

# Nicolas Barral

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## Research associate at Imperial College London

### Work experience

- 2016 - **Research Associate**, Imperial College London, Department of Earth Science and Engineering.  
Adaptation de maillage appliquée à la modélisation de l'océan.
- 2012 - 2015 **Doctorant**, Inria - *Projet Gamma3*.  
Encadrant : F. Alauzet. Adaptation de maillage pour géométries mobiles en 3D.
- Fév. - Mai **Visiteur**, Mississippi State University.  
2013 Comparaison de techniques de bouger de maillage.
- 2011-2012 **Stages de master (2 fois 6 mois)**, Inria - *Projet Gamma3*.  
Encadrant : F. Alauzet. Adaptation de maillage instationnaire.

### Education

- 2018 **Software Carpentry Foundation**, Instructeur certifié.
- 2015 **PhD**, Inria / Université Paris 6 Pierre et Marie Curie.
- 2012 **Master**, École Centrale Paris, mention TB.  
Master Modélisation et Simulation, co-habilitation INSTN, ENSTA, ECP et ENS.
- 2012 **Diplôme d'ingénieur**, École Centrale Paris.  
Option Mathématiques Appliquées (méthodes numériques, calcul stochastique, data mining).

### Teaching experience

- 2018- **Imperial College London**, *Applying Computational Science*.  
ACSE MSc, examinateur (8h), coordinateur : G. Collins
- 2018- **Imperial College London**, *Modern Programming Techniques*.  
ACSE MSc, 4 amphis (12h) + TDs, coordinateur : G. Gorman.
- 2017- **Imperial College London**, *Numerical Methods 1*.  
L1, amphis + TDs, 30h, coordinateur : G. Gorman.
- 2018 **Imperial College London**, *Shell & git workshop*.  
L2, atelier de 2 jours (12h), Instructeur principal.
- 2016- **Imperial College London**, *Introduction to programming for geoscientists*.  
L1, amphis + TDs, 30h, coordinateur : G. Gorman (2016-17) puis N. Barral (2018).
- 2014 **École Centrale Paris**, *Analyse théorique et numérique des EDPs*.  
1ère année d'école d'ingénieur (L3), 20h, coordinatrice : P. Lafitte.

### Student supervision

- 2017- **Imperial College London**, *Joe Wallwork*.  
MRes+PhD, Méthodes adaptatives pour la propagation de tsunamis. Encadrant principal : M. Piggott

### Skills

- Mathématiques Analyse et méthodes numériques. Adaptation de maillage. Solvers ALE
- Physique CFD : Euler compressible, SWE.
- Informatique Langages : C, C++, Perl, Python, MatLab, Maple, R ; HPC : threads, MPI.

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## Financements et bourses

- 2017-2018 **eCSE 11 grant** , *9 month, ARCHER Service.*  
Adaptation de maillage parallele dans PETSc/DMPlex.
- 2016-2017 **Industrial project**, *Imperial College-Weir Group.*  
Simulation de pompes centrifuges.
- 2013-2015 **ANR project MAIDESC.**  
Maillages adaptatifs pour les interfaces instationnaires avec déformations, étirements, courbures.  
Partenaires : Inria, Univ. Montpellier, Univ. Bordeaux, Ecole des Mines de Paris.
- 2013 **Bourse**, *Fondation Sciences Mathématiques de Paris.*  
Bourse pour un séjour de 4 mois à Mississippi State University.

## *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.