Mathieu RIGAL

Post-doctoral researcher in applied mathematics

— **Contact details** —
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Research interests

I am interested in the design, study and implementation of efficient numerical schemes in the context of environmental applications, and in particular complex geophysical flows. In this regard, my research is currently focused on the issue of boundary conditions for a dispersive Boussinesq model in presence of varying bathymetry, its discretization and validation against experimental data.

During my thesis, I also worked on the hyperbolic nonlinear shallow water system, by studying asymptotic preserving implicit-explicit methods for the low Froude limit, together with well-balanced implicit kinetic schemes admitting a discrete entropy inequality.

Work experience

Post-doctoral researcher December 1st 2024 – present
Sorbonne Université, Paris
Modelling extreme waves in littoral areas

Post-doctoral researcher December 1st 2022 – November 30th 2024
Institut de Mathématiques de Bordeaux
Boundary conditions for a Boussinesq-type model

Ph.D candidate October 1st 2019 – November 30th 2022
Sorbonne Université, Paris
Low Froude regime and implicit kinetic schemes for the Saint-Venant system
Monitor mission (192 hours of teaching)

Research internship March 20th 2019 – September 19th 2019
Institut national de recherche en informatique et automatique, Paris
Exact reconstruction scheme on isolated shocks

Education

Laboratory Jacques-Louis Lions, Sorbonne Université, Paris, France 2019–2022
Ph.D degree under the supervision of Nina Aguillon and Nathalie Ayi, and under the direction of Jacques Sainte-Marie (Sorbonne University, LJLL)

Sup Galilée, University Paris 13, Villetaneuse, France 2016–2019
Engineering degree, equivalent to a master degree
Major: Applied Mathematics and Scientific Computing

Technical University of Munich, Germany winter semester 2018–2019
Exchange semester

University Paris 13, Villetaneuse, France 2016–2017
Bachelor degree in Mathematics

Publications

Published and accepted

- C. El Hassanieh, M. Rigal and J. Sainte-Marie. "Implicit kinetic scheme for the Saint-Venant system". ESAIM: M2AN (2025)
- D. Lannes and M. Rigal. "General boundary conditions for a Boussinesq model with varying bathymetry". In: Studies in Applied Mathematics 153.4 (2024)
- D. Del Sarto, E. Deriaz, X. Lhebrard and M. Rigal. "Adaptive wavelet schemes and finite volumes". ESAIM: ProcS 70 107-123 (2021)

Preprint

- M. Rigal, D. Lannes and P. Bonneton. "Open boundary condition for an improved Boussinesq-Abbott model applied to irregular wave fields"

In preparation

- D. Aregba, S. Brull and M. Rigal. "A discrete BGK scheme for Saint-Venant system with hydrostatic reconstruction"

Software contributions

- Contributing to the `wavebox` code developped by Fabien Marche, which consists in discontinuous Galerkin methods for solving water waves problems, written in C++;
- `BA_waves`: numerical methods for the dispersive Boussinesq-Abbott model with a new treatment of general boundary conditions, written in vectorized Matlab (Gitlab link);
- `swimpy`: a collection of finite volumes schemes for the shallow water system (incluldling kinetic methods and implicit time integrators) written in vectorized Python (Gitlab link);

Talks and presentations

Conferences and workshops

Talence, July 18, 2025 - 5th Korea-France Conference in Mathematics
Castro Urdiales, June 18, 2025 - CIEM workshop
Nice, January 9, 2025 - Journées Jeunes EDPistes 2025
Ile de Ré, May 31, 2024 - CANUM 2024
Amiens, November 17, 2023 - GDR MathGeoPhy
Bordeaux, November 14, 2023 - Workshop "Analysis, modeling and numerical methods for kinetic models"
Ile d'Aix, October 4, 2023 - JMVPR workshop
Bordeaux, June 29, 2023 - NumHyp23 conference
Évian-les-Bains, June 15, 2022 - Congrès national d'Analyse NUMérique

Seminars

Paris, March 5, 2025 - Stochastic parameterization half-day, LJLL
Bordeaux, March 21, 2024 - CSM seminar
Rennes, February 08, 2024 - IRMAR seminar
Bordeaux, February 05, 2024 - GT non permanents, Institut de Mathématiques de Bordeaux
Paris, January 12, 2024 - Team ANGE seminar, Inria Paris and LJLL
Paris, January 8, 2024 - Launch of the ANR Bourgeons, LJLL
Bordeaux, June 13, 2023 - Seminar of the team EDP et Physique mathématique at IMB
Amiens, October 10, 2022 - Seminar of the LAMFA laboratory
Paris, December 2, 2021 - Inria Paris, team ANGE seminar
Strasbourg, November 9, 2021 - Séminaire Equations aux dérivées partielles, IRMA team
Online, November 16, 2020 - MathInnov day
Online, June 16, 2020 - Inria Paris, team ANGE seminar
Paris, February 20, 2020 - Ph.D seminar of Laboratory Jacques-Louis Lions
Paris, November 18, 2019 - Inria Paris, team ANGE seminar

Poster session

Pornichet, March 10, 2022 - MoHyCon conference

Teaching (French)

Introduction à l'analyse numérique (niveau L2)
travaux dirigés (2023, 14h40) et travaux machine (2023–2024, 14h40);

Analyse hilbertienne, intégration et topologie (niveau L3)
travaux dirigés (2019–2021, 36h00);

Analyse vectorielle (niveau L2)
révisions (2020, 18h00), cours (2020, 18h00), travaux dirigés (2019–2020, 18h00);

Introduction à Matlab (niveau L1)
travaux machine (2019–2021, 4h00);

Skills

Programming skills: Python, Matlab, C/C++
Software: Linux environment, Git, visualization with VTK, SLURM interface (notions)
Tongues: French (mother tongue), English