Nicolas Boullé

DPhil student, University of Oxford

Mathematical Institute
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Research interests

Numerical analysis, machine learning, computational physics

Education

2018-2022 **University of Oxford**, United Kingdom
DPhil student in Numerical Analysis, supervised by Prof. Patrick Farrell and Prof. Alex Townsend.

2017-2018 **Cornell University**, USA
Visiting Research Student, supervised by Prof. Alex Townsend.

2015-2017 **École Normale Supérieure de Rennes**, France
BSc and 1st year of MSc in Mathematics.

2013-2015 **Lycée Saint-Louis**, France
Two-year university foundation course in mathematics and physics.

Prizes and scholarships

2022 **STEM for Britain**, *finalist*
For work on learning Green's functions.

2021 **IMA Leslie Fox Prize for Numerical Analysis**, *2nd prize*
For work on PDE learning theory with Green's functions.

2021 **G-Research PhD Prize**, *2nd place (£5000)*
For the development of rational neural networks.

2018-2022 **Oxford-Radcliffe Graduate Scholarship**

2015-2018 **Scholarship from ENS Rennes**

Travel awards

SIAM Student Travel Award in 2020, 2021, and 2022.

Research supervision

2021-2022 **1 undergraduate student from Yale**

Summer 21 **3 undergraduate students from Cornell, Johns-Hopkins, Yale**, *(with A. Townsend)*

Summer 20 **1 MSc student**, *(with Y. Nakatsukasa and D. Samaddar)*

Teaching

Fall 21 **Tutor for Approximation of functions**, Mathematical Institute, University of Oxford

Fall 20 **Tutor for Approximation of functions**, Mathematical Institute, University of Oxford

Fall 19 **TA for Practical Numerical Analysis**, Mathematical Institute, University of Oxford

Fall 19 **TA for Approximation of functions**, Mathematical Institute, University of Oxford

Submitted papers

15. **N. Boullé**, I. Newell, P. E. Farrell, and P. G. Kevrekidis, Two-Component 3D Atomic Bose-Einstein Condensates Support Complex Stable Patterns, submitted.

14. **N. Boullé**, P. E. Farrell, and M. E. Rognes, *Optimal control of Hopf bifurcations*, submitted.

13. **N. Boullé**, J. Słomka, and A. Townsend, *An optimal complexity spectral method for Navier–Stokes simulations in the ball*, submitted.

Publications

12. **N. Boullé**, S. Kim, T. Shi, and A. Townsend, *Learning Green's functions associated with parabolic partial differential equations*, J. Mach. Learn. Res. (2022).

11. **N. Boullé**, P. E. Farrell, and A. Paganini, *Control of bifurcation structures using shape optimization*, SIAM J. Sci. Comput. (2022).

10. **N. Boullé** and A. Townsend, *A generalization of the randomized singular value decomposition*, ICLR (2022).

9. **N. Boullé**, C. J. Earls, and A. Townsend, *Data-driven discovery of Green's functions with human-understandable deep learning*, Sci. Rep. (2022).

8. **N. Boullé**, V. Dallas, and P. E. Farrell, *Bifurcation analysis of two-dimensional Rayleigh–Bénard convection using deflation*, Phys. Rev. E (2022).

7. A. Ellingsrud, **N. Boullé**, P. E. Farrell, and M. E. Rognes, *Accurate numerical simulation of electrodiffusion and osmotic water movement in brain tissue*, Math. Med. Biol. (2021).

6. **N. Boullé** and A. Townsend, *Learning elliptic partial differential equations with randomized linear algebra*, Found. Comput. Math. (2022).

5. **N. Boullé**, E. G. Charalampidis, P. E. Farrell, and P. G. Kevrekidis, *Deflation-based identification of nonlinear excitations of the three-dimensional Gross–Pitaevskii equation*, Phys. Rev. A (2020).

4. **N. Boullé**, Y. Nakatsukasa, and A. Townsend, *Rational neural networks*, NeurIPS (2020).

3. E. G. Charalampidis, **N. Boullé**, P. E. Farrell, and P. G. Kevrekidis, *Bifurcation analysis of stationary solutions of two-dimensional coupled Gross–Pitaevskii equations using deflated continuation*, Commun. Nonlinear Sci. Numer. Simulat. (2020).

2. **N. Boullé** and A. Townsend, *Computing with functions in the ball*, SIAM J. Sci. Comput. (2020).

1. **N. Boullé**, V. Dallas, Y. Nakatsukasa, and D. Samaddar, *Classification of chaotic time series with deep learning*, Physica D (2020).

Study group with industry reports

2. D. Barton, N. Boullé, E. Campillo-Funollet, C. Hall, S. Ruangdech, and Y. Zhou, *Compressing aerodynamic hazard data* (with Zenotech), ESGI 162, 2020.

1. E. Campillo-Funollet, N. Boullé, M. Ebeling-Rump, A. Pichler, A. Farid, M. P. Goodridge, H. Lee, B. Lyu, and M. Sejeso, *Uncertainty in seismic inverse problems* (with BP), ESGI 145, 2019.

Academic visits and talks

Aug 22   **BIFD conference**, *Netherlands*
July 22   **Equadiff 15 conference**, *Czech Republic*

June 22	**IMA Conference on Numerical Linear Algebra and Optimization**, *Birmingham*
June 22	**Householder Symposium on Numerical Linear Algebra**, *Italy*
May 22	**University of Oxford**, *Numerical Analysis seminar*
Apr 22	**ICLR 2022 conference**
Apr 22	**SIAM Conference on Uncertainty Quantification**
Mar 22	**Virtual study group**, *V-KEMS*
Mar 22	**STEM for Britain**
Feb 22	**Cornell University**, *invited by Alex Townsend*
Jan 22	**PRISM Residential workshop**
Jan 22	**SIAM UKIE Annual Meeting**
Oct 21	**University of Oxford**, *Junior Applied Mathematics Seminar*
Aug 21	**11th Montreal Industrial Problem Solving Workshop**
July 21	**SIAM Annual Meeting**
July 21	**British Early Career Mathematicians' Colloquium**, *University of Birmingham*
June 21	**20th IMA Leslie Fox Prize Event**
Jan 21	**21st Geilo Winter School**
Dec 20	**NeurIPS 2020 conference**
Nov 20	**University of Oxford**, *Numerical Analysis seminar*
July 20	**European Study Group with Industry 162**, *University of Leeds*
Aug-Sept 19	**Simula Research Laboratory**, *visiting Marie Rognes*
Apr 19	**European Study Group with Industry 145**, *University of Cambridge*
Oct 18	**University of Oxford**, *Numerical Analysis seminar*
Apr 18	**MIT**, *visiting Jonasz Słomka*
Nov 17	**Cornell University**, *SCAN seminar*
Sept 17	**Memorial University of Newfoundland**, *visiting Alex Bihlo*

Professional activities

2023	**Co-organizer of a minisymposium**, 93rd GAMM Annual Meeting Title: Randomized algorithms in numerical linear algebra.
2022	**Highlighted Reviewer of ICLR 2022**
Since 2021	**Referee for NeurIPS, ICML, ICLR, SIAM J. Sci. Comput., and Physical Review Research**
2021	**Co-organizer of a minisymposium**, SIAM Annual Meeting Title: Approximation theory of neural networks.