

Matteo Croci | Curriculum Vitae

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Research Interests

I am a Postdoctoral Research Assistant in Computational Stochastics in the Mathematical Institute of the University of Oxford, working with Michael B. Giles. My research is in the field of uncertainty quantification and computational and industrial mathematics, with a focus on multilevel (quasi) Monte Carlo methods, reduced- and mixed-precision numerical algorithms, and biomedical computing. I am the core developer of the ML(Q)MC software libraries FEMLMC and pymlmc, and I am an extensive user of the FEniCS finite element software. My work enabled parallel geometric multigrid in FEniCS for the first time.

My research interests are:

- Multilevel (quasi) Monte Carlo methods.
- Reduced- and mixed-precision numerical algorithms for PDEs.
- Fast Gaussian field sampling and uncertainty quantification for PDEs with random coefficients.
- Mathematical modelling of the physiology of the brain.
- Finite element method.
- Multiple solutions of variational inequalities.

Education

DPHil (PhD) in Mathematics

University of Oxford, University College, UK, Industrially Focused Mathematical Modelling CDT 2015–2019
Thesis: Multilevel Monte Carlo Methods for Uncertainty Quantification in Brain Simulations,
Supervisors: P. E. Farrell, M. B. Giles.
Industrial supervisor: M. E. Rognes (Simula Research Laboratory, Lysaker, Norway).

MSc in Mathematical Modelling and Scientific Computing

University of Oxford, St. Anne's College, UK, final award: distinction 2014–2015
Thesis: Deflation Methods for Complementarity Problems. Published in Optimization Methods and Software.
Supervisor: P. E. Farrell.

BSc in Mathematical Engineering

Politecnico di Milano, Milan, Italy, final award: 110/110 cum laude (distinction) 2011–2014

Exchange Student in Mathematical Engineering

University of Maryland, College Park, MD, USA, academic honors (distinction) 2013

Publications

- M. Croci, M. B. Giles - *Effects of round-to-nearest and stochastic rounding in the numerical solution of the heat equation in low precision* - submitted to SINUM - arxiv.org/abs/2010.16225 (2020).
- M. Croci, M. B. Giles, P. E. Farrell - *Multilevel quasi Monte Carlo methods for elliptic PDEs with random field coefficients via fast white noise sampling* - submitted to SISC - arxiv.org/abs/1911.12099 (2020).
- M. Croci, V. Vinje and M. E. Rognes - *Fast uncertainty quantification of tracer distribution in the brain interstitial fluid with multilevel and quasi Monte Carlo* - IJNMBE - doi: 10.1002/cnm.3412 (2020).
- M. Croci, P. E. Farrell - *Complexity bounds on supermesh construction for quasi-uniform meshes* - Journal of Computational Physics - doi:10.1016/j.jcp.2020.109459 (2020) .
- M. Croci, V. Vinje, M. E. Rognes - *Uncertainty quantification of parenchymal tracer distribution using random diffusion and convective velocity fields* - Fluids and Barriers of the CNS - doi:10.1186/s12987-019-0152-7 (2019).
- P. E. Farrell, M. Croci, T. M. Surowiec - *Deflation for semismooth equations* - Optimization Methods and

Software - doi:10.1080/10556788.2019.1613655 (2019).

- M. Croci, M. B. Giles, M. E. Rognes, P. E. Farrell - *Efficient white noise sampling and coupling for multilevel Monte Carlo with non-nested meshes* - SIAM JUQ - doi:10.1137/18M1175239 (2018).

Scholarships & Awards

Oxford-Radcliffe Scholarship

University of Oxford, University College, Oxford, UK 2015–2019

Academic honors for the Fall Term

University of Maryland, College Park, MD, USA 2013

Scholarship for students with very high merit

Politecnico di Milano, Milan, Italy, (awarded every academic year) 2011–2013

Award for best freshmen in the academic year

Politecnico di Milano, Milan, Italy 2011–2012

Employment

Postdoctoral research assistant in Computational Stochastics

Mathematical Institute, University of Oxford, UK 2019–pres.
Principal Investigator: Michael B. Giles.

External PhD student

Simula Research Laboratory, Lysaker, Norway 2016–2019.

Swimming instructor in several swimming pools

Italian Federation of Swimming (FIN), Municipality of Milan, Italy 2010–2015

Teaching

Tutor in Part A Numerical Analysis

New College, University of Oxford, UK 2021

Lecturer in Matlab for the MSc in Mathematical Modelling and Scientific Computing

Mathematical Institute, University of Oxford, UK 2020–pres

Tutor in Stochastic Simulation for the Mathematics of Random Systems CDT

Mathematical Institute, University of Oxford, UK 2019–pres

Head demonstrator for the Computational Mathematics Course

Mathematical Institute, University of Oxford, UK 2018–2019
Coordinating all demonstrators, classes and all (around 200) first year students.

Tutor in Advanced Monte Carlo Methods for the MSc in Mathematical and Computational Finance

Mathematical Institute, University of Oxford, UK 2017–2019

Tutor in Continuous Mathematics

Balliol and Wadham Colleges, University of Oxford, UK 2017–2018

Demonstrator for the Computational Mathematics course

Mathematical Institute, University of Oxford, UK 2016–2018

TA in Numerical Analysis for the MSc in Mathematical Modelling and Scientific Computing

Mathematical Institute, University of Oxford, UK 2016–2017

Tutor for the B6.2 Numerical Solutions of Differential Equations II course

Lincoln College, University of Oxford, UK 2016–2017

TA in B6.2 Numerical Solutions of Differential Equations II

Mathematical Institute, University of Oxford, UK 2016–2017

Italian Tutor and Language Partner in the Language Partner Program

University of Maryland, College Park, MD, USA

2013

Selected Presentations

SIAM CSE 2021 (online)

Stochastic rounding for parabolic PDEs in half precision

2021

Invited talks at the University of Manchester, the University of Leicester, Simula Research Lab.

Reduced precision solvers for parabolic PDEs

2020

SIAM CSE 2019 (Spokane, USA) & ICIAM 2019 (Valencia, Spain) conferences

MLQMC methods for elliptic PDEs driven by white noise

2019

13th MCQMC (Rennes, France)

Efficient white noise sampling and coupling for multilevel Monte Carlo

2018

SCICADE 2017 (Bath, UK)

White noise coupling for multilevel Monte Carlo

2017

Administrative Duties while at the University of Oxford

Early Career Researchers Committee and Health and Safety Committee member

2020–pres

Convener of the North Meet South colloquia

2020–pres

Convener of the Stochastic Simulation seminars

2019–pres

Numerical Analysis Group graduate student coordinator

2018–pres

Co-organiser of the FEniCS'18 conference

2018

Peer-review

I acted as a reviewer for the Mathematical Programming and SIAM Journal on Scientific Computing journals.

Membership of Professional Organisations

- **SIAM** - Society for Industrial and Applied Mathematics (Early Career Member).
- **IMA** - Institute of Mathematics and its Applications (Associate Member).

Outreach

- In 2018 I have helped in the organisation of the "It All Adds Up" outreach event at the Mathematical Institute in Oxford whose aim is to inspire young women in year 9-12 to continue with Maths education.
- In 2017 I have delivered an outreach Mathematics lecture for the year 12 students of the St Gregory the Great Catholic School in Oxford, UK.

Languages

Italian: native language, **English:** fluent, **Spanish:** intermediate, **French:** basic.

Programming Languages & Software

Programming Languages: MATLAB, Python, C++, C, Bash, R.

Software : MPI, OpenMP, FEniCS, Pybind11, KNITRO, SAS, Git, \LaTeX , Gurobi.

Other Interests

Swimming, water polo, biking, tennis, squash and theatre.