

Dylan Rubini

Mechanical Engineer

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Research Interests

- Computational modelling of complex multiphysics and multiscale transport problems, including thermofluids and catalytic reacting flows.
- Working at the intersection of machine learning, computational science and aerothermochemical design to develop multiphysics & multidisciplinary numerical tools accelerate the net-zero energy transition.
- Modelling transonic turbulent flow interactions within internal and external flows using high-fidelity computations.
- Developing numerical flow solvers for multicore CPU & GPU hardware.

Academic Positions

Oct. 24–Now **IAA Doctoral Impact Postdoctoral Research Fellow**, *University of Oxford*.

- *Research Projects:*
 1. Commercialisation of machine-learning-accelerated aerochemical modelling platform and development for catalytic modelling.
 2. *Collaborative Project:* Computational multiphysics modelling of multiscale nanomembrane transport phenomena within CO₂ direct air capture systems.
 3. *Collaborative Project:* Automating engineering design & simulation using multi-agent large language model systems.

Education and Research

2020–2024 **PhD in Engineering Science on EPSRC Scholarship**, *University of Oxford*.

- *Supervisors:* Budimir Rosic (Oxford) and Liping Xu (Cambridge).
- *Lab:* Oxford Thermofluids Institute - leading thermofluids & heat transfer lab
- *Main Thesis:* pioneering work developing multi-fidelity machine-learning-assisted model to accelerate multiphysics coupling in a new class of turbomachines for zero-carbon high-temperature chemical processes. This has enabled aerochemically-guided design optimisation for the first time in turbomachinery.

○ *Further Research Contributions:*

1. developed unstructured computational fluid dynamics solver using highly-optimised code generation for both multi-core CPU & GPU backends.
2. developed Python-based numerical tool for chemical kinetic analysis in turbomachines.
3. numerically investigated complex aerothermal flow interactions and quantified aerodynamic loss mechanisms in turbomachines for high-temperature processes.
4. implemented and leveraged multiobjective chemical-reaction-guided design optimisation for a new class of turbomachines.

2016–2020 **MEng in Engineering Science, First Class**, *University of Oxford*.

- *Final Year Dissertation:* first work computationally modelling the uniquely complex aerothermodynamics for a new class of high-speed turbomachines to decarbonise industry. This helped inform aerodynamic design decisions.
- *Achievements:* top mark in the cohort for the 4th year project (scoring **93%**), as well as scoring above an average of **80%** overall.
- *3rd-year Advanced Courses:* Electronic Devices, Circuits & Communications, Software Engineering, Information Engineering Systems, Fluid Mechanics (Turbulence, Compressible Flow and Turbomachinery.)
- *4th-year Advanced Courses:* Aerothermal Engineering, Hydraulics, Sustainable Energy, Microelectronics, Machine Learning, Electrochemical Energy Technology.

2008–2016 **A-Levels, A*A*A, GCSEs 8A*s, 4As.**

Awards and Achievements

- 2024 **ASME J. Davis Best paper award**, *International Gas Turbine Institute*, Ref. [4].
- 2024 **Letter of commendation for DPhil thesis**, *Oxford Engineering Department*.
- 2024 **Drapers Company Junior Research Fellow**, *St Anne's College (Oxford)*.
- 2024 **Awarded competitive IAA Doctoral Impact prize**, *University of Oxford*.
- 2024 **Presented at Reynolds competition**, *University of Manchester*.
- 2023–2025 **Awarded 20k computing research grant**, *UKRI ARCHER2 HPC access*.
- 2023 **Best paper award**, *Journal of Global Power & Propulsion Society*, Ref. [3].
- 2022 **Best poster award**, *ASME Turbo Expo: Power for Land, Sea and Air*.
- 2020–2024 **Doctoral scholarship**, *UKRI DTP EPSRC*.
- 2020 **Prestigious IMechE Project Award**, *Institution of Mechanical Engineers*.
- 2020 **Top mark in 4th year MEng project (93%)**, *Oxford Engineering Dept.*
- 2020 **Best project poster award**, *Oxford Engineering Dept.*
- 2018–2020 **Academic prize awards**, *Oriel College, University of Oxford*.

Industry Experience

Autumn 2024 **Mitsubishi Heavy Industries, Japan**, Placement.

- Nitridation & oxidation modelling in ammonia boilers by coupling chemical thermodynamics, combustion simulations and surface reaction modelling.

2019–2024 **Coolbrook Oy**, *Finland*, Collaborator.

- Collaborating on developing new numerical tools for modelling complex aerothermochemical flows within a new class of high-speed turbomachines.

Summer 2017 **GNL Quintero**, *Chile*, Intern.

- Investigated failures in pipes used for liquefied natural gas transport.

Research Experience

Summer 2019 **Research Intern**, *Oxford Thermofluids Institute*, Advisor: Budimir Rosic.
MPI-parallelised an in-house computational fluid dynamics solver

Summer 2018 **Research Intern**, *Oxford Thermofluids Institute*, Advisor: Peter Ireland.
Designed flow measurement and instrumentation systems within a new wind tunnel

Journal Publications

- [1] **D. Rubini** and B. Rosic. ChemZIP: Accelerated Modeling of Complex Aerothermochemical Interactions in Novel Turbomachines for Sustainable High-Temperature Chemical Processes. 2025. In Preparation.
- [2] **D. Rubini**, B. Rosic, and L. Xu. Energy Conversion Mechanisms in Turbomachines for High-Temperature Endothermic Reactions: Redefining Energy Quality. *Appl. Therm. Eng.*, 2025.
- [3] **D. Rubini**, N. Karefyllidis, B. Rosic, L. Xu, and E. Nauha. Decarbonisation of High-Temperature Endothermic Chemical Reaction Processes Using a Novel Turbomachine: Robustness of the Concept to Feed Variability. *J. Glob. Power Propuls. Soc.*, 2024 (**Best Paper**).
- [4] N. Karefyllidis, **D. Rubini**, B. Rosic, L. Xu, and V.-M. Purola. A Novel Axial Energy-Imparting Turbomachine for High-Enthalpy Gas Heating: Robustness of the Aerodynamic Design. *ASME J. Turbomach.*, 2023 (**Best Paper**).
- [5] **D. Rubini**, N. Karefyllidis, L. Xu, B. Rosic, and H. Johannesdahl. Accelerating the Development of a New Turbomachinery Concept in an Environment With Limited Resources and Experimental Data: Challenges. In *ASME Turbo Expo*, 2022.
- [6] **D. Rubini**, N. Karefyllidis, L. Xu, B. Rosic, and H. Johannesdahl. A New Robust Regenerative Turbo-Reactor Concept for Clean Hydrocarbon Cracking. *J. Glob. Power Propuls. Soc.*, 2022.
- [7] **D. Rubini**, L. Xu, B. Rosic, and H. Johannesdahl. A New Turbomachine for Clean and Sustainable Hydrocarbon Cracking. *ASME J. Eng. Gas Turbines Power*, 2021.

Talks and Conference Presentations

2023 **Conference**, *Global Power and Propulsion Society, Hong Kong*, “Ref. [3]”.

2023 **Invited Talk**, *Mitsubishi Heavy Industries, Japan*, “Ultra-Fast Multiphysics Coupling Tools Required for the Future Decarbonised World”.

- 2022 **Invited Talk**, *Osney Thermofluids Institute, Oxford*, “Designing a Turbo-Reactor to Selectively Control Chemical Reactions”.
- 2022 **Invited Talk**, *Coolbrook Oy, Finland*, “Accelerated Aerochemistry Coupling Toolchain Enabling a Controllable, Selective and High-Yield Turbo-Reactor Design”.
- 2022 **Conference**, *ASME Turbo Expo, Rotterdam*, “Ref. [5]”.
- 2021 **Conference**, *Global Power and Propulsion Society, Xi'an*, “Ref. [6]”.
- 2021 **Conference**, *ASME Turbo Expo, London*, “Ref. [7]”.

Academic Community Contributions

- Session Chair, 2024 Combustion - GPPS Turbomachinery Technical Conference, Greece
- Reviewer, 2023 Organic Rankine Cycles - Journal of the Global Power and Propulsion Society
- Reviewer, 2023 Elsevier Journal of Cleaner Production

Teaching

- Spring 2025 2nd year engineering mathematics and thermofluids
- Spring 2025 2nd year heat transfer lab
- 2020–Present Supervising PhD & MEng students and mentoring prospective Oxford applicants

Technical Skills

- Languages 1 *Experienced*: Python, Fortran, Matlab, MPI programming, Domain Specific Languages, \LaTeX , Shell scripting
- Languages 2 *Familiar*: C/C++, Cuda, OpenMP programming
- ML libraries TENSORFLOW, PYMOO (multiobjective genetic optimisation)

Software

- Fluids ANSYS FLUENT (CFD), BOXERMESH (meshing), ICEM (meshing), in-house code TBLOCK (CFD), Lattice Boltzmann OPENLB (CFD), SolidWorks CAD, PARAVIEW (post-processing)
- Chemistry RMG-PY (generating heterogeneous kinetics), CANTERA (solving kinetics)
- General Git, Visual Studio Code, Sublime Text, CorelDraw, Inkscape, Overleaf
- HPC Facilities ARCHER2, Advanced Research Computing Facility (Oxford)
- OS Linux (Ubuntu & CentOS), Windows, macOS

Certified Courses

- OPENLB Learnt to develop custom lattice Boltzmann PDE solvers

Referees

Available upon request