TSAI, Yen-Hsi Richard

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Academic appointments

2013 Professor
Mathematics Department and Oden Institute for Computational Engineering and Sciences, University of Texas at Austin.

2007 Associate Professor
Mathematics Department and Institute for Computational Engineering and Sciences, University of Texas at Austin.

2004 Assistant Professor
Mathematics Department and Institute for Computational Engineering and Sciences, University of Texas at Austin.

2002 Veblen Research Instructor
Joint employment of Princeton University and Institute for Advanced Study.

Education

2002 Ph.D. Mathematics, University of California Los Angeles, June 2002.

1999 M.A. Mathematics, University of California Los Angeles.

1995 B.S. Mathematics, National Taiwan University, Taiwan.

Honors and Awards

- Peter O'Donnell Distinguished Research Award, 2018
- Simons Fellow in Mathematics, 2013-2014
- Moncrief Grand Challenge Award, 2012
- Alfred P. Sloan Fellowship, 2006-2008
- The FEMLAB Prize, April 2002

Other fellowships and awards

- Simons Participant and Senior Fellow, IPAM, 2019
- NCTS Scholar, National Center for Theoretical Sciences, Taiwan, 2016-2019
- Sid Richardson Fellowship, 2012-2015
- Visiting Fellowship of the Isaac Newton Institute for Mathematical Sciences, 2007, 2014

Professional Services

Advising Board membership

- CRM-Fields-PIMS Prize Selection Committee, 2020, 2021
- Subject Committee, The 2018 International Consortium of Chinese Mathematicians (ICCM) Best Paper Award
- Advisory Committee of George Washington University's program "GW Mathematics And Statistics Training, Education, and Research (MASTER)", 2014-2017
- Scientific Advisory Board of **Banff International Research Station for Mathematical Innovation and Discovery (BIRS)**, 2010-2013

Editorial Board membership

- Associate editor, SIAM Multiscale Modeling and Simulations, 2008-present
- Editor, Taiwanese Journal of Mathematics, 2023-present
- Associate editor, Communications in Mathematical Sciences, 2011-2014

Selected Conference and workshop Organization (2018-2023)

- Oberwolfach Workshop "Constrained Dynamics, Stochastic Numerical Methods and the Modeling of Complex Systems" (scheduled for May 2024)
- Workshop at Mittag-Leffler Institut, "New trends in numerical multiscale methods and beyond", July 2020
- Invited Minisymposium at SciCADE 2015, 2017, 2019(2022)
- Workshop at Banff International Research Station, June 17-22, 2018
  Advanced Developments for Surface and Interface Dynamics -- Analysis and Computation

Memberships of other professional organizations

- NCTS Scholar, National Center for Theoretical Sciences, Taiwan, 2016-2019
- Simons Foundation Fellow, 2013
- Alfred P. Sloan Fellow, 2006-2008
- Institute for Advanced Study, 2002 - 2004
- Society of Industrial and Applied Mathematics, 1997 - present

Selected publication of Yen-Hsi Richard Tsai

Mathematical theory for machine learning

1. Side effects of learning from low dimensional manifolds. J. He, R. Tsai, and R. Ward, Research in the Mathematical Sciences 10 (1), 13, 2023
2. Linear regression on manifold structured data: the impact of extrinsic geometry on solutions. L. Liu, J. He, and R. Tsai. To appear, Proceedings of ICLR.
3. Nearest neighbor sampling of point sets using random rays. L. Liu, C. Macdonald, and R Tsai. To appear, Commun. Appl. Math. Comput.

Hamilton-Jacobi equations and hyperbolic conservation laws

4. Usable boundary for visibility-based surveillance-evasion games. C. Esteve-Yagüe and R. Tsai. arXiv:2308.09152
5. Equivalent Extensions of Hamilton–Jacobi–Bellman Equations on Hypersurfaces. L. Martin and Y-H R Tsai, J. Sci. Computing (2020) 84:43
6. Optimal trajectories of curvature constrained motion in the Hamilton-Jacobi formulation R. Takei and R. Tsai. J. Sci. Comput. 54:622-644, 2013

(Fast sweeping methods)

7. Fast sweeping methods for hyperbolic systems of conservation laws at steady state II B. Engquist, B. D. Froese, Y.-H. R. Tsai. J. Comput. Phys. 286: 70-86, 2014
8. Fast Sweeping Methods for a Class of Hamilton-Jacobi Equations. Y.-H. R. Tsai, L.-T. Cheng, S. Osher, and H.-K. Zhao. SIAM Journal of Numerical Analysis, 41 (2), 2003

Algorithms for non-parametric interfaces

(The Implicit boundary integral methods)

9. High order corrected trapezoidal rules for a class of singular integrals F. Izzo, O. Runborg, and R. Tsai, Advances in Computational Mathematics 49 (4), 2023
10. Corrected Trapezoidal Rules for Singular Implicit Boundary Integrals F. Izzo, O. Runborg, and R. Tsai, J. of Comput. Phys. 461, 111193. 2022
11. An implicit boundary integral method for computing electric potential of macromolecules in solvent. Y. Zhong, K. Ren, and R. Tsai, J. Comput. Phys. 359, 2018
12. Volumetric variational principles for a class of partial differential equations defined on surfaces and curves. J. Chu and R. Tsai. Res. Math. Sci. (2018) 5: 19.
13. Integration over curves and surfaces defined by the closest point mapping. C. Kublik and R. Tsai. Res. Math. Sci. 3(3), 2016.
14. An extrapolative approach to integration over hypersurfaces in the level set framework C. Kublik and R. Tsai. Mathematics of Computation, 2017.
15. An implicit interface boundary integral method for Poisson's equation on arbitrary domains. C. Kublik, N. M. Tanushev, and R. Tsai. J. Comput. Phys. Vol. 247, 2013

(Threshold dynamics)

16. Diffusion generated motion using signed distance functions
    S. Ruuth, S. Esedoglu, and R. Tsai. J. Comput. Phys. 229 (4), 2010
17. Threshold Dynamics for the piecewise constant Mumford-Shah Functional
    S. Esedoglu and Y.-H. Tsai. J. of Comput. Phys, 211(1), 2006

Multiscale algorithms

18. Numerical wave propagation aided by deep learning
    H. Nguyen and R. Tsai, J. Of Compute. Phys, 475, 2023
19. Gaussian beam decomposition of high frequency wave fields
    N. Tanushev, B. Engquist, and R. Tsai. J. Comput. Phys., 228 (23), 2009
20. A stable parareal-like method for the second order wave equation
    H. Nguyen and R. Tsai, J. Compute. Phys. 405, 2020.
21. Parareal methods for highly oscillatory ordinary differential equations
    G. Ariel, S. J. Kim, and R. Tsai. SIAM J. of Sci. Comput. 38-6, 2016
22. A multiscale technique for finding slow manifolds of stiff mechanical systems
    G. Ariel, J.M. Sanz-Serna, and R. Tsai. SIAM Multi. Model. and Sim., Vol. 10, No.4, 2012
23. A multiscale method for highly oscillatory ordinary differential equations with resonance
    G. Ariel, B. Engquist, and R. Tsai. Math. Comp., 78(266):929–956, 2009
24. Heterogeneous Multiscale Methods for Stiff ODEs
    B. Engquist and Y.-H. Tsai. Math. of Comp., 74, 1707-1742, 2005

Line-of-sight constrained optimization

25. Efficient and robust sensor placement in complex environments
    L. Taus and R. Tsai, 2023. arXiv preprint arXiv:2309.08545
26. Visibility optimization for surveillance-evasion games
    L. Ly and R. Tsai, 2020. arXiv Preprint arXiv:2010.09001
27. Strategy synthesis for surveillance-evasion games with learning-enabled visibility optimization. S. Bharadwaj, L. Ly, B. Wu, R. Tsai, and U. Topcu. Proceedings of 2019 IEEE 58th Conference on Decision and Control (CDC)
28. Autonomous exploration, reconstruction, and surveillance of 3D environments aided by deep learning. L. Long and R. Tsai. Proceedings of ICRA 2019

Inverse source problems

29. Heat Source Identification Based on L1 Constrained Minimization
    Y. Li, S. Osher, and R. Tsai. Inverse Problems and Imaging, Vol 8, N0. 1. 2014
30. Point Source Identification in Non-Linear Advection-Diffusion-Reaction Systems
    A. Mamonov and R. Tsai. Inverse Problems 29, 2013