Jonathan Viquerat

Research Engineer
PhD in applied mathematics

06130 Grasse
jonathan.viquerat@minesparis.psl.eu
Webpage

Professional experience

2018 – Present **Research engineer**, *CEMEF Mines Paris PSL, (Sophia Antipolis, France)*, CFL research group, Topics : Coupling of numerical methods with machine learning
References : Élie Hachem (elie.hachem@minesparis.psl.eu), Aurélien Larcher (aurelien.larcher@minesparis.psl.eu)

2015 – 2018 **Research engineer**, *INRIA, (Sophia Antipolis, France)*, Nachos project-team, Topic : Development of a discontinuous Galerkin solver suite for nano-optics problems
Reference : Stéphane Lanteri (stephane.lanteri@inria.fr)

2012 – 2015 **PhD in applied mathematics and numerical simulation**, *INRIA, (Sophia Antipolis, France)*, Nachos project-team, Topic : Discontinuous Galerkin time-domain method for nanophotonics
Reference : Stéphane Lanteri (stephane.lanteri@inria.fr)

Research axes, projects and developments

drl-based flow control Coupling of CFD environments with deep reinforcement learning agents for flow control, including :

- Two reviews (link and link)
- Methodological contributions on distributed environments and state representation learning,
- DRAGONFLY, a modular DRL library,
- BEACON, a set of flow control benchmarks (link)

drl-based optimization An approach exploiting the deep reinforcement learning framework to perform optimization, including :

- The PBO (policy-based optimization) method (paper and github),
- Multiple applicative papers,
- SPARKLE, a modular gradient-free optimization library

supervised models for fluid dynamics Several works on neural networks CFD surrogates, including :

- Convolutional neural networks models for laminar and turbulent flows (see MINDS project below),
- Autoregressive graph neural networks approaches (thesis of P. Garnier, ERC Cure)

exalib A modern C++ CFD library, developed with A. Larcher, including :

- A modular parallel finite element framework,
- A set of compressible and incompressible flow solvers,
- A set of mesh modification tools,
- A continuous integration framework.

minds A CARNOT project, led by E. Hachem, bringing together numerical computation and data sciences, including :

- A research activity organized around supervised and reinforcement learning for CFD problems,
- The co-advising of three PhD students (J. Chen, *Convolutional neural networks for steady flow prediction around 2D obstacles* - H. Ghraieb, *On the coupling of deep reinforcement learning and computational fluid dynamics* - A. Patil, *Deep learning assisted modeling of turbulence in fluids*),
- A website (see `https://cfl-minds.github.io/`),
- Regular seminars, given by experts in the field.

diogenes A discontinuous Galerkin library for electromagnetics and nano-optics applications, written in modern Fortran, including :

- ◇ A parallel discontinuous Galerkin time-domain solver for Maxwell's equations, with an advanced mesh processing library, a mesh partitioning tool, a material processing tool for metal and semiconductor permittivity laws, and a coupling with optimization libraries,
- ◇ The computation of a large set of real-life problems, set up in collaboration with academic and industrial partners (CNRS LPMC, Bristol University, C2N, CEA LETI, ...),
- ◇ A website (see https://diogenes.inria.fr/).

Studies

2012 **Master's degree internship (2^{nd} year)**, *INRIA, (Sophia Antipolis, France)*, Nachos project-team, Topic : Discontinuous Galerkin time-domain method for nanophotonics
Reference : Stéphane Lanteri (stephane.lanteri@inria.fr)

2011 **Master's degree internship (1^{st} year)**, *University College, (London, UK)*, Mechanical engineering department, Topic : Assessment of transcatheter aortic valve devices by numerical simulation on commercial solver
Reference : Gaetano Burriesci, g.burriesci@ucl.ac.uk

2009 – 2012 **Engineering degree in applied mathematics**, *ENSTA ParisTech (Paris, France)*

2011 – 2012 **Master's degree in modelisation and numerical simulation, with distinctions**, *CEA (Saclay, France)*

Selected publications (link to full list)

2025 P. Garnier, V. Lannelongue, J. Viquerat, E. Hachem *MeshMask : Physics-based simulations with masked graph neural networks*, accepted in **ICLR 2025**

2024 J. Viquerat, P. Meliga, P. Jeken-Rico, E. Hachem, *Beacon, a lightweight deep reinforcement learning benchmark library for flow control*, **Applied Sciences**, vol. 14, iss. 9, pp. 3561

2023 A. Patil, J. Viquerat, E. Hachem, *Autoregressive transformers for data-driven spatiotemporal learning of turbulent flows*, **APL Machine Learning**, vol. 1, iss. 4, pp. 046101

2023 J. Viquerat, E. Hachem, *Parallel bootstrap-based on-policy deep reinforcement learning for continuous fluid flow control applications*, **Fluids**, vol. 8, iss. 7, pp. 304

2023 J. Viquerat, R. Duvigneau, P. Meliga, A. Kuhnle, E. Hachem, *Policy-based optimization : single-step policy gradient method seen as an evolution strategy*, **Neural Computing and Applications**, vol. 35, iss. 1, pp. 449 – 467

2022 J. Viquerat, P. Meliga, A. Larcher, E. Hachem, *A review on deep reinforcement learning for fluid mechanics : an update*, **Physics of Fluids**, vol. 34, iss. 11, pp. 111301

2022 J. Chen, J. Viquerat, E. Hachem, *A twin-decoder structure for incompressible laminar flow reconstruction with uncertainty estimation around 2D obstacles*, **Neural Computing and Applications**, vol. 34, pp. 6289 – 6305

2021 A. Patil, J. Viquerat, E. Hachem, *Robust deep learning for emulating turbulent viscosities*, **Physics of Fluids**, vol. 33, iss. 10, pp. 105118

2021 J. Viquerat, J. Rabault, A. Kuhnle, H. Ghraieb, E. Hachem, *Direct shape optimization through deep reinforcement learning*, **Journal of Computational Physics**, vol. 428, pp. 110080

2021 P. Garnier, J. Viquerat, J. Rabault, A. Larcher, A. Kuhnle, E. Hachem, *A review on deep reinforcement learning for fluid mechanics*, **Computer and Fluids**, vol. 225, pp. 104973

2019 V. Belus, J. Rabault, J. Viquerat, Z. Che, E. Hachem, U. Reglade, *Exploiting locality and translational invariance to design effective deep reinforcement learning control of the 1-dimensional unstable falling liquid film*, **AIP Advances**, vol. 9, pp. 125014

2019 J. Viquerat, N. Schmitt, C. Scheid, *Simulating 3D periodic structures at oblique incidences with discontinuous Galerkin time-domain methods : theoretical and practical considerations*, **SMAI Journal of Computational Mathematics**, vol. 5, pp.131 – 159

2019 J. Viquerat, *Efficient time-domain numerical analysis of waveguides with tailored wideband pulses*, **Microwave and Optical Technology Letters**, vol. 61, pp. 1534 – 1539

2018 J. Viquerat, *Fitting experimental dispersion data with a simulated annealing method for nano-optics applications*, **Journal of Nanophotonics**, vol. 12, pp. 036014

2018 N. Schmitt, C. Scheid, J. Viquerat, S. Lanteri, *Simulation of three-dimensional nanoscale light interaction with spatially dispersive metals using a high-order curvilinear DGTD method*, **Journal of Computational Physics**, vol. 373, pp. 210 – 229

2016 J. Viquerat, S. Lanteri, *Simulation of near-field plasmonic interactions with a local approximation order discontinuous Galerkin time-domain method*, **Photonics and Nanostructures-Fundamentals and Applications**, vol. 18, pp. 43 – 58

2016 N. Schmitt, C. Scheid, S. Lanteri, A. Moreau, J. Viquerat, *A DGTD method for the numerical modeling of the interaction of light with nanometer scale metallic structures taking into account non-local dispersion effects*, **Journal of Computational Physics**, vol. 316, pp. 396 – 415

2015 J. Viquerat, *Simulation of electromagnetic wave propagation in nano-optics with a high-order discontinuous Galerkin time-domain method*, PhD thesis (see https://www.archives-ouvertes.fr/tel-01272010/)

2015 J. Viquerat, C. Scheid, *A 3D curvilinear discontinuous Galerkin time-domain solver for nanoscale light-matter interactions*, **Journal of Computational and Applied Mathematics**, vol. 289, pp. 37 – 50

Conferences

2018 GDR Ondes, Paris (France), *Diogenes : a DG-based software suite for nano-optics problems*

2014 Acomen, Ghent (Belgium), *A curvilinear discontinuous Galerkin time-domain method for nanophotonics*

2014 Meta, Singapore, *Discontinuous Galerkin time-domain method for nanophotonics*

2013 Waves, Tunis (Tunisia), *Discontinuous Galerkin Time-Domain method for nanophotonics*

2012 GDR Ondes, Troyes (France), *Méthode Galerkin discontinue en domaine temporel pour la propagation d'ondes électromagnétiques en nano-optique*

Teaching and supervising

2018 – Present **Co-advisor of 5 PhD students and 1 post-doctoral student**, *CEMEF Mines ParisTech (Sophia Antipolis, France)*

2019 – Present **Advisor of M.Sc. internships**, *CEMEF Mines ParisTech (Sophia Antipolis, France)*

2014 – 2016 **Advisor of M.Sc. internships**, *INRIA (Sophia Antipolis, France)*

2010 – 2011 **Computing science teacher in "Classes préparatoires"**, *Lycée Marcelin Berthelot (Saint-Maur des Fossés, France)*

Skills

Programming C++, Python, Fortran

HPC MPI, OpenMP

Machine learning Tensorflow, Pytorch

Meshes Gmsh, MeshGems

Post-treatment Paraview, Vizir, Medit

Development Git, CI, CMake, Jenkins, Emacs

Systems Linux, OsX

Misc. LaTeX, HTML, CSS

Languages English (fluent)

Hobbies

Sports Climbing, alpinism, ski-touring

Others Photography