Andrea Natale

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Research themes

— Geometric methods in fluid dynamics, incompressible Euler equations, Camassa-Holm equation
— Optimal transport, data analysis in fluid dynamics, numerical optimization
— Numerical analysis, finite element, finite volume and particle methods, structure preservation

Current position

11/2020–present **Junior research scientist**
Équipe RAPSODI, Inria Lille - Nord Europe (France).

Past positions

11/2019–10/2020 FMJH/LMH Postdoctoral research fellow.
LMO, **Université Paris-Sud** (France).

11/2017–10/2019 Postdoctoral research fellow.
INRIA Paris, **Mokaplan** team (France).

Education

02/2014–11/2017 Ph.D. Applied Mathematics and Mathematical Physics.
Imperial College London (UK).
Thesis title : *Structure-preserving finite element methods for fluids.*
Advisor : Dr. Colin J. Cotter.

09/2011–10/2013 M.Sc. Aerospace Engineering.
Delft University of Technology, Delft (Netherlands).
Thesis title : *A compatible discretization approach for the incompressible Euler equations.*
Advisor : Dr. Marc Gerritsma.

09/2008–07/2011 B.Sc. Aerospace Engineering.
University of Naples Federico II, Napoli (Italy).
Thesis title : *Spatial Filtering Improved Tomographic PIV.*
Advisor : Prof. Tommaso Astartita.
Co-advisor : Prof. Stefano Discetti.

Publications

Preprints, submitted articles

[1] T. Gallouët, Q. Merigot, A. Natale. Convergence of a Lagrangian discretization for barotropic fluids and porous media flow. arXiv preprint arXiv :2105.12605. 2021.

[2] A. Natale, G. Todeschi. A mixed finite element discretization of dynamical optimal transport. arXiv preprint arXiv :2003.04558. 2020.

[3] S. Di Marino, A. Natale, R. Tahraoui, F.-X. Vialard. Metric completion of Diff$([0, 1])$ with the H^1 right-invariant metric. *arXiv preprint arXiv :1906.09139*, 2019.

[4] C.J. Cotter, D.A. Ham, A.T.T. McRae, L. Mitchell., and A. Natale. On the shallow atmosphere approximation in finite element dynamical cores. *arXiv preprint 1410.3069v1*, 2014.

Accepted articles

[5] A. Natale, G. Todeschi. Computation of optimal transport with finite volumes. To appear in ESAIM : M2AN. arXiv preprint arXiv :2012.00349. 2021.

[6] A. Natale, and G. Todeschi. TPFA Finite Volume approximation of Wasserstein gradient flows. *Finite Volumes for Complex Applications* (conference paper), 2020.

[7] T.O. Gallouët, A. Natale, and F.-X. Vialard. Generalized compressible fluid flows and solutions of the Camassa-Holm variational model. *Archive for Rational Mechanics and Analysis*. doi : 10.1007/s00205-019-01453-x , 2019.

[8] A. Natale and F.-X. Vialard. Embedding Camassa-Holm equations in incompressible Euler. *Journal of Geometric Mechanics*, 11(2) :205, 2019.

[9] A. Natale and C.J. Cotter. A variational H(div) finite element discretisation for perfect incompressible fluids. *IMA Journal of Numerical Analysis*, 38(3) :1388–1419, 2018.

[10] A. Natale and C.J. Cotter. Scale-selective dissipation in energy-conserving finite element schemes for atmospheric flow simulations. *Quarterly Journal of the Royal Meteorological Society*, 143(705) :1734-1745, 2017.

[11] A. Natale, J. Shipton, and C.J. Cotter. Compatible finite element spaces for geophysical fluid dynamics. *Dynamics and Statistics of the Climate System*, 1(1) :dzw005, 2016.

[12] S. Discetti, A. Natale, and T. Astarita. Spatial filtering improved tomographic PIV. *Experiments in Fluids*. 54 :1505, 2013.

Invited Talks

06/2021	*Journée du Laboratoire LPP*. University of Lille (France).
05/2021	*LPP ANEDP seminar* (online). University of Lille (France).
02/2021	*Oberwolfach Workshop Applications of Optimal Transportation in the Natural Sciences* (online meeting). Oberwolfach (Germany).
11/2020	*LAMA seminar* (online). University Savoie Mont-Blanc (France).
11/2019	*MAGA days*, Université Paris-Sud, Paris (France).

10/2019 *Journé de rentrée de l'equipe ANEDP*, Université Paris-Sud, Paris (France).

10/2019 *Rencontres Inria-LJLL en calcul scientifique*, LJLL, Paris (France).

09/2019 *Workshop on Variational Discretizations for GFD*, Fields Institute, Toronto (Canada).

12/2018 *BIRS Workshop : "Shape Analysis, Stochastic Geometric Mechanics and Applied Optimal Transport"*, Banff (Canada).

12/2018 *Canadian Mathematical Society Winter Meeting*, Vancouver (Canada).

07/2018 *MokaMeeting*, INRIA Paris (France).

09/2017 *MokaMeeting*, INRIA Paris (France).

06/2017 *Geometric Methods for GFD*, University of Hamburg, Hamburg (Germany).

01/2016 *Applied Geometric Mechanics (AGM) meeting*, University of Surrey, Surrey (UK).

07/2014 *5th European Conference on Computational Mechanics (ECCM V)*, Barcelona (Spain).

Teaching Experience

09/2021–10/2021 Course instructor.
École centrale de Lille, Lille (France).
Refresher in Mathematics (M2)

01/2021–04/2021 Teaching assistant.
Université de Lille, Lille (France).
Résolution numérique de problèmes non-linéaires (M1).

09/2019–12/2019 Course instructor.
Université Paris-Sud, Paris (France).
Analyse et simulations numériques (L2).

09/2019–12/2019 Course instructor.
Université Paris-Sud, Paris (France).
Python pour le calcul scientifique (L2).

09/2018–12/2018 Teaching assistant.
Université Paris Dauphine, Paris (France).
Calcul différentiel et optimisation (L3).

09/2016–04/2017 Tutoring activity.
Imperial College London, London (UK).
Tutored a group of 7 students in the first year undergraduate Joint Maths and Computing (JMC) program, following their progress on their Maths modules including : Applied Methods, Linear Algebra, Algebra and Analysis, Foundations of Analysis, and Mathematical Methods.

05/2015–04/2017 Teaching assistant.
Imperial College London, London (UK).
Teaching assistant : Calculus, Mecanics, Matlab, LaTeX (Bachelor, Mathematics) ; Numerical solution of PDEs (*Master*, Mathematics).

04/2013–07/2013 Teaching assistant.
TU Delft, Delft (Netherlands).
Computational modelling (Bachelor, Aerospace Engineering).

Teaching activity outside university

10/2016–04/2017 *We Solve Problems*, London (Royaume-Uni). Worked for this charity to promote advanced mathematics between young students and prepare them for Maths Battles.

10/2015 *Supporting African Maths Initiatives (SAMI) Maths Camp*, London (Royaume-Uni). Volunteered as teacher for students in year 9-13.

Computer Skills

— Languages : Python, C++.

— Computer Applications : Matlab, Mathematica, Maple, Paraview, LaTeX, most common packages for Windows.

— Operating Systems : Microsoft Windows family, Linux.

Language Knowledge

Italian (native), **English** (fluent), **French** (fluent), **Spanish** (fluent).

Lille, 8 juin 2022