

Nicolas Barral

Department of Earth Science and Engineering
Imperial College London - London SW7 2AZ
☎ +44 (0)20 7594 9984
✉ n.barral@imperial.ac.uk
🌐 <http://www.imperial.ac.uk/people/n.barral>

Research associate at Imperial College London

Work experience

- 2016 - **Research Associate**, *Imperial College London, Department of Earth Science and Engineering.*
Mesh adaptation applied to ocean modelling.
- 2012 - 2015 **Phd student**, *Inria - Gamma3 Project.*
Supervisor : F. Alauzet. Mesh adaptation for moving geometry problems in 3D.
- Feb. - May **Doctoral visit**, *Mississippi State University.*
2013 Comparison of several moving mesh techniques.
- 2011 - 2012 **Masters internship (twice 6 months)**, *Inria - GAMMA3 team.*
Supervisor : F. Alauzet. Unsteady mesh adaptation.

Education

- 2018 **Software Carpentry Foundation**, *Certified Instructor.*
- 2015 **PhD**, *Inria / Université Paris 6 Pierre et Marie Curie.*
- 2012 **M. Res.**, *École Centrale Paris*, with high honors.
Numerical methods and high performance computing.
- 2012 **Engineering degree**, *École Centrale Paris.*
Student in one of the top French engineering schools. Major in applied mathematics (numerical methods, stochastic calculus, data mining).

Teaching experience

- 2018- **Imperial College London**, *Applying Computational Science.*
ACSE MSc, examiner (8h), course leader : G. Collins
- 2018- **Imperial College London**, *Modern Programming Techniques.*
ACSE MSc, 4 lectures (12h) + tutorials, course leader : G. Gorman.
- 2017- **Imperial College London**, *Numerical Methods 1.*
1st year, lectures + tutorials, 30h, course leader : G. Gorman.
- 2018 **Imperial College London**, *Shell & git workshop.*
2nd year, 2 day workshop (12h), Lead instructor.
- 2016- **Imperial College London**, *Introduction to programming for geoscientists.*
1st year, lectures + tutorials, 30h, course leader : G. Gorman (2016-17) then N. Barral (2018).
- 2014 **École Centrale Paris**, *Theoretical and practical analysis of Partial Differential Equations.*
1st year of engineering school (3rd year of University), 20h, course leader : P. Lafitte.

Student supervision

- 2017- **Imperial College London**, *Joe Wallwork.*
MRes+PhD, Adaptive methods for tsunami propagation. Main supervisor : M. Piggott

Skills

- Mathematics Numerical analysis and methods. Mesh adaptation. ALE solvers
- Physics Computational Fluid Dynamics (CFD) : compressible Euler flows, shallow water equation.
- Computing Languages : C, C++, Perl, Python, MatLab, Maple, R; HPC : threads, MPI.

Funding and grants

- 2017-2018 **eCSE 11 grant** , *9 month, ARCHER Service.*
Parallel anisotropic mesh adaptation in PETSc/DMPlex.
- 2016-2017 **Industrial project**, *Imperial College-Weir Group.*
Simulation of centrifugal pumps.
- 2013-2015 **ANR project MAIDESC**, *(French National Agency for Research).*
Adaptive meshes for unsteady interface with deformation and curvature.
Partners : Inria, Univ. Montpellier, Univ. Bordeaux, Ecole des Mines de Paris.
- 2013 **Grant**, *Fondation Sciences Mathématiques de Paris.*
Grant for a 4-month visit at Mississippi State University.

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List of publications

Journal articles

- **Three-dimensional CFD simulations with large displacement of the geometries using a connectivity-change moving mesh approach**, N. Barral and F. Alauzet, *Engineering with Computers*, 2018.
- **Time-accurate anisotropic mesh adaptation for three-dimensional time-dependent problems with body-fitted moving geometries**, N. Barral, G. Olivier and F. Alauzet, *Journal of Computational Physics*, 2017.
- **Geometric validity (positive Jacobian) of high-order Lagrange finite elements, theory and practical guidance**, P.L. George, H. Borouchaki and N. Barral, *Engineering with Computers*, 2015.

Preprints

- **Anisotropic mesh adaptation in Firedrake with PETSc DMPlex**, N. Barral, M.G. Knepley, M. Lange, M.D. Piggott and G.J. Gorman, 25th International Meshing Roundtable, Washington DC, USA, September 2016.
- **Construction and geometric validity (positive Jacobian) of serendipity Lagrange finite elements, theory and practical guidance**, P.L. George, H. Borouchaki and N. Barral, to be published.

Proceedings with peer review

- **Verification of Unstructured Grid Adaptation Components**, M. Park, A. Balan, W. Anderson, M. Galbraith, P. Caplan, H. Carson, T. Michal, J. Krakos, D. Kamenetskiy, A. Loseille, F. Alauzet, L. Frazza, and N. Barral, AIAA Scitech 2019 Forum, AIAA Paper 2019-1723, San Diego, CA, USA, Jan 2019.
- **Unstructured Grid Adaptation and Solver Technology for Turbulent Flows**, M. Park, N. Barral, D. Ibanez, D. Kamenetskiy, J. Krakos, T. Michal and A. Loseille, 56th AIAA Aerospace Sciences Meeting, AIAA Paper 2018-1103, Kissimmee, FL, USA, Jan 2018.
- **First Benchmark of the Unstructured Grid Adaptation Working Group**, D. Ibanez, N. Barral, J. Krakos, A. Loseille, T. Michal and M. Park, *Proc. of the 26th International Meshing Roundtable*, *Procedia Engineering*, vol 203, pp. 154-166, Washington DC, USA, 2017.
- **Metric-based anisotropic mesh adaptation for three-dimensional time-dependent problems involving moving geometries**, N. Barral, F. Alauzet and A. Loseille, 53th AIAA Aerospace Sciences Meeting, AIAA Paper 2015-2039, Kissimmee, FL, USA, Jan 2015.
- **Two mesh deformation methods coupled with a changing-connectivity moving mesh method for CFD Applications**, N. Barral, E. Luke and F. Alauzet, *Proc. of the 23th International Meshing Roundtable*, *Procedia Engineering*, vol 82, pp. 213-227, London, England, 2014.
- **Large displacement body-fitted FSI simulations using a mesh-connectivity-change moving mesh strategy**, N. Barral and F. Alauzet, 44th AIAA Fluid Dynamics Conference, AIAA Paper 2014-2773, Atlanta, GA, USA, June 2014.

Communications

- **Tidal power plant modelling using anisotropic mesh adaptation in Thetis**, N. Barral, A. Angeloudis, S. Kramer, G. Gorman and M. Piggott, *Firedrake '18 : The Firedrake user and developer workshop*, London, UK, 2018.
- **An anisotropic mesh adaptation approach for regional tidal energy hydrodynamics modelling**, N. Barral, A. Angeloudis, S. Kramer, G. Gorman and M. Piggott, EGU, Vienna, Austria, 2018.
- **Anisotropic mesh adaptation in Firedrake**, N. Barral, M.G. Knepley, M. Lange, M.D. Piggott and G.J. Gorman, *Firedrake '17 : The Firedrake user and developer workshop*, London, UK, 2017.

- **Parallel anisotropic mesh adaptation with DMPlex and Pragmatic**, N. Barral, M.G. Knepley, M. Lange, M.D. Piggott and G.J. Gorman, ADMOS 2017, Verbania, Italy, June 2017.
- **Anisotropic mesh adaptation in DMPlex**, N. Barral and M. Knepley, PETSc users meeting, Boulder, CO, USA, 2017.
- **Anisotropic mesh adaptation in Firedrake with PETSc DMPlex**, N. Barral, M.G. Knepley, M. Lange, M.D. Piggott and G.J. Gorman, 25th IMR, Washington DC, September 2016.
- **Anisotropic error estimates for adapted dynamic meshes**, N. Barral and F. Alauzet, ADMOS 2015, Nantes, France, June 2015.
- **Large displacement simulations with an efficient mesh-connectivity-change moving mesh strategy**, N. Barral and F. Alauzet, WCCM 2014, Barcelona, Spain, July 2014.
- **Parallel time-accurate anisotropic mesh adaptation for time-dependent problems**, N. Barral and F. Alauzet, WCCM 2014, Barcelona, Spain, July 2014.

Research reports

- **Moving mesh methods in Fluidity and Firedrake**, T. McManus, J. Percival, B. Yeager, N. Barral G. Gorman and M. Piggott, 2017.
- **Carreaux Bézier-Serendip de degré arbitraire**, P.L George, H. Borouchaki and N. Barral, INRIA RR-8624, 2014.
- **Construction et validation des éléments Serendip associés à un carreau de degré arbitraire**, P.L George, H. Borouchaki and N. Barral, INRIA RR-8572, 2014.
- **Construction et validation des éléments réduits associés à un carreau simplicial de degré arbitraire**, P.L George, H. Borouchaki and N. Barral, INRIA RR-8571, 2014.

Ph.D. thesis

- **Time-accurate anisotropic mesh adaptation for three-dimensional moving mesh problems**, N. Barral, Université Pierre et Marie Curie, 2015.

Talks and seminars

- **Framework pour des simulations côtières avec adaptation de maillage anisotrope**, Rencontres MathOcéan, Bordeaux, Janvier 2019.
- **Adaptation de maillage anisotrope pour simulations instationnaires**, Séminaire Calcul Scientifique et Modélisation, Institut Mathématique de Bordeaux, Bordeaux, Octobre 2018.
- **Time-accurate anisotropic mesh adaptation for three-dimensional moving mesh problems**, N. Barral, AMCG Seminar, Imperial College, London, December 2015.
- **Adaptation de maillages non structurés pour des problèmes instationnaires, et maillage en géométrie mobile**, N. Barral, Numerical Analysis and PDEs Seminar, Ecole Centrale Paris, November 2014.
- **Du réel au numérique : la science des maillages**, P.L. George and N. Barral, Pint of Science, 2015.

Awards

- **IMR Meshing Contest Award**, 23th International Meshing Roundtable, London, October 2014.