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 CO_2 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. *J. of Chem. Eng.*, 2025. Under Review.

[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