Dylan Rubini

Mechanical Engineer

Oxford Thermofluids Institute
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Research Focus

- Developing machine-learning-assisted numerical tools to accelerate multiphysics design optimisation, within zero-carbon thermochemical & energy systems, and aerospace, aerodynamic and turbomachinery applications.
- Working at the intersection between machine learning, computational science and aerothermochemical design to develop multidisciplinary numerical tools accelerate the transition to a zero-carbon society.
- Investigating complex supersonic turbulent interactions in internal and external flows to inform design decisions.

Education and Research

2020–Present **DPhil Engineering Science**, *University of Oxford*, Oxford, UK.

- *Supervisors*: Budimir Rosic (Oxford) and Liping Xu (Cambridge).
- *Lab*: Oxford Thermofluids Institute - leading thermofluids & heat transfer lab worldwide
- *Funding*: won competitive UKRI DTP EPSRC scholarship award.
- *Main Thesis*: pioneering work developing multi-fidelity machine-learning-assisted reduced-order modelling techniques to accelerate multiphysics coupling in a new class of high-speed turbomachines for zero-carbon high-temperature chemical reaction processes. This enables aerochemically-guided design optimisation for the first time in turbomachinery. This is first-ever work on reacting flows along the bladed path of a turbomachine.
- *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 within new turbomachines for high-temperature processes for the first time.
  4. implemented and leveraged multiobjective chemical-reaction-guided design optimisation of a new class of turbomachines.

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

- *Final Year Dissertation*: the first work on computational modelling the uniquely complex aerothermodynamics and proving the feasibility of a new class of turbomachines to decarbonise heavy industry, which has helped inform aerodynamic design decisions.
- *Achievements*: top mark in the year for the 4^{th} year project (scored 93%), as well as scoring above an average of 80% overall.

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

Awards and Achievements

2024 **Presented at Reynolds competition**, *Manchester university*.

2024 **Best paper award**, *ASME Journal of Turbomachinery*, Ref. [4].

2023–Present **Awarded 20k computing research grant**, *UKRI ARCHER2 HPC access*.

2023 **Best paper award**, *Global Power and Propulsion Society*, Ref. [3].

2022 **Best poster award**, *ASME Turbo Expo: Power for Land, Sea and Air*.

2020–Present **Doctoral scholarship**, *UKRI DTP EPSRC*.

2020 **Prestigious IMechE Project Award**, *Institution of Mechanical Engineers*.

2020 **Top mark in 4^{th} year MEng project (93%)**, *Engineering Science Dept*.

2020 **Best project poster award**, *Oxford Engineering Science Dept*.

2018–2020 **Academic prize award**, *Oriel College, University of Oxford*.

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**, B. Rosic, and L. Xu. Efficiently Modelling Aerochemical Interactions in Turbomachines. 2024. 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.*, 2024. Under Review.

[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.

[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.

[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 Lecture**, *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 Lecture**, *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].

Industry Experience

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

- Two month placement working on numerical design and modelling of combustors

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

- Collaborating on developing new numerical tools for modelling complex aerothermochemical flows within a new class of turbomachines to decarbonise high-temperate gas heating across 40 industries.

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

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

Academic Community Contributions

Session Chair Combustion - GPPS Turbomachinery Technical Conference, Greece, 2024

Reviewer Organic Rankine Cycles - Journal of the Global Power and Propulsion Society, 2023

Reviewer Elsevier Journal of Cleaner Production, 2023

Mentoring PhD & MEng students and prospective Oxford applicants, 2019–present

Technical Skills

Languages *Experienced:* `Python`, `Fortran`, `Matlab`, `MPI` programming, Domain Specific Language, LaTeX, Shell, *Familiar:* `C/C++`, `Cuda`, `OpenMP` programming

ML libraries TensorFlow, Pymoo (multiobjective genetic optimisation)

Software

Fluids	Ansys Fluent (CFD), BoxerMesh (meshing), Icem (meshing), Tblock (CFD), Lattice Boltzmann OpenLB (CFD), SolidWorks CAD, ParaView (Post-processing)
Chemistry	Cantera, Rmg-Py
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 Boltzman PDE solvers