

Tobin A. Driscoll

Department of Mathematical Sciences

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University of Delaware

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Research interests

Numerical analysis and applied mathematics, particularly:

Spectral and high-order methods in space and time for PDE

Radial basis functions

Numerical software

Numerical methods for thin film evolution; applications to human tear films

Numerical conformal mapping and applications

Simulation of rare events

Education

Ph.D. in Applied Mathematics, Cornell University, 1996

Thesis title: *Domain decomposition methods for conformal mapping and eigenvalue problems*

Advisor: Lloyd N. Trefethen

M.S. in Applied Mathematics, Cornell University, 1993

B.S. in Mathematics with honors, Pennsylvania State University, 1991

Honors thesis title: *Comparison of computational efficiency and sensitivity of several solution algorithms for the linear-quadratic optimal control problem*

Advisor: John E. Dzielski

B.S. in Physics, Pennsylvania State University, 1991

Professional experience

University of Delaware, 2010–present

Professor, Department of Mathematical Sciences

University of Delaware, 2004–2010

Associate Professor, Department of Mathematical Sciences

University of Delaware, 2000–2004

Assistant Professor, Department of Mathematical Sciences

University of Colorado at Boulder, 1996–2000

Research postdoctoral fellow, Department of Applied Mathematics

Honors

- Winner, 100 Digit Challenge (SIAM), 2002
- NSF VIGRE Postdoctoral Fellow, 1999–2000
- NSF Mathematical Sciences Postdoctoral Research Fellow, 1996–1999
- SIAM Outstanding Paper Prize, 1999
- Runner-up, Richard C. DiPrima Dissertation Prize, 1998
- Second Prize, Leslie Fox Competition, 1997
- SIAM Student Paper Prize Honorable Mention, 1995
- NSF Graduate Fellow, 1991–94
- A. D. White Fellow (Cornell graduate), 1991–94
- Braddock Scholar (Penn State undergraduate), 1987–91

Grants

- R. J. Braun (PI) and T. A. Driscoll, Modeling tear film dynamics. NSF DMS-1022706, \$444,000, 2010.
- L. F. Rossi, T. Driscoll, and R. Luke, Strengthening mathematics instruction with automated algorithmic mastery activities. Center for Teaching Effectiveness (UD), \$20,000, 2007.
- R. Braun, L. P. Cook, and T. A. Driscoll (co-PIs), Modeling the blink cycle and lipid dynamics in the tear film. NSF DMS-0616483, \$325,000, 2006.
- H. B. White *et al.*, (co-PIs), with T. A. Driscoll and others as senior personnel. Howard Hughes Medical Institute Undergraduate Science Education grant, 2006, \$1,500,000.
- R. Braun, T. A. Driscoll, P. Monk, L. F. Rossi (co-PIs). NSF Scientific Computing Research Environments for the Mathematical Sciences. NSF DMS-0322583, \$68,460, 2003.
- University of Delaware International Travel Award, 2003.
- T. A. Driscoll (PI). Novel fast and accurate methods for partial differential equations. NSF DMS-0104229, \$88,407, 2001.
- T. A. Driscoll (PI). Fast time stepping for the computational simulation of differential equations. University of Delaware Research Foundation, 2001–2002, \$21,042.
- T. A. Driscoll (PI). NSF Mathematical Sciences Postdoctoral Research Fellowship (University of Colorado). NSF DMS-9627677, \$75,000, 1996.

Books

- T. A. Driscoll. *Learning MATLAB*. To appear from the Society for Industrial and Applied Mathematics, July 2009.
- T. A. Driscoll and L. N. Trefethen. *Schwarz–Christoffel mapping*. Cambridge University Press, 2002.

Book chapters

- T. A. Driscoll and B. Fornberg. Padé-based interpretation and correction of the Gibbs phenomenon. In *Advances in the Gibbs Phenomenon*, ed. by A. Jerri, Sigma Sampling Publishing, Potsdam, NY, 2007.
- T. A. Driscoll and L. N. Trefethen. Numerical construction of conformal maps. Appendix to *Fundamentals of Complex Analysis with Applications to Engineering, Science, and Mathematics*, 3rd edition, by E. D. Saff and A. D. Snider, Prentice Hall, 2002.

Refereed publications

- W. M. Reid, T. A. Driscoll, M. F. Doty. [Material constraints on the formation of delocalized states in quantum dot-based intermediate band solar cells](#). Submitted to *Advanced Materials*.
- Q. Deng and T. A. Driscoll. A fast treecode for multiquadric interpolation with varying shape parameters. Submitted to *SIAM J. Sci. Comput.*
- A. Birkišson and T. A. Driscoll. Automatic Fréchet differentiation for the numerical solution of boundary-value problems. Resubmitted to *ACM Trans. Math. Soft.*
- R. J. Braun, R. Usha, G. B. McFadden, T. A. Driscoll, L. P. Cook, and P. E. King–Smith. [Thin film dynamics on a prolate spheroid with application to the cornea](#). *J. Eng. Math.* online (2011). DOI: [10.1007/s10665-011-9482-4](#)
- A. M. Neves, T. A. Driscoll, A. R. H. Heryudono, A. J. Ferreira, C. M. Soares, and R. M. Jorge. [Adaptive methods for analysis of composite plates with radial basis functions](#), *Mech. Adv. Materials Struct.* 18 (2011), 420–430. DOI: [10.1080/15376494.2010.528155](#)
- D. C. Usher, T. A. Driscoll, P. Dhurjati, J. A. Pelesko, L. F. Rossi, G. Schleiniger, K. Pusecker, and H. B. White. [A transformative model for undergraduate quantitative biology education](#). *CBE Life Sci. Educ.* 9 (2010), 181–188. DOI: [10.1187/cbe.10030029](#)
- A. R. H. Heryudono and T. A. Driscoll. [Radial basis function interpolation on irregular domain through conformal transplantation](#). *J. Sci. Comput.* 44 (2010), 286–300. DOI: [10.1007/s10915-010-9380-3](#)

- T. A. Driscoll. [Automatic spectral collocation for integral, integro-differential, and integrally reformulated differential equations](#). *J. Comput. Phys.* 229 (2010), 5980–5998. DOI: [10.1016/j.jcp.2010.04.029](#)
- T. A. Driscoll, F. Bornemann and L. N. Trefethen. [The chebop system for automatic solution of differential equations](#). *BIT* 48 (2008), 701–723. DOI: [10.1007/s10543-008-0198-4](#)
- K. L. Maki, R. J. Braun, T. A. Driscoll, and P. E. King-Smith. [An overset grid method for the study of reflex tearing](#). *Math. Medicine and Biology* 25 (2008), 187–214. DOI: [10.1093/imammb/dqn013](#)
- T. DeLillo, T. Driscoll, A. Elcrat, and J. Pfaltzgraff. [Radial and circular slit maps of unbounded multiply connected circle domains](#). *Proc. Roy. Soc. A* 464 (2008), 1719–1737.
- A. Heryudono, R. J. Braun, T. A. Driscoll, K. L. Maki and L. P. Cook. [Single-equation models for the tear film in a blink cycle: realistic lid motion](#). *Mathematical Medicine and Biology* 24 (2007), 347–377. DOI: [10.1093/imammb/dqm004](#)
- T. A. Driscoll and K. Maki. [Searching for rare growth factors using multicanonical Monte Carlo methods](#). *SIAM Review* 49 (2007), p. 673–692.
- T. A. Driscoll and A. Heryudono. [Adaptive residual subsampling methods for radial basis function interpolation and collocation problems](#). *Computers Math. Appl.* 53 (2007), p. 927–939. DOI: [10.1016/j.camwa.2006.06.005](#)
- R. Platte and T. A. Driscoll. [Eigenvalue stability of radial basis function discretizations for time-dependent problems](#). *Computers Math. Appl.* 51 (2006), 1251–1268. DOI: [10.1016/j.camwa.2006.04.007](#)
- T. DeLillo, T. A. Driscoll, A. Elcrat, and J. Pfaltzgraff. [Computation of multiply connected Schwarz–Christoffel maps for exterior domains](#). *Comput. Meth. Function Theory* 6 (2006), 301–315.
- J. A. Pelesko and T. A. Driscoll. [The effect of the small-aspect-ratio approximation on canonical electrostatic MEMS models](#). *J. Engng. Math.*, 53 (2005), 239–252. DOI: [10.1007/s10665-005-9013-2](#)
- R. Platte and T. A. Driscoll. [Polynomials and potential theory for Gaussian radial basis function interpolation](#). *SIAM J. Num. Anal.* 43 (2005), 750–766. DOI: [10.1137/040610143](#)
- T. A. Driscoll. [Algorithm 843: Improvements to the MATLAB toolbox for Schwarz–Christoffel mapping](#). *ACM Trans. Math. Soft.* 31 (2005), 239–251. DOI: [10.1145/1067967.1067971](#)
- R. Platte and T. A. Driscoll. [Computing eigenmodes of elliptic operators using radial basis functions](#). *Computers Math. Appl.* 48 (2004), 561–576. DOI: [10.1016/j.camwa.2003.08.007](#)
- C. R. Collins, T. A. Driscoll, and K. Stephenson. [Curvature flow in conformal mapping](#). *Comput. Meth. Function Theory* 3 (2003), 325–347.

- T. A. Driscoll and H. P. W. Gottlieb. [Isospectral shapes with Neumann and alternating boundary conditions](#). *Phys. Rev. E* 68, 016702 (2003).
- T. A. Driscoll. [A composite Runge-Kutta method for the spectral solution of semilinear PDE](#). *J. Comp. Phys.* 182 (2002), 357–367.
- T. A. Driscoll and B. Fornberg. [Interpolation in the limit of increasingly flat radial basis functions](#). *Computers Math. Appl.* 43 (2002), 413–422.
- B. Fornberg, T. A. Driscoll, G. Wright, and R. Charles. [Observations on the behavior of radial basis function approximations near boundaries](#). *Computers Math. Appl.* 43 (2002), 473–490.
- M. Goano, F. Bertazzi, P. Caravelli, G. Ghione, and T. A. Driscoll. [A general conformal-mapping approach to the optimum electrode design of coplanar waveguides with arbitrary cross-section](#). *IEEE Microw. Theory Tech.* 49 (2001), 1573–1580.
- T. A. Driscoll and B. Fornberg. [A Padé-based algorithm for overcoming the Gibbs phenomenon](#). *Numerical Algorithms* 26 (2001), 77–92.
- T. A. Driscoll and B. Fornberg. [Note on nonsymmetric finite differences for Maxwell’s equations](#). *J. Comput. Phys.* 161 (2000), 723–727.
- M. Ghrist, T. A. Driscoll, and B. Fornberg. [Staggered time integrators for wave equations](#). *SIAM J. Num. Analy.* 38 (2000), 718–741.
- B. Fornberg and T. A. Driscoll. [A fast spectral algorithm for nonlinear wave equations with linear dispersion](#). *J. Comput. Phys.* 155 (1999), 456–467.
- T. A. Driscoll and B. Fornberg. [Block pseudospectral methods for Maxwell’s equations: II. Two-dimensional, discontinuous-coefficient case](#). *SIAM J. Sci. Comput.* 21 (1999), 1146–1167.
- T. A. Driscoll. [A nonoverlapping domain decomposition method for Symm’s equation for conformal mapping](#). *SIAM J. Num. Analy.* 36 (1999), 922–934.
- T. A. Driscoll and B. Fornberg. [A block pseudospectral method for Maxwell’s equations: I. One-dimensional case](#). *J. Comput. Phys.* 140 (1998), 47–65. [[GOOGLE SCHOLAR SEARCH](#)]
- T. A. Driscoll, K.-C. Toh, and L. N. Trefethen. [From potential theory to matrix iterations in six steps](#). *SIAM Review* 40 (1998), 547–578. ([Google Scholar search](#))
- T. A. Driscoll and S. A. Vavasis. [Numerical conformal mapping using cross-ratios and Delaunay triangulation](#). *SIAM Sci. Comp.* 19 (1998), 1783–1803. ([Google Scholar search](#))
- T. A. Driscoll. [Eigenmodes of isospectral drums](#). *SIAM Review* 39 (1997), 1–17. ([Google Scholar search](#))
- T. A. Driscoll. [A MATLAB Toolbox for Schwarz–Christoffel mapping](#). *ACM Trans. Math. Soft.* 22 (1996), 168–186. ([Google Scholar search](#))

- J. S. Baggett, T. A. Driscoll, and L. N. Trefethen. [A mostly linear model of transition to turbulence](#). *Physics of Fluids A* 7 (1995), 833–838. ([Google Scholar search](#))
- T. A. Driscoll and L. N. Trefethen. [Pseudospectra for the wave equation with an absorbing boundary](#). *J. Comp. Appl. Math.* 69 (1996), 125–142. ([Google Scholar search](#))
- L. N. Trefethen, A. E. Trefethen, S. C. Reddy, and T. A. Driscoll. [Hydrodynamic stability without eigenvalues](#). *Science* 261 (1993), 578–584. ([Google Scholar search](#))
- J. E. Dzielski and T. A. Driscoll. Error bound on the solution of a linear-differential equation in Chebyshev series. *Int. J. Systems Sci.* 24 (1993), 1317–1327.

Software

- T. A. Driscoll, R. Pachón, R. Platte, and L. N. Trefethen. [Chebfun](#).
 2009 (team): Version 3.0 of chebfun, including automatic differentiation for chebop
 2008 (team): Version 2.0 of chebfun, for numerical representation of functions
 2008 (Driscoll): First release of chebop, for automatic solutions differential equations
- T. A. Driscoll. [Schwarz–Christoffel Toolbox for MATLAB](#).
 1994: Initial release.
 1996: Inclusion of CRDT algorithm for elongated regions.
 2000: Object-oriented interface for polygons and maps.
 2002: Module for solving Laplace’s equation with piecewise constant boundary conditions.

Other works

- M. Hassner, D. V. Leykin, and T. A. Driscoll. An analytic model of MR/GMR head sensitivity function. IBM Research Report RJ 10167, 1999.
- T. A. Driscoll. Review of *Computational Conformal Mapping*, by P. K. Kythe. *SIAM Review* 41 (1999), pp. 832–834.
- L. N. Trefethen and T. A. Driscoll. Schwarz–Christoffel mapping in the computer era. Proceedings of the International Congress of Mathematicians, Vol. III (Berlin, 1998). *Doc. Math.* 1998, Extra Vol. III, 533–542 (electronic).
- G. Wojcik, B. Fornberg, R. Waag, J. Mould, T. A. Driscoll, and L. Nikodym. Pseudospectral methods for large-scale bioacoustic models. Proceedings of the 1997 IEEE Ultrasonics Symposium.
- T. A. Driscoll. Uses of the Berenger PML in pseudospectral methods for Maxwell’s equations. Proceedings of the 1997 IUTAM Symposium on Computational Methods for Unbounded Domains, T. L. Geers, ed.
- T. A. Driscoll. *Domain Decomposition Methods for Conformal Mapping and Eigenvalue Problems*. Ph.D. thesis, Center for Applied Mathematics, Cornell University, 1996.

- T. A. Driscoll and B. Land. Vibrations of isospectral drums. Computer animation video produced at the Cornell Theory Center, 1995.
- T. A. Driscoll. Schwarz–Christoffel Toolbox user’s guide. Cornell Computer Science Technical Report TR 94-1422, 1994.

Recent invited presentations

- Automatic Fréchet differentiation for the spectral solution of boundary-value problems
SIAM Annual Meeting, July 2010
- Automatic solution of differential equations in the chebfun system
Canadian Applied and Industrial Mathematics Society, University of Western Ontario, June 2009
SIAM Southeastern-Atlantic Section Conference, University of South Carolina, April 2009
Courant Institute seminar, February 2009
- Solving continuous differential equations numerically: chebfun and chebop
SIAM Annual Meeting, San Diego, July 2008
University of Manchester seminar, May 2008
Oxford University seminar, April 2008
University of Dundee seminar, April 2008
- Least squares methods for conformal mapping and boundary value problems
SIAM Annual Meeting, San Diego, 2008
- Modeling and simulation of human tear film dynamics
SUNY Buffalo colloquium, November 2007
- Detection and approximation of jumps using complex-variable techniques
7th International Conference on Spectral and High-Order Methods, Beijing, China, June 2007
- Spectral least-squares for conformal mapping and potential theory
Computational and Conformal Geometry Workshop, SUNY Stony Brook, April 2007
- Radial basis function methods for meshless PDE computation
New Jersey Institute of Technology seminar, January 2007
Oxford University Computing Laboratory seminar, January 2007
- Conformal mapping 2.0
Dartmouth College seminar, October 2006
- Developing a computational framework for conformal mapping
SIAM Annual Meeting, Boston, July 2006
- Optimal node placement for Gaussian radial basis function interpolation

SIAM Annual Meeting, Boston, July 2006

Tufts University seminar, February 2006

SVD-based importance sampling for an optics-based dynamical system

SIAM Nonlinear Waves and Coherent Structures, University of Central Florida,
October 2004

High-order time stepping methods for electromagnetics

Computational Electromagnetics, Math. Forschungsinstitut Oberwolfach, February
2004

Professional activities

Associate Editor of the *SIAM Journal on Scientific Computing*, 2008–present

Member, Society for Industrial and Applied Mathematics

Referee for SISC, SINUM, J. Comput. Phys., Proc. Royal Soc. A, J. Comput. Appl.
Math., Computers Math. Appl., J. Sci. Comput., Num. Meth. Fluids, J. Phys. A,
Phys. Rev. E, SIAM J. on Applied Dynamical Systems, Constr. Approx., Complex
Var., Comput. Meth. Func. Theory

Book reviewer for SIAM Review, Wiley, J. Flu. Mech.

Reviewer of grant proposals for NSF and the Swiss National Science Foundation

Organizing committee of Mathematical Problems in Industry, 2004 (Delaware)

Students supervised

Rodrigo Platte (Ph.D., 2005)

Alfa Heryudono (Ph.D., 2008)

Teaching experience

Undergraduate

Calculus A,B,C

Includes special section of Calculus A for life sciences majors

Linear algebra

ODEs

PDEs

Numerical analysis (two-semester sequence)

Complex analysis

Graduate

Numerical linear algebra

Numerical ODEs/PDEs

Spectral/high-order methods
Radial basis functions

Use of technology

Maple demos, labs, and projects in computer classrooms for calculus, ODEs
MATLAB demos, labs, and projects in computer classrooms for linear algebra,
numerical analysis
In-class demos for complex analysis
Student blogs and wikis
Maple TA, Webassign for computer assigned/graded homework in calculus

Academic visits _____

Oxford University Computing Laboratory, January–June 2008

Oxford University Computing Laboratory, June 1999

ETH-Zürich (Swiss Federal Institute of Technology) Supercomputing Institute,
Summer 1994

Consultations _____

United Technologies, 2002–2003

Contact: Fabio Bertolotti. Use of spectral methods in investigating thermoacoustic instability (“singing flame”) in power-generating turbines.

Weidlinger Associates, 1998–2000

Contact: Greg Wojcik. High-order and spectral methods in space and time for the numerical simulation of acoustic wave propagation in tissue.

IBM Almaden Research Center, 1995–2001

Contact: Martin Hassner. Applications of conformal mapping to inductive and magnetoresistive read heads for hard drives.