Thomas Trogdon

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Research Interests

General: Approximation theory, numerical analysis, probability, random matrix theory, data analysis, mathematical physics and nonlinear PDEs

Specific: Average-case analysis for numerical algorithms
Universality in context of statistical mechanics as a tool for data science
Integrable dispersive PDEs and other nonlinear special functions
Riemann–Hilbert problems and oscillatory and singular integrals
Perturbations of integrable systems

Positions

- **Courant Institute — New York University** — New York, NY
  NSF Postdoctoral Fellow — *2013 - Present*
  - Research Supervisor: Percy Deift

Education

- **University of Washington** — Seattle, WA
  Ph.D. Applied Mathematics — *2008 - 2013*
  - Research Supervisor: Bernard Deconinck
- **University of Washington** — Seattle, WA
  M.Sc. Applied Mathematics — *2007 - 2008*
- **University of Minnesota** — Minneapolis, MN
  B.Sc. Mathematics — *2003 - 2007*

Refereed Publications (available at http://www.cims.nyu.edu/∼trogdon, 126 citations)

Books and Book Chapters

26. T. Trogdon and S. Olver, "Riemann–Hilbert Problems, Their Numerical Solution and the Computation of Nonlinear Special Functions," SIAM (in press, to be published in 2015/2016). **400 pages**

25. T. Trogdon, "A Unified Numerical Approach for the Nonlinear Schrödinger Equations," B. Pelloni and A. S. Fokas (Eds.), *Unified transform method for boundary value problems: applications and advances*, SIAM, 2014. **34 pages**

Dissertation

24. T. Trogdon, "Riemann–Hilbert Problems, Their Numerical Solution and the Computation of Nonlinear Special Functions," PhD Dissertation, University of Washington, 2013. **314 pages**

    - Winner of the 2014 SIAM Richard C. DiPrima Prize.

Journal Articles

23. D. Bilman and T. Trogdon, "Numerical inverse scattering for the Toda lattice, (submitted for publication), 1–40, 2015. **40 pages**

22. P. Deift, G. Menon and T. Trogdon, "On the condition number of the critically-scaled Laguerre Unitary Ensemble", (submitted for publication), 1–59, 2015. **59 pages**

21. C. Bordenave, P. Germain and T. Trogdon, "An extension of the Derrida–Lebowitz–Speer–Spohn equation", (submitted to *J. Phys. A*), 1–20, 2015. **20 pages**

20. G. Biondini and T. Trogdon, "Gibbs phenomenon for dispersive PDEs", (submitted to *Comm. Pure Appl. Math.*), 1–42, 2014. **42 pages**

19. A. Townsend, T. Trogdon and S. Olver, "Fast computation of Gauss quadrature nodes and weights on the whole real line", (to appear in *IMA J. Numer. Anal.*), 1–19, 2014. **19 pages**

18. P. Deift, G. Menon, S. Olver and T. Trogdon, "Universality in Numerical Computations with Random Data", *PNAS*, **111**, 14973–8, 2014. **8 pages**

17. S. Olver, R. R. Nadakuditi and T. Trogdon, "Sampling unitary ensembles", (to appear in *Random Matrix Theory and Applications*), 1–17, 2014. **17 pages**

16. T. Trogdon, "Rational approximation, oscillatory Cauchy integrals and Fourier transforms", (to appear in *Constructive Approximation*), 1–27, 2014. **27 pages**

15. T. Trogdon and S. Olver, "A Riemann–Hilbert approach to Jacobi operators and Gaussian quadrature", (to appear in *IMA J. Numer. Anal.*), 1–21, 2014. **21 pages**

14. T. Trogdon, "On the application of GMRES to oscillatory singular integral equations," (to appear in *BIT Numer. Math.*), 1–27, 2014. **27 pages**

13. T. Trogdon and B. Deconinck, "Dispersive and soliton perturbations of finite-genus solutions of the KdV equation: computational results," *Physics Letters A*, **378**, 617–622, 2014. **6 pages**

12. S. Olver and T. Trogdon, "Numerical solution of Riemann–Hilbert problems: orthogonal polynomials and random matrix theory," *Constr. Approx.*, **39**, 101–149, 2014. **49 pages**

11. B. Deconinck, V. Vasan and T. Trogdon, "The Method of Fokas for Solving Linear Partial Differential Equations," *SIAM Review*, **56**, 159–186, 2014. **28 pages**

10. S. Olver and T. Trogdon, "Nonlinear steepest descent and the numerical solution of Riemann–Hilbert problems," *Comm. Pure Appl. Math.*, **67**, 1353–1389, 2014. **37 pages**

9. T. Trogdon and B. Deconinck, "A numerical dressing method for the nonlinear superposition of solutions of the KdV equation," *Nonlinearity*, **27**, 67–85, 2013. **19 pages**

8. T. Trogdon and B. Deconinck, "Numerical computation of the finite-genus solutions of the Korteweg–de Vries equation via Riemann–Hilbert problems," *Appl. Math. Lett.*, **16**, 5–9, 2013. **9 pages**

7. T. Trogdon and B. Deconinck, "A Riemann–Hilbert problem for the finite-genus solutions of the Korteweg–de Vries equation and its numerical solution," *Physica D*, **251**, 1–18, 2013. **18 pages**

6. S.-P. Gorza, B. Deconinck, T. Trogdon, P. Emplit, and M. Haelterman, "Neck instability of bright solitary waves in hyperbolic Kerr media," *Optics Letters*, **37**, 4657–4659, 2012. **3 pages**

5. T. Trogdon and S. Olver, "Numerical inverse scattering for the focusing and defocusing nonlinear Schrödinger equations," *Proc. Roy. Soc. A*, **469**, 1–23, 2012. **23 pages**

4. T. Trogdon, S. Olver and B. Deconinck, "Numerical inverse scattering for the Korteweg–de Vries and modified Korteweg–de Vries equations," *Physica D*, **241**, 1003–1025, 2012. **23 pages**

3. T. Trogdon and B. Deconinck, "The Solution of Linear Constant-Coefficient Evolution PDEs With Periodic Boundary Conditions," *Applicable Analysis*, **91**, 529–544, 2012. **16 pages**

2. S.-P. Gorza, P. Emplit, T. Trogdon, B. Deconinck, M. Haelterman, "Experimental demonstration of the oscillatory snake instability of the bright soliton of the (2+1)D hyperbolic nonlinear Schrödinger equation," *Phys. Rev. Lett.*, **106**, 146–149, 2011. **4 pages**

1. S.-P. Gorza, M. Haelterman, P. Emplit, T. Trogdon, and B. Deconinck, "Transverse Instability of Bright Solitons in Hyperbolic Dispersive Media," *Nonlinear Photonics, OSA Technical Digest*, NMD4, 1–2, 2011. **2 pages**

Awards, Grants & Honors

- **SIAM Richard C. DiPrima Prize** 2014
- **Dept. Nominee for UW Distinguished Dissertation Award** 2013
- **Marie Curie Fellowship — declined in favor of NSF Fellowship** 2013
- **Best Student Paper Award at The Eighth IMACS Conference** 2013
- **Best Poster Award, SIAM Nonlinear Waves and Coherent Structures** 2012
- **Boeing Research Award** 2012
- **University of Washington Pearson Fellow** 2012-2013
- **NSF VIGRE Fellow** 2009-2010
- **MAA American Mathematics Competition, East High School Winner** 2003

Reviewer for:

- Communications in Mathematical Physics
- Wave Motion
- Advances in Computational Mathematics
- Mathematical Proceedings of the Cambridge Philosophical Society

- Proceedings of the Royal Society A
- Mathematical Reviews
- Journal of Mathematical Physics
- Journal of Nonlinear Science
- Constructive Approximation
- Studies in Applied Mathematics

Invited Presentations

33. CRM workshop on asymptotics in integrable systems, random matrices and random processes and universality, CRM, June 11, 2015: "Universality in numerical computations with random data"
32. SIAM Conference on Orthogonal Polynomials and Special Functions, NIST, June 2, 2015: "Uniformly accurate computation of Painlevé II transcendents"
31. SIAM Conference on Orthogonal Polynomials and Special Functions, NIST, June 2, 2015: "The condition number of the critically–scaled Laguerre Unitary Ensemble"
30. IMACS, Athens, GA, April 1-5, 2015: "Gibbs phenomenon for dispersive PDEs on the line"
29. Numerical Analysis Seminar, Courant Institute, February 20, 2015: "Universality in numerical computations with random data"
28. Mathematics Department Seminar, Dartmouth College, February 6, 2015: "Riemann–Hilbert problems, computation and universality"
27. Modern Applications of Complex Variables, Banff International Research Station, January 13, 2015: "Gibbs phenomenon for dispersive PDEs on the line"
26. Joint Applied Math/Probability Colloquium, Columbia University, December 2, 2014: "Universality in numerical computations with random data"
25. Applied Math Colloquium, CU Boulder, November 14, 2014: "Riemann–Hilbert problems, computation and universality"
24. LCDS Seminar, Brown University, October 20, 2014: "Universality in numerical computations with random data"
23. Analysis Seminar, Courant Institute, October 16, 2014: "Gibbs phenomenon for dispersive PDEs on the line"
22. SIAM Conference on Nonlinear Waves and Coherent Structures, Cambridge, UK, August 11-14, 2014: "Gibbs-like behavior of dispersive PDEs"
21. SIAM Conference on Nonlinear Waves and Coherent Structures, Cambridge, UK, August 11-14, 2014: "Universality in numerical computations with random data"
20. SIAM Conference on Nonlinear Waves and Coherent Structures, Cambridge, UK, August 11-14, 2014: "Oscillatory integrals and integrable systems"

19. Frontiers in Computational and Applied Mathematics, NJIT, May 22-23, 2014: "Oscillatory integrals and integrable systems"

18. Applied Mathematics Seminar, Courant Institute, April 18, 2014: "Riemann–Hilbert problems and the inverse scattering transform: From asymptotics to computation"

17. Mathematical Methods Seminar, University of Washington, April 1, 2014: "Gibbs-like behavior of dispersive PDEs"

16. Sydney Random Matrix Theory Workshop, The University of Sydney, January 13, 2014: "Monte Carlo Methods and Universality in Numerical Algorithms"

15. Graduate Student and Postdoc Seminar, Courant Institute, December 13, 2013: "Riemann-Hilbert problems, orthogonal polynomials and computation"

14. Applied Mathematics Seminar, University of Illinois at Chicago, October 25, 2013: "Riemann–Hilbert problems, their numerical solution and the computation of nonlinear special functions"

13. Integrable Systems Seminar, The University of Sydney, May 9, 2013: "A numerical Riemann–Hilbert approach for the Korteweg-de Vries equation"

12. AMS Sectional meeting, Boulder, CO, April 13-14, 2013: "A numerical Riemann–Hilbert approach for the Korteweg-de Vries equation"

11. Applied Mathematics Seminar, SUNY Buffalo, April 9, 2013: "A numerical Riemann-Hilbert approach for the Korteweg-de Vries equation"

10. IMACS, Athens, GA, March 25-27, 2013: "Numerical inverse scattering and the uniform approximation of solutions of integrable PDEs"

9. SIAM Conference on Computational Science and Engineering, Boston, MA, February 25 - March 1, 2013: "Numerical inverse scattering: Uniformly accurate resolution of dispersion"

8. AMS Sectional meeting, Tucson, AZ, October 27-28, 2012: "Instabilities of the hyperbolic $(2+1)$-dimensional NLS equation: Water waves and nonlinear optics"

7. SIAM Conference on Nonlinear Waves and Coherent Structures, Seattle, WA, June 13-16, 2012: "Finite-genus solutions of integrable equations: a numerical Riemann–Hilbert approach"

6. ICMS Workshop on Boundary-value Problems for Linear Elliptic and Integrable PDEs: theory and computation, Edinburgh, UK, May 28-June 1, 2012: "Numerical inverse scattering: uniform approximation of solutions of integrable PDEs"

5. AMS Sectional meeting, Honolulu, HI, March 03-04, 2012: "Uniform numerical approximation of integrable equations via Riemann–Hilbert problems"

4. ICIAM, Vancouver, BC, July 19-22, 2011: "Numerical inverse scattering for the Korteweg–de Vries and modified Korteweg-de Vries equations"

3. IMACS, Athens, GA, April 04-07, 2011: "Numerical inverse scattering for the Korteweg–de Vries equation"

2. Oxford Numerical Analysis Group, February 29, 2011: "Numerical inverse scattering: the Korteweg–de Vries equation"

1. Department of Applied Mathematics and Theoretical Physics, Cambridge, UK, February 26, 2010, guest lecture.

Contributed Presentations and Posters

2. SIAM Annual meeting, July 9-13, 2012: "Uniform numerical approximation of solutions of integrable equations via Riemann–Hilbert problems" (presentation)

1. SIAM Conference on Nonlinear Waves and Coherent Structures, Seattle, WA, June 13-16, 2012: "Numerical inverse scattering: Uniform approximation of solutions of integrable PDEs" (poster)

Membership in Professional Societies

- Member of The New York Academy of Sciences
- Member of AMS (American Mathematical Society)
- Member of SIAM (Society for Industrial and Applied Mathematics)
  - Member of the SIAM Activity Group on Special Functions and Orthogonal Polynomials
  - Member of the SIAM Activity Group on Nonlinear Waves and Coherent Structures

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Lecturer Experience

- **MATH-UA 140 — Linear Algebra** — New York University
  Lecturer — *Spring, 2015*
- **MATH-UA 123 — Calculus III** — New York University
  Lecturer — *Fall, 2014*
- **AMATH 352 — Applied Linear Algebra** — University of Washington
  Lecturer — *Summer, 2012*
- **AMATH 351 — Ordinary Differential Equations** — University of Washington
  Lecturer — *Summer, 2011*

Other Teaching Experience

- **AMATH 503** — University of Washington
  Teaching Assistant — *Spring, 2012*
- **AMATH 352** — University of Washington
  Teaching Assistant — *Winter, 2012*
- **AMATH 575** — University of Washington
  Teaching Assistant — *Spring, 2011*
- **MATH 124** — University of Washington
  Teaching Assistant — *Fall, 2009*
- **AMATH 351** — University of Washington
  Teaching Assistant — *Summer, 2009*
- **MATH 124/5** — University of Washington
  Teaching Assistant — *Fall, 2008 - Spring, 2009*

- **Physics/Calculus** — University of Washington
  Tutor — *Winter, 2008 - Summer, 2009*
- **AMATH 351** — University of Washington
  Grader — *Spring, 2008*

Service

- **SIAM Student Chapter** — University of Washington
  Vice President — *Fall, 2011–Summer, 2012*
- **Math Fair** — Lockwood Elementary
  Volunteer — *Fall, 2010–Spring, 2012*
- **Minisymposium organizer** — SIAM Nonlinear Waves
  Riemann–Hilbert problems: analysis and computation — *2012*
- **Minisymposium organizer** — SIAM OPSFA
  Riemann–Hilbert Problems: Orthogonal Polynomials and Random Matrix Theory — *2015*
- **Minisymposium organizer** — SIAM OPSFA
  Riemann–Hilbert Problems: Differential Equations — *2015*

Miscellaneous

- *Computer skills:* Python, Maple, Matlab, Mathematica, C++, Java, Lisp