Dr. Quentin Malé
Computational scientist, researcher at ETH Zurich
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The interdisciplinary nature of computational science and engineering enables me to grow in many different domains. I enjoy developing sophisticated simulation methods to address crucial needs in our society, and I intend to continue on this path.

EXPERIENCE

ETH Zurich — Zurich, CH
Established researcher (Oberassistent), SNSF fellowship — Jan 2024 onward

- Established a data-driven machine learning framework to model H_2 reaction rates for high-fidelity Large Eddy Simulation (LES).
- Developed an Adaptive Mesh Refinement (AMR) strategy to simulate nonthermal plasma streamer discharge.
- Supported the group with High-Performance Computing (HPC) applications. Developed GPU-accelerated computing.

ETH Zurich — Zurich, CH
Postdoctoral researcher, part of the ERC "TORCH" project — Apr 2021–Dec 2023

- Integrated plasma effects into a massively parallel code to better understand plasma-assisted combustion. Clarified the formation of nitrogen oxides (NO_x) and control of thermoacoustic instabilities in real systems, giving design indications.
- Led a joint experimental-numerical (LES) project to characterize the operation of a new LEAF H_2 burner, featuring complex flame topology with mixed combustion regimes. Clarified combustion modes and NO_x formation routes.
- Implemented a nonthermal plasma solver (electron Boltzmann equation) in Cantera (open source) for plasma rate computation.
- Supported the group with HPC applications ($\approx$ 15 people).

European Center in Research and Advanced Training on Scientific Computing (CERFACS) — Toulouse, FR
Postdoctoral researcher, part of the ERC "CoEC" project — Dec 2020–Mar 2021

The University of Melbourne — Melbourne, AU
Visiting PhD student — Dec 2018–Mar 2019

- Developed a Direct Numerical Simulation (DNS) framework to acquire high-fidelity data for subsequent reduced modeling.

European Center in Research and Advanced Training on Scientific Computing (CERFACS) — Toulouse, FR
PhD student, ANRT Cifre fellowship — Sep 2017–Nov 2020

- Built a Reduced Order Model (ROM) of a new engine technology to quickly assess designs, enabling optimization process.
- Conceived a ROM to predict the outcome of a hot, turbulent jet penetrating a flammable mixture for energy and safety scenarios.
- Developed dynamic mesh adaptation techniques to handle moving mesh during LES, enabling simulation of reciprocating engines.

EDUCATION

PhD Computational Reacting Flow		**MSc Energy Engineering**		**MRes Energy and Fluids**	
CERFACS	2017-2020	INSA Rouen	2014-2017	University of Rouen	2017
Advisor: Thierry Poinsot		GPA: 17.1/20 (ranked $1^{st}/60$)		GPA: 18.6/20 (ranked $1^{st}/16$)	

AWARDED RESEARCH GRANTS

- SNSF/ANR Lead Agency, 516K €: "Joint experimental and numerical study of H_2 plasma-assisted combustion" — 2024–2027
- 3× CSCS HPC access, 40MM core-h in total (grant no. s1138, s1220 and s1262) — 2022–2024
- 2× PRACE HPC access, 35MM core-h in total (grant no. 2019204881 and 2021250004) — 2019 & 2021
- GENCI HPC early access (Irene at TGCC) 8MM core-h (grant no. gch0301) — 2018

TEACHING AND SUPERVISION EXPERIENCE

- Exercise sessions at ETH Zurich, MSc level, "Numerical simulation of flame archetypes" Spring 2023 & 2024
  Design of the solutions to the exercises and discussion of the results
- Lecture at ETH Zurich, MSc level, "Numerical simulation of turbulent reactive flows" Spring 2022 & 2023
  Design and execution of the lecture
- Hands-on at CAPS lab., ETH Zurich, "Large eddy simulation of reactive flows using AVBP" Spring 2022
  Design of the materials and guidance during the tutorials/exercises
- Hands-on at CERFACS, "Large eddy simulation of reactive flows using AVBP" 2018–2020
  Guidance of the tutorials/exercises

I supervised the work of five MSc and two BSc students (thesis and projects) on topics such as: Numerical simulation of nonthermal plasma and turbulent reacting flows; Algorithms for reaction path analysis of plasma, combustion and NO_x chemistry; Reduced order modeling of thermochemical systems. The work of my students has all been successfully carried out as part of their studies. I also actively co-supervised PhD work at ETH Zurich on HPC of complex flows, including thermoacoustics, hydrogen combustion and nonthermal plasma.

ACADEMIC SERVICE

Research project peer review:

German Research Foundation (DFG)	2024

Journal peer review:

Flow, Turbulence and Combustion	2021-2024
Combustion and Flame	2019-2024
Proceedings of the Combustion Institute	2022-2024

JOURNAL PUBLICATIONS

[1] Q. Malé, C. Lapeyre, N. Noiray, "Hydrogen reaction rate modeling based on convolutional neural network for large eddy simulation", 2024, Submitted to Data-Centric Engineering, arXiv:2408.16709 [cs.CE]. URL.

[2] M. Impagnatiello, Q. Malé, N. Noiray, "Acoustic scattering of a sequential combustor controlled with non-equilibrium plasma: A numerical study", *Proc. Combust. Inst.*, 2024. URL.

[3] Q. Malé, K. Pandey, N. Noiray, "The LEAF concept operated with hydrogen: Flame topology and NOx formation", *Proc. Combust. Inst.*, 2024. URL.

[4] Q. Malé, S. Shcherbanev, M. Impagnatiello, N. Noiray, "Stabilization of a thermoacoustically unstable sequential combustor using non-equilibrium plasma: Large eddy simulation and experiments", *Proc. Combust. Inst.*, 2024. URL.

[5] M. Impagnatiello, Q. Malé, N. Noiray, "Numerical Study of Ignition and Combustion of Hydrogen-Enriched Methane in a Sequential Combustor", *Flow Turbul. Combust.*, 2024. URL.

[6] Q. Malé, N. Barléon, S. Shcherbanev, B. Dharmaputra, N. Noiray, "Numerical study of nitrogen oxides chemistry during plasma assisted combustion in a sequential combustor", *Combust. Flame*, 2024. URL.

[7] Q. Malé, S. Shcherbanev, N. Noiray, "Numerical study of plasma assisted combustion in a sequential combustor", *Proc. Combust. Inst.*, 2023. URL.

[8] S. A. Shcherbanev, Q. Malé, B. Dharmaputra, R. Solana-Pérez, N. Noiray, "Effect of plasma-flow coupling on the ignition enhancement with non-equilibrium plasma in a sequential combustor", *J. Phys. D: Appl. Phys.*, 2022. URL.

[9] Q. Malé, O. Vermorel, F. Ravet, T. Poinsot, "Jet ignition prediction in a zero-dimensional pre-chamber engine model", *Int. J. Engine Res.*, 2022. URL.

[10] Q. Malé, O. Vermorel, F. Ravet, T. Poinsot, "Direct numerical simulations and models for hot burnt gases jet ignition", *Combust. Flame*, 2021. URL.

[11] T. Jaravel, O. Dounia, Q. Malé, O. Vermorel, "Deflagration to detonation transition in fast flames and tracking with chemical explosive mode analysis", *Proc. Combust. Inst.*, 2021. URL.

[12] Q. Malé, G. Staffelbach, O. Vermorel, A. Misdariis, F. Ravet, T. Poinsot, "Large Eddy Simulation of Pre-Chamber Ignition in an Internal Combustion Engine", *Flow Turbul. Combust.*, 2019. URL.

[13] J. Lamouroux, S. Richard, Q. Male, G. Staffelbach, A. Dauptain, A. Misdariis, "On the Combination of Large Eddy Simulation and Phenomenological Soot Modeling to Calculate the Smoke Index From Aero-Engines Over a Large Range of Operating Conditions", *J. Eng. Gas Turbine Power*, 2018. URL.

RESEARCH PRESENTATIONS

Invited talks:

- 7th Int. Flame Chemistry Workshop: "Integrating plasma effects into simulations [...]: status and challenges" Jul 2024
- Swiss Combustion Day: "Multiphysics high performance computing of plasma-assisted combustion" Feb 2024
- AVBP user's committee: "Large eddy simulation of plasma-assisted combustion" Dec 2023
- GENCI early access grant feedback at TGCC: "High performance computing for innovative engine design" Jun 2019
- French Combustion Scientific Meeting: "Impact of rich burnt gas radicals on turbulent jet ignition: numerical study" Mar 2018

Conference presentations:

- Int. symposium on combustion: "Stabilization of a thermoacoustically unstable sequential combustor [...]" Jul 2024
- Int. symposium on combustion: "The LEAF concept operated with hydrogen [...]" Jul 2024
- Int. symposium on combustion: "Numerical study of plasma-assisted combustion in a sequential combustor" Jul 2022
- Int. workshop on plasma-assisted combustion: "Numerical simulations of plasma-assisted combustion [...]" Jun 2022
- Int. symposium on combustion: "Direct numerical simulations of jet ignition" Aug 2018