

Tobin A. Driscoll

Department of Mathematical Sciences

October 2008

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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

Experience

University of Delaware, 2004–present

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), 1991–94
Braddock Scholar (Penn State), 1987–91

Grants

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.

Book

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. To appear in an untitled volume on the Gibbs phenomenon, edited by A. Jerri.
- 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

- T. A. Driscoll, F. Bornemann and L. N. Trefethen. [The chebop system for automatic solution of differential equations](#). Submitted to *BIT*.
- 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.
- 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.
- R. Platte and T. A. Driscoll. [Eigenvalue stability of radial basis function discretizations for time-dependent problems](#). *Computers Math. Appl.* 51 (2006), 1251–1268.
- 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.
- R. Platte and T. A. Driscoll. [Polynomials and potential theory for Gaussian radial basis function interpolation](#). *SIAM J. Num. Anal.* 43 (2005), 750–766.
- T. A. Driscoll. [Algorithm 843: Improvements to the MATLAB toolbox for Schwarz–Christoffel mapping](#). *ACM Trans. Math. Soft.* 31 (2005), 239–251.
- R. Platte and T. A. Driscoll. [Computing eigenmodes of elliptic operators using radial basis functions](#). *Computers Math. Appl.* 48 (2004), 561–576.
- 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.
- 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.
- T. A. Driscoll and S. A. Vavasis. [Numerical conformal mapping using cross-ratios and Delaunay triangulation](#). *SIAM Sci. Comp.* 19 (1998), 1783–1803.
- T. A. Driscoll. [Eigenmodes of isospectral drums](#). *SIAM Review* 39 (1997), 1–17.
- T. A. Driscoll. [A MATLAB Toolbox for Schwarz–Christoffel mapping](#). *ACM Trans. Math. Soft.* 22 (1996), 168–186.
- 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.

- T. A. Driscoll and L. N. Trefethen. [Pseudospectra for the wave equation with an absorbing boundary](#). *J. Comp. Appl. Math.* 69 (1996), 125–142.
- L. N. Trefethen, A. E. Trefethen, S. C. Reddy, and T. A. Driscoll. [Hydrodynamic stability without eigenvalues](#). *Science* 261 (1993), 578–584.
- 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. The chebfun system for MATLAB.
- 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.

Invited conference presentations

- Solving differential equations numerically in the chebfun system
SIAM Annual Meeting, San Diego, 2008
- Least squares methods for conformal mapping and boundary value problems
SIAM Annual Meeting, San Diego, 2008
- 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
- 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
- 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
- The EigTool system for exploring matrix eigenmode problems
International Congress on Industrial and Applied Mathematics, Sydney, Australia,
July 2003 (Minisymposium)
- Numerical conformal mapping in 2003: A survey
International Congress on Industrial and Applied Mathematics, Sydney, Australia,
July 2003 (Minisymposium, organizer)
- Overdetermined formulations for eigenmode problems
International Congress on Industrial and Applied Mathematics, Sydney, Australia,
July 2003 (Minisymposium)
- Schwarz–Christoffel mapping in MATLAB
European Microwave Week, Milan, Italy, September 2002 (Workshop)
- Wavenumber-dependent time stepping methods for semilinear evolution equations
IMACS Conference on Nonlinear Waves, University of Georgia, April 2001
(Minisymposium)
- Schwarz–Christoffel conformal mapping
Computational Methods and Function Theory, University of Aveiro, Portugal, June
2001 (Plenary speaker)

Contributed conference presentations

Directed random walks and importance sampling for noisy optical communications

IMACS Nonlinear Evolution Equations and Wave Phenomena, April 2003

Use of the SVD for finding rare events in noisy optical communications

SIAM Annual Meeting, July 2002

An efficient spectral method for the solution of nonlinear wave equations

Dundee Numerical Analysis Conference, 1999

Colorado Days at Los Alamos National Laboratory, 1999

Block pseudospectral methods for Maxwell's equations in inhomogeneous media

SIAM Annual Meeting, 1998

SIAM Conference on Wave Propagation, 1998

Los Alamos Days at Colorado, 1998

Uses of the Berenger PML with pseudospectral methods for Maxwell's equations
(poster)

IUTAM: Computational Methods for Unbounded Domains, 1997

Numerical conformal mapping using cross-ratios and Delaunay triangulation

Computational Methods and Function Theory, 1997

ISAAC, University of Delaware, 1997

Eigenmodes of isospectral drums

MATLAB conference, 1995

SIAM Annual Meeting, 1995

ICOSAHOM, 1995

Conformal mapping and the convergence of Krylov iterations

Colorado Conference on Iterative Methods, 1994

Pseudospectra of the wave operator with an absorbing boundary

SIAM Annual Meeting, 1993

Invited seminars and colloquia

Solving continuous differential equations numerically: chebfun and chebop

University of Manchester, May 2008

Oxford University, April 2008

University of Dundee, April 2008

Modeling and simulation of human tear film dynamics

SUNY Buffalo, November 2007

Radial basis function methods for meshless PDE computation

New Jersey Institute of Technology, January 2007
Oxford University Computing Laboratory, January 2007

Conformal mapping 2.0

Dartmouth College, October 2006

Radial basis function methods for computational PDE

Tufts University, February 2006

SVD-based importance sampling for finding rare events in noisy optical transmission

Rice University, October 2004

Schwarz–Christoffel maps to surfaces in space

University of Maryland, Baltimore County, April 2004

Solution of Laplace’s equation by conformal mapping

Oxford University Computing Laboratory, 2003

Schwarz–Christoffel conformal mapping

University of Delaware, 2002

Significant perturbations of NLS from SVD analysis

Northwestern University, January 2002
University of Maryland, Baltimore County, August 2001

Fast time stepping methods for semilinear evolution equations

Northwestern University, June 2001

Radial basis functions for the simulation of PDEs

Courant Institute (NYU), November 2000
Brown University, October 2000

High-order space and time methods for propagation problems

University of California–Santa Barbara, 2000
University of Michigan, 2000
University of Delaware, 2000
Georgia Institute of Technology, 1999

Staggered time integrators for wave equations

Oxford University Computing Laboratory, 1999

Spectrally accurate summation of Fourier series for functions with jump discontinuities

University of Colorado, 1998

Block pseudospectral methods for Maxwell’s equations in inhomogeneous media

Oak Ridge National Laboratory, 1998

Numerical conformal mapping using cross-ratios and Delaunay triangulation

Leslie Fox Prize Competition, 1997
University of Colorado, 1996

Eigenmodes of isospectral drums

Colorado State University, 1997
Colorado School of Mines, 1997
University of Colorado at Denver, 1997
MIT, 1997
Cornell University, 1995

Schwarz–Christoffel mapping in MATLAB

University of Tennessee at Knoxville, 1998
Wichita State University, 1996
University of Colorado, 1996
Universität Karlsruhe, 1994
ETH-Zürich, 1994
Cornell Numerical Analysis Day, 1993

Teaching experience

Undergraduate

Calculus A,B,C
Includes special section of Calculus A for life sciences majors
Linear algebra, ODEs (for math majors and for engineers)
Numerical analysis (two-semester sequence)
Complex analysis

Graduate

Numerical linear algebra
Numerical ODEs/PDEs
Spectral/high-order methods (special topics)

Use of technology

Maple in computer classrooms for calculus, ODEs
MATLAB in computer classrooms for linear algebra, numerical analysis
In-class demos for complex analysis
Maple TA for creating online practice exams in Calculus C

Students supervised

Rodrigo Platte (PhD completed in 2005)
Alfa Heryudono (PhD completed in 2008)

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

Attended Mathematical Problems in Industry, 2002 (RPI), co-organizer in 2004 (Delaware)

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.