Loïc Cappanera
Position: Assistant Professor
Email: lmcappan@central.uh.edu
Office address: PGH 602
Office phone: 713-743-1246

Department of Mathematics
University of Houston
Houston, TX 77004

EDUCATION

PhD in Fluid Mechanics: 10/2012 to 12/2015, Paris-Sud University (Orsay, France).
Thesis: Nonlinear stabilization of MHD equations and applications to multiphase flows.

Master of Science in Mathematics: 09/2008 to 06/2012, Paris-Sud University (Orsay, France).
French Agregation in Mathematics: 09/2010 to 06/2011, ENS Cachan (Cachan, France). Tenure awarded 10/2015. On leave of absence since 10/2015.

Bachelor in Mathematics: 09/2005 to 06/2008, Paris-Sud University (Orsay, France).

WORK EXPERIENCE

- since 08/2019: Assistant Professor, Department of Mathematics, University of Houston (Houston, TX, USA).
- 02/2017 to 06/2019: Postdoctoral Research Associate, Department of Computational and Applied Mathematics, Rice University (Houston, TX, USA).
- 01/2016 to 12/2016: Postdoctoral Research Associate, Department of Mathematics, Texas A&M University (College Station, TX, USA).
- 10/2012 to 09/2015: PhD candidate and Teaching Assistant, Paris-Sud University (Orsay, France).
- 02/2013 to 12/2013: Research assistant, Department of Mathematics of Texas A&M University.

RESEARCH INTERESTS

Scientific Computing, Numerical Analysis, Navier-Stokes and Maxwell equations, Multiphase Flow Problems, Level Set Method, Finite Element Method, Large Eddy Simulation, Porous Media, Reservoir Simulation.

ARTICLES IN REFEREED JOURNALS

[24] S. Benard, W. Herreman, L. Cappanera, C. Nore "Connecting alloy composition to electrical potential in liquid metal batteries", submitted

[23] A. Vu, L. Cappanera, "Error Analysis of a Semi-Implicit Time-Stepping Scheme for Incompressible Flows with Variable Density and Viscosity", submitted

[22] G. Jaramillo, L. Cappanera, C. Ward, "Analysis and Simulation of a Nonlocal Gray-Scott model", submitted

[21] D. Geneste, H. Faller, T. Chaabo, A. Cheminet, V. Valori, Y. Ostovan, L. Cappanera, C. Cuvier , F. Daviaud, J.-M. Foucaut, J.-L. Guermond, J.-P. Laval, C. Nore, V. Padilla, C.

Wiertel-Gasquet, B. Dubrulle, "Experimental study of subgrid stresses at the Kolmogorov scale in a turbulent von Kármán flow", submitted

[20] S. Bénard, L. Cappanera, W. Herreman, C. Nore, "Magnetic field based finite element method for magneto-static problems with discontinuous electric potential distributions", Comptes Rendus. Mécanique, 351.S1 (2023): 1-20, DOI: 10.5802/crmeca.184

[19] W. Herreman, L. Wierzchalek, G. M. Horstmann, L. Cappanera and C.Nore, "Stability theory for metal pad roll in cylindrical liquid metal batteries", Journal of Fluid Mechanics, 962 (2023): A6, DOI: https://doi.org/10.1017/jfm.2023.238

[18] G. Sosa Jones, B. Riviere, L. Cappanera, *Existence and convergence of a discontinuous Galerkin method for the compressible three-phase flow problem in porous media*, IMA Journal of Numerical Analysis (2022) 00, 1–34 , DOI: https://doi.org/10.1093/imanum/drac053

[17] V. Girault, B. Riviere, L. Cappanera, *A Finite element method for degenerate two-phase flow in porous media. Part II: convergence*, Journal of Numerical Mathematics, 29 (2021). DOI: 10.1515/jnma-2020-0005

[16] G. Jaramillo, L. Cappanera, C. Ward, *Numerical Methods for a Diffusive Class Nonlocal Operators*, J Sci Comput, 88, 30 (2021), DOI: https://doi.org/10.1007/s10915-021-01543-7

[15] W. Herreman, C. Nore, L. Cappanera, J.-L. Guermond, *Efficient mixing by swirling electrovortex flows in liquid metal batteries*, Journal of Fluid Mechanics, 915 (2021) A17, DOI: https://doi.org/10.1017/jfm.2021.79

[14] H. Faller, D. Geneste, T. Chaabo, A. Cheminet, V. Valori, Y. Ostovan, L. Cappanera, Ch. Cuvier, F. Daviaud, J.-M. Foucaut, J.-L. Guermond, J.-Ph. Laval, C. Nore, V. Padilla, C. Wiertel-Gasquet and B. Dubrulle, *On the nature of intermittency in a turbulent von Karman flow*, Journal of Fluid Mechanics, 914 (2021) A2, DOI: https://doi.org/10.1017/jfm.2020.908

[13] C. Nore, L. Cappanera, J.-L. Guermond, T. Weier, W. Herreman, *Feasibility of metal pad roll instability experiments at room temperature*, Phys. Rev. Lett., 126 (2021), 184501, DOI: https://doi.org/10.1103/PhysRevLett.126.184501

[12] V. Girault, B. Riviere, L. Cappanera, *A Finite element method for degenerate two-phase flow in porous media. Part I: well-posedness*, Journal of Numerical Mathematics, 29 (2021). DOI: 10.1515/jnma-2020-0004

[11] L. Cappanera, P. Debue, H. Faller, D. Kuzzay, E-W. Saw, C. Nore, J.-L. Guermond, F. Daviaud, C. Wiertel-Gasquet, B. Dubrulle, *Turbulence in realistic geometries with moving boundaries: when simulations meet experiments*, Computer & Fluids, 214 (2021): 104750, DOI: 10.1016/j.compfluid.2020.104750

[10] W. Herreman, S. Benard, C. Nore, P. Personnettaz, L. Cappanera, J.-L. Guermond, *Solutal buoyancy and electrovortex flow in liquid metal batteries*, Physical Review Fluids, 5 (2020), DOI: 10.1103/PhysRevFluids.5.074501

[9] W. Herreman, C. Nore, J.-L. Guermond, L. Cappanera, N. Weber, G. M. Horstmann, *Metal pad roll instability in cylindrical reduction cells*, Journal of Fluid Mechanics, 878 (2019) 598-646, DOI: 10.1017/jfm.2019.642

[8] W. Herreman, C. Nore, P. Ziebell Ramos, L. Cappanera, J.-L. Guermond, *Numerical simulation of electro-vortex flows in cylindrical fluid layers and liquid metal batteries*, Physical Review Fluids, 4 (2019), DOI: 10.1103/PhysRevFluids.4.113702

[7] L. Cappanera and B. Riviere, *Discontinuous Galerkin method for solving the black oil problem in porous media*, Numer Methods Partial Differential Eq. (2018) 1-29, DOI:10.1002/num.22324

[6] C. Nore, D. Castanon Quiroz, L. Cappanera and J.-L. Guermond, *Numerical simulation of the Von-Karman-Sodium experiment*, Journal of Fluid Mechanics, 854, (2018) 164-195, DOI:10.1017/jfm.2018.582

[5] L. Cappanera, J.-L. Guermond, W. Herreman, C. Nore, *Momentum based approximation of incompressible multiphase fluid flows*, Int. J. Numer. Meth. Fluids, 86 (2018) 541–563, DOI: 10.1002/fld.4467

[4] R. Zanella, C. Nore, F. Bouillault, L. Cappanera, I. Tomas, X. Mininger and J.-L. Guermond, *Study of Magnetoconvection Impact on a Coil Cooling by Ferrofluid with a Spectral / Finite Element Method*, IEEE Transactions on Magnetics, 54:3 (2018) 460014, DOI: 10.1109/TMAG.2017.2749539

[3] C. Nore, D. Castanon Quiroz, L. Cappanera and J.-L. Guermond, *Direct numerical simulation of the axial dipolar dynamo in the Von-Karman-Sodium experiment*, Euro. Phys. Letters, 114 (2016) 65002, DOI:10.1209/0295-5075/114/65002

[2] L. Cappanera, J.-L. Guermond, J. Léorat , C. Nore, *Two spinning ways for precession dynamo*, Physical Review E, 93 (2016) 043113, L. Cappanera, J.-L. Guermond, J. Léorat, C. Nore, "Two spinning ways for precession dynamo", Physical Review E, 93 (2016) 043113, DOI: 10.1103/physreve.93.043113

[1] W. Herreman, C. Nore, L. Cappanera, J.-L. Guermond, *Tayler instability in liquid metal columns and liquid metal batteries*, Journal of Fluid Mechanics, 771 (2015) 79-114, DOI: 10.1017/jfm.2015.159

REVIEWED PROCEEDINGS IN CONFERENCES

[2] L. Cappanera, B. Riviere, *Flexible Discretizations of the Three-Component Three-Phase Flow Problem*, Society of Petroleum Engineers Reservoir Simulation Conference, April 10-11 2019, DOI: 10.2118/193906-ms

[1] C. Nore , J. Léorat, J. L. Guermond, L. Cappanera, F. Luddens, *Dynamo action in precessing cylinders*, 9th PAMIR International Conference, Fundamental and Applied MHD, June 16-20 2014

PARTICIPATION TO RESEARCH GRANTS

- NSF-DMS (2208046), 09/1/2022 to 08/31/2025, PI Loic Cappanera, Numerical methods for incompressible multiphase flows applied to magnetohydrodynamics.
- NSF-DMS (1620058), 08/2016 to 07/2019, PI Jean-Luc Guermond, Advanced numerical methods for multiphysics Magnetohydrodynamics. Participation as Postdoctoral Research Associate.

- NFS-DMS (1015984), 09/2010 to 08/2015, PI Jean-Luc Guermond, Approximation techniques for MHD flows in highly heterogeneous domains. Participation as Research Assistant.

TEACHING EXPERIENCE

- MATH 6371: Numerical Analysis II.
  Department of Mathematics, University of Houston, Houston TX, USA.
  Spring 2023.

- MATH 6370: Numerical Analysis I.
  Department of Mathematics, University of Houston, Houston TX, USA.
  Fall 2023.

- MATH 4364: Introduction to Numerical Analysis in Scientific Computing.
  Department of Mathematics, University of Houston, Houston TX, USA.
  Spring 2023, Spring 2024.

- MATH 2318: Linear Algebra.
  Department of Mathematics, University of Houston, Houston TX, USA.
  Fall 2022.

- MATH 4335: Partial Differential Equations I.
  Department of Mathematics, University of Houston, Houston TX, USA.
  Fall 2021.

- MATH 4377-6308: Advanced Linear Algebra I.
  Department of Mathematics, University of Houston, Houston TX, USA.
  Spring 2021.

- MATH 3363 Introduction to PDEs.
  Department of Mathematics, University of Houston, Houston TX, USA.
  Fall 2020, Spring 2022, Fall 2022.

- MATH 1451: Accelerated Calculus II.
  Department of Mathematics, University of Houston, Houston TX, USA.
  Spring 2020.

- MATH 1450: Accelerated Calculus I.
  Department of Mathematics, University of Houston, Houston TX, USA.
  Fall 2019.

- CAAM 519: Computational Science I.
  CAAM Department of Rice University, Houston, TX, USA.
  Fall 2017, Fall 2018.

- Mathematics (Calculus, Differential Equations) for 1st year college students.
  IUT Orsay, Department of Chemistry (Paris-Sud University, France).
  Fall 2012, Spring 2014, Spring 2015.

- Computer science (Excel, Powerpoint, Statistics) for 1st year college students.
  IUT Orsay, Department of Chemistry (Paris-Sud University, France).
  Fall 2012, Spring 2014, Spring 2015.
- Graph theory for 1st year college statudents.
  IUT Orsay, Department of Informatics (Paris-Sud University, France).
  Spring 2014.
- Examiner for weekly oral mathematics exams for 1st year college students.
  CPGE, Institution Sainte-Marie d'Antony (France).
  Fall 2007 to Spring 2010.