Daniel F. Fortunato

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RESEARCH AREAS

Fast methods for partial differential and integral equations, spectral methods, *hp* element methods, fast direct solvers, computational fluid & solid mechanics, and multigrid methods

EDUCATION

Harvard University 2015–2020
Ph.D. in Applied Mathematics
M.S. in Applied Mathematics
Advisors: Alex Townsend, Chris Rycroft

Tufts University 2009–2013
B.S. in Mathematics, Computer Science
Honors: *summa cum laude*, Highest Honors in Thesis
Advisor: Christoph Börgers

PROFESSIONAL EXPERIENCE

Flatiron Institute New York, NY
Associate Research Scientist 2023–present
Flatiron Research Fellow 2020–2023
Research Associate Summer 2019

Lawrence Berkeley National Laboratory Berkeley, CA
Research Affiliate Summer 2017

Walt Disney Animation Studios Burbank, CA
Graduate Associate Summer 2016

Wolfram Research Somerville, MA
Developer 2014–2015
Junior Developer 2013–2014

Apple Inc. Cupertino, CA
Software Engineering Intern Summer 2012

AWARDS & HONORS

Leslie Fox Prize for Numerical Analysis (Second Prize) 2019
Institute of Mathematics and its Applications

Copper Mountain Student Paper Competition Winner 2019
19th Copper Mountain Conference on Multigrid Methods

Certificate of Distinction in Teaching 2018
Derek Bok Center, Harvard University

National Defense Science & Engineering Graduate Fellowship 2016–2019
U.S. Air Force Research Laboratory

Phi Beta Kappa Society 2013
Tufts University

Ralph S. Kaye Memorial Prize 2013
Department of Mathematics, Tufts University

Benjamin G. Brown Scholarship 2013
Tufts University

PUBLICATIONS

[10] D. Fortunato, D. B. Stein, and A. H. Barnett, *A fully adaptive, high-order, fast Poisson solver for complex two-dimensional geometries*, submitted, https://arxiv.org/abs/2501.17967.

[9] K. J. Burns, D. Fortunato, K. Julien, and G. M. Vasil, *Corner cases of the generalized tau method*, submitted, https://arxiv.org/abs/2211.17259.

[8] R. Ohana, M. McCabe, L. Meyer, R. Morel, F. J. Agocs, M. Beneitez, M. Berger, B. Burkhart, S. B. Dalziel, D. B. Fielding, D. Fortunato, J. A. Goldberg, K. Hirashima, Y.-F. Jiang, R. R. Kerswell, S. Maddu, J. Miller, P. Mukhopadhyay, S. S. Nixon, J. Shen, R. Watteaux, B. Régaldo-Saint Blancard, F. Rozet, L. H. Parker, M. Cranmer, and S. Ho, *The Well: a Large-Scale Collection of Diverse Physics Simulations for Machine Learning*, NeurIPS 2024, https://openreview.net/forum?id=00Sx577BT3.

[7] D. Fortunato, *A high-order fast direct solver for surface PDEs*, SIAM J. Sci. Comput., 46 (2024), pp. A2582–A2606, https://doi.org/10.1137/22M1525259.

[6] P. Miller, D. Fortunato, M. Novaga, S. Shvartsman, and C. Muratov, *Generation and motion of interfaces in a mass-conserving reaction-diffusion system*, SIAM J. Appl. Dyn. Syst., 22 (2023), pp. 2408–2431, https://doi.org/10.1137/22M152548X.

[5] P. Miller, D. Fortunato, C. Muratov, L. Greengard, and S. Shvartsman, *Forced and spontaneous symmetry breaking in cell polarization*, Nat. Comput. Sci., 2 (2022), pp. 504–511, https://doi.org/10.1038/s43588-022-00295-0.

[4] D. Fortunato, N. Hale, and A. Townsend, *The ultraspherical spectral element method*, J. Comput. Phys., 436 (2021), pp. 110087, https://doi.org/10.1016/j.jcp.2020.110087.

[3] D. Fortunato and A. Townsend, *Fast Poisson solvers for spectral methods*, IMA J. Numer. Anal., 40 (2020), pp. 1994–2018, https://doi.org/10.1093/imanum/drz034.

[2] D. Fortunato, C. Rycroft, and R. Saye, *Efficient operator-coarsening multigrid schemes for local discontinuous Galerkin methods*, SIAM J. Sci. Comput., 41 (2019), pp. A3913–A3937, https://doi.org/10.1137/18M1206357.

[1] A. Mijailovic, B. Qing, D. Fortunato, and K. Van Vliet, *Characterizing viscoelastic mechanical properties of highly compliant polymers and biological tissues using impact indentation*, Acta Biomater., 71 (2018), pp. 388–397, https://doi.org/10.1016/j.actbio.2018.02.017.

SOFTWARE

- `surfacefun`: A MATLAB package for numerically computing with functions on surfaces, https://surfacefun.readthedocs.io.
- `ultraSEM`: The ultraspherical spectral element method, https://ultraSEM.org.
- `treefun`: A MATLAB package for numerically computing with piecewise polynomials on adaptive trees, https://github.com/danfortunato/treefun.
- `fully-adaptive-poisson`: A fully adaptive Poisson solver for complex geometries in 2D, https://github.com/danfortunato/fully-adaptive-poisson.
- `surface-diffusion`: Spectral methods for reaction-diffusion systems on axisymmetric surfaces, https://github.com/danfortunato/surface-diffusion.

- `spherical-harmonic-interfaces`: A unified MATLAB interface to spherical harmonic transform libraries, https://github.com/danfortunato/spherical-harmonic-interfaces.
- `multigrid-ldg`: Efficient multigrid methods for local discontinuous Galerkin discretizations in C++, https://github.com/danfortunato/multigrid-ldg.
- `fast-poisson-solvers`: Fast spectrally-accurate Poisson solvers on a variety of domains, https://github.com/danfortunato/fast-poisson-solvers.

PRESENTATIONS

Interfaces and Unfitted Discretization Methods, IML, Sweden	September 2025
ICOSAHOM 2025, Montreal, Quebec	July 2025
SIAM CSE 2025, Fort Worth, TX	March 2025
Colloquium, Department of Computer Science, Tufts University	February 2025
SciCADE 2024, Singapore	July 2024
Computation Tools for PDEs with Complicated Geometries, Flatiron Institute	June 2024
Mechanics of Life II, Flatiron Institute	December 2023
SIAM-NNP, NJIT	October 2023
Workshop on Numerical Differential Geometry, CASUS, Görlitz, Germany	September 2023
ICIAM 2023, Tokyo	August 2023
Numerical Analysis in the 21st Century, Oxford, UK	August 2023
Biophysical Modeling Software Summer School, Flatiron Institute	June 2023
SIAM Conference on Computational Science and Engineering, Amsterdam	February 2023
Faculty Candidate Seminar, UMass Lowell	February 2023
Faculty Candidate Seminar, NJIT	January 2023
Computational Mathematics and Scientific Computing Seminar, Courant Institute	January 2023
Computational Mathematics Seminar, CU Boulder	October 2022
Fluid Mechanics and Waves Seminar, NJIT	September 2022
SIAM Annual Meeting, Pittsburgh, PA	July 2022
Outstanding Challenges in Computational Methods for Integral Equations, Oaxaca	May 2022
Fast Direct Solvers, Purdue University	October 2021
Flatiron-wide Algorithms and Mathematics, Flatiron Institute	October 2021
ICOSAHOM 2020, Vienna, Austria	July 2021
Numerical Analysis and PDE Seminar, University of Delaware	May 2021
SIAM Conference on Computational Science and Engineering, Fort Worth, TX	March 2021
Canadian Mathematical Society Winter Meeting	December 2020
Sidney Fernbach Fellowship Seminar, Lawrence Livermore National Laboratory	February 2020
Numerical Methods for Partial Differential Equations Seminar, MIT	December 2019
Numerical Analysis Seminar, Flatiron Institute	July 2019
28th Biennial Numerical Analysis Conference, Glasgow, UK	June 2019
19th Copper Mountain Conference on Multigrid Methods, Copper, CO	March 2019
SIAM Conference on Computational Science and Engineering, Spokane, WA	February 2019
Scientific Computing and Numerical Analysis Seminar, Cornell University	November 2018
ICOSAHOM 2018, London, UK	July 2018
SIAM Conference on Computational Science and Engineering, Atlanta, GA	February 2017
SIAM Student Chapter, Tufts University	November 2014

ORGANIZER ACTIVITIES

- Co-organizer of minisymposium "Advances in domain decomposition methods and fast solvers" at SIAM CSE (March 2025)
- Co-organizer of conference "Flatiron-Wide Autumn Meeting" at Flatiron Institute (October 2024)

- Co-organizer of minisymposium "Integral equation and related methods for PDEs with complex geometries" at SciCADE (July 2024)
- Co-organizer of conference "Computation Tools for PDEs with Complicated Geometries and Interfaces" at Flatiron Institute (June 2024)
- Lead organizer of conference "Flatiron-Wide Autumn Meeting" at Flatiron Institute (October 2023)
- Co-organizer of minisymposium "Boundary integral equations, boundary element methods, and applications" at SIAM CSE (February 2023)
- Co-organizer of the "Scientific Computing Seminar" in the Center for Computational Mathematics at Flatiron Institute (2022–present)

TEACHING EXPERIENCE

New York University, *Guest Lecturer for Leslie Greengard*

- MATH-UA.0394: Exploring ODEs — Spring 2023

Harvard University, *Teaching Fellow*

- AM 205: Advanced Scientific Computing: Numerical Methods I — Fall 2019
- AM 225: Advanced Scientific Computing: Numerical Methods II — Spring 2018

Tufts University, *Teaching Assistant*

- COMP 170: Computation Theory — Spring 2012
- COMP 15: Data Structures — Spring 2011
- COMP 11: Introduction to Computer Science — Fall 2010

SKILLS

Languages: C++11, C, MATLAB, Mathematica, Python, LaTeX
Technologies: BLAS, LAPACK, Git, OpenMP

PROFESSIONAL ACTIVITIES

Referee for: Journal of Computational Physics, Journal of Scientific Computing, Advances in Computational Mathematics, IMA Journal of Numerical Analysis, SIAM Journal on Matrix Analysis and Applications

Member of SIAM and AMS