference on Turbomachinery Fluid Dynamics & Thermodynamics, Budapest, Hungary

**Sadowski, W.** (2024). *Towards seamless modelling of flows over porous media: insights from particle-resolved simulations*. Ames Research Centre, Entry System and Technology Division seminar

**Sadowski, W.**, Demir, H., & di Mare, F. (2025). *Mean flow properties in a packed bed with varying geometry*. 2nd International Workshop on Reacting Particle-Gas Systems, Magdeburg, Germany

## Teaching and supervisory work

### Teaching

Preparation of material and conducting exercises for a graduate course *Numerical Methods for Internal Aerodynamics* in 2024 and 2025.

Conducting an introductory lecture for an undergraduate course *Computer simulation of fluid flows* in 2024.

Help with conducting and evaluation of the exams from *Numerical Methods for Internal Aerodynamics* and *Computer simulation of fluid flows*.

Conducting a workshop session for members of *Bulk-Reaction* project about the use of Git and Gitlab for code and research data management.

### Supervision

**Master thesis:** *Applying OpenFOAM to simulate turbulent flows in domains partly occupied by porous media*

**Master thesis:** *Implementation and Validation of a Low-Dissipation Solver for Scale-Resolving Simulations in OpenFOAM*

## Awards

Grant for computation time on SuperMUC-NG, approx. 13 Mcore-h (*January 2022*)

Ministry of Science and Higher Education Scholarship for Scientific Achievements (*March 2018*)

Finalist of Hyperloop Pod Competition II (*Los Angeles, August 2017*)

3rd place, Kropelka 2.0 project, Shell Eco-Marathon Challenger (*Le Mans, 2018*)

2nd place, PAKS project, Shell Eco-Marathon Challenger (*Le Mans, 2016*)

## Skills

### Continuum mechanics and numerics:

(Computational) fluid mechanics, turbulence modelling (RANS/LES/DNS), flow in porous media (micro and macro scale, upscaling), structural mechanics, heat transfer, Finite Element/Volume Methods

### Programming and computer science:

C/C++, Matlab, python, Julia, bash,  $\LaTeX$ , Linux systems, optimization

### CAE software:

OpenFOAM, Ansys Fluent & Mechanical, ParaView

## Languages

English	very good (level C1)
German	intermediate (level B1)
Polish	native

## Personal interests

Sailing, science-fiction literature