

CURRICULUM VITAE

Justin C. Tzou

Department of Mathematics, Macquarie University
Sydney, NSW, Australia, 2109

tel: +61 2 9850 8925; **email:** tzou.justin@gmail.com

homepage: web.science.mq.edu.au/~jtzou

Citizenship

- Canada

Education

- Ph.D. Applied Mathematics, Northwestern University, December 2012
 - advisors: Bernard J. Matkowsky, Vladimir A. Volpert, Alvin Bayliss
- B.A.Sc. Engineering Physics, University of British Columbia, May 2007, with distinction

Academic positions

- Senior Lecturer (Jan. 2023 – Present), School of Mathematical and Physical Sciences, Macquarie University
- Lecturer (Sept. 2017 – Dec. 2022), Department of Mathematics and Statistics, Macquarie University
- PIMS CRG Postdoctoral Fellow (Sept. 2015 – Aug. 2017), Mathematics Department, University of British Columbia
 - supervisor: Michael Ward
- AARMS Postdoctoral Fellow (Sept. 2013 – Aug. 2015), Department of Mathematics and Statistics, Dalhousie University
 - supervisor: Theodore Kolokolnikov
- Postdoctoral Fellow (Dec. 2012 – July 2013), Department of Mathematics, Technion – Israel Institute of Technology
 - supervisor: Alexander Nepomnyashchy

Research interests

- First passage processes and narrow escape problems; reaction-diffusion systems; pattern formation in flat and curved geometries; localized patterns; singular perturbations; matched asymptotic methods; dynamical systems.

Grants

- Australian Research Council Discovery Project DP220101808 (co-CI with Leo Tzou, University of Sydney) *Microlocal Analysis - A Unified Approach for Geometric Models in Biology*; \$405,000 over 3 years

Preprints and publications

(*electronic copies may be found at* <http://web.science.mq.edu.au/~jtzou/publications.html>)

29. J. C. Tzou, L. Tzou, *A counterexample to the Lévy Flight Foraging Hypothesis in the narrow capture framework*, accepted, Physical Review Research, 16 pages.
28. M. Nursultanov, W. Trad, J. C. Tzou, L. Tzou, *Eigenvalue Variations of the Neumann Laplace Operator Due to Perturbed Boundary Conditions*, submitted to Communications in Partial Differential Equations, 27 pages.

27. M. Nursultanov, W. Trad, J. C. Tzou, L. Tzou, *The narrow capture problem on general Riemannian surfaces*, accepted, Differential and Integral Equations, 30 pages.
26. J. C. Tzou, S. Xie, *Oscillatory translational instabilities of localized spot patterns in the Schnakenberg reaction-diffusion system on general 2-D domains*, accepted, Nonlinearity, 44 pages.
25. M. Nursultanov, L. Tzou, J. C. Tzou, *On the mean first arrival time of Brownian particles on Riemannian manifolds*, J. Math. Pures Appl., **150** (2021), pp. 202–240.
24. J. C. Tzou, L. Tzou, *Analysis of spot patterns on a coordinate-invariant model for vegetation on a curved terrain*, SIAM J. Appl. Dyn. Syst. **19** (4) (2020), pp. 2500–2529.
23. J. C. Tzou, L. Tzou, *Spot patterns of the Schnakenberg reaction-diffusion system on a curved torus*, Nonlinearity, **33** (2) (2019), pp. 643–674.
22. J. C. Tzou, B. R. Wetton, *Optimal covering points and curves*, AIMS Mathematics, **4**(6) (2019), pp. 1796–1804.
21. R. A. Fernandes, K. A. Ganzinger, J. C. Tzou, P. Jonsson, S. F. Lee, M. Palayret, A. M. Cunha Santos, A. R. Carr, A. Ponjavic, V. T. Chang, C. Macleod, C. Lagerholm, A. E. Lindsay, O. Dushek, A. Tilevik, S. J. Davis, D. Klenerman, *A cell topography-based mechanism for ligand discrimination by the T cell receptor*, PNAS, **116**(28), (2019), pp. 14002–14010.
20. T. Kolokolnikov, M. J. Ward, J. C. Tzou, J. C. Wei, *Stabilizing a homoclinic stripe*, Philos. Trans. Royal Soc. A, **376**(2135), (2018), 20180110.
19. Chang, Y., J. C. Tzou, M. J. Ward, J. C. Wei, *Refined stability thresholds for localized spot patterns for the Brusselator model in \mathbb{R}^2* , European J. of Appl. Math. **30** (4), (2017), pp. 791–828.
18. J. C. Tzou, M. J. Ward, *The stability and slow dynamics of spot patterns in the 2D Brusselator model: The effect of open systems and heterogeneities*, Physica D: Nonlinear Phenomena **373**, (2018), pp. 13–37.
17. J. C. Tzou, M. J. Ward, J. C. Wei, *Anomalous scaling of Hopf bifurcation thresholds for the stability of localized spot patterns for reaction-diffusion systems in 2-D*, SIAM J. Appl. Dyn. Syst. **17** (1) (2018), pp. 982–1022.
16. V. Rottschäfer, J. C. Tzou, M. J. Ward, *Transition to blow-up in a reaction-diffusion model with localized spike solutions*, European J. of Appl. Math. **28** (6), (2017), pp. 1015–1055.
15. A. E. Lindsay, R. T. Spoonmore, J. C. Tzou, *Hybrid asymptotic-numerical approach for estimating first passage time densities of the two-dimensional narrow capture problem*, (2016), Phys. Rev. E **94** (3), 042418 (2016), 15 pages.
14. J. C. Tzou, S. Xie, T. Kolokolnikov, M. J. Ward, *The stability and slow dynamics of localized spot patterns for the 3-D Schnakenberg reaction-diffusion model*, SIAM J. Appl. Dyn. Syst. **16** (1) (2017), pp. 294–336.
13. A. E. Lindsay, J. C. Tzou, T. Kolokolnikov, *Optimization of first passage times by multiple cooperating mobile traps*, (2016), SIAM Multiscale Model. Simul. **15** (2) (2017), pp. 920–947.
12. J. C. Tzou, P. G. Kevrekidis, T. Kolokolnikov, R. Carretero-González, *Weakly nonlinear analysis of vortex formation in a dissipative variant of the Gross-Pitaevskii equation*, SIAM J. Appl. Dyn. Syst. **15** (2) (2016), pp. 904–922.
11. Y. Chen, T. Kolokolnikov, J. C. Tzou, C. Gai, *Patterned vegetation, tipping points, and the rate of climate change*, European J. of Appl. Math. **26** (6), (2015), pp. 945–958.
10. A. E. Lindsay, T. Kolokolnikov, J. C. Tzou, *Narrow escape problem with a mixed trap and the effect of orientation*, Phys. Rev. E **91** (3), 032111 (2015), 15 pages.
9. V. Kurella, J. C. Tzou, D. Coombs, M. J. Ward, *Asymptotic analysis of first passage time problems inspired by ecology*, (2014), B. Math. Biol. **77** (1), (2015), pp. 83–125.
8. J. C. Tzou, T. Kolokolnikov, *Mean first passage time for a small rotating trap inside a reflective disk*, SIAM Multiscale Model. Simul. **13** (1), (2015), pp. 231–255.

7. J. C. Tzou, M. J. Ward, T. Kolokolnikov, *Slowly varying control parameters, delayed bifurcations, and the stability of spikes in reaction-diffusion systems*, *Physica D: Nonlinear Phenomena* **290**, (2015), pp. 24–43.
6. J. C. Tzou, S. Xie, T. Kolokolnikov, *First passage times, mobile traps, and Hopf bifurcations*, *Phys. Rev. E* **90** (6), 062138 (2014), 10 pages.
5. J. C. Tzou, Y. -P. Ma, A. Bayliss, B. J. Matkowsky, V. A. Volpert, *Homoclinic snaking near a codimension two Turing-Hopf bifurcation point in the Brusselator model*, *Phys. Rev. E* **87** (2), 022908 (2013), 20 pages.
4. J. C. Tzou, Y. Nec, M. J. Ward, *The stability of localized spikes for the 1-D Brusselator reaction-diffusion model*, *European J. of Appl. Math.*, **24** (4), (2013), pp. 515–564.
3. J. C. Tzou, A. Bayliss, B. J. Matkowsky, V. A. Volpert, *Stationary and slowly moving localized pulses in a singularly perturbed Brusselator model*, *European J. of Appl. Math.* **22** (5), (2011), pp. 423–453.
2. J. C. Tzou, A. Bayliss, B. J. Matkowsky, V. A. Volpert, *Interaction of Turing and Hopf modes in the superdiffusive Brusselator model near a codimension two bifurcation point*, *Math. Model. Nat. Phenom.* **6** (1), (2011), pp. 87–118.
1. J. C. Tzou, B. J. Matkowsky, V. A. Volpert, *Interaction of Turing and Hopf modes in the superdiffusive Brusselator model*, *Appl. Math. Lett.* **2**, (2009), pp. 1432–1437.

Student supervision

- Siwen Deng, PhD, March 2022 - present (principal supervisor)
- Zahid Amin, PhD, June 2023 - present (principal supervisor)

Conferences and talks

- *Green's functions in pattern formation and random search* (invited seminar speaker), University of New South Wales, Sydney, NSW, Australia, April 2024.
- *Lévy flight versus Brownian search strategies - a matched asymptotics approach* (mini-symposium speaker), Australia and New Zealand Industrial and Applied Mathematics 2024, Handorf, South Australia, Australia, February 2024.
- *Localized spot dynamics: curvature and instability* (invited mini-symposium speaker), 10th International Congress on Industrial and Applied Mathematics, Tokyo, Japan, August 2023.
- **Mini-symposium co-organizer**, session title “Patterns in Earth’s Climate System,” SIAM Conference on Applications of Dynamical Systems, Portland, USA, May 2023.
- *Effect of surface curvature on spotted and striped patterns* (invited mini-symposium speaker), SIAM Conference on Applications of Dynamical Systems, Portland, USA, May 2023.
- *Computing surface Green's functions and some applications* (invited mini-symposium speaker), Canadian Applied and Industrial Mathematics Annual Meeting, Kamloops, Canada, June 2023.
- *Modeling and analysis of localized vegetation patterns on curved topography*, Analysis-Applied Math-Physics Seminar, Dalhousie University, Halifax, Canada, 2022 (online).
- **Mini-symposium co-organizer**, session title “Novel and unconventional reaction–diffusion problems,” Canadian Applied and Industrial Mathematics Annual Meeting, Waterloo, Ontario, Canada, June 2021 (online).
- *Computing surface Green's functions and some applications*, SIAM Conference on Mathematical Aspects of Materials Science, Bilbao, Spain, May 2021 (online).
- *Modeling and analysis of localized vegetation patterns on curved topography*, PIMS Workshop on New Trends in Localized Patterns in PDEs in Honor of Michael Ward, University of British, Vancouver, Canada, May 2021 (online).

- *Localized patterns and narrow escape problems in more general geometries* (mini-symposium speaker), Canadian Mathematical Society Winter Meeting, December 2020 (online).
- *A framework for analyzing localized patterns on curved surfaces* (mini-symposium speaker), Australia and New Zealand Industrial and Applied Mathematics 2020, Hunter Valley, NSW, Australia, February 2020.
- *A framework for analysing localized patterns and the narrow escape problem on curved surfaces* (**plenary speaker**), Joint ANZIAM NSW and ACT Branch Meeting 2019, Kirby Institute, Sydney, Australia, November 2019.
- *Numerically computing Green's functions on a ring torus with application to the dynamics and stability of spot patterns* (invited mini-symposium speaker), Canadian Applied and Industrial Mathematics Annual Meeting, Vancouver, Canada, June 2019.
- **Mini-symposium co-organizer**, session title "Recent advances in diffusive and reaction-diffusion systems," SIAM Conference on Applications of Dynamical Systems, Snowbird, Utah, USA, May 2019.
- *An analytic-numerical method for Green's functions on surfaces: applications to spot patterns* (invited workshop speaker), Workshop on Emerging Areas in Reaction-Diffusion Systems (invited workshop speaker), Shanghai, China, April 2019.
- *Anomalous scaling of Hopf bifurcation thresholds of localized spot patterns in 2-D* (mini-symposium speaker), Australia and New Zealand Industrial and Applied Mathematics 2019, Nelson, New Zealand, February 2019.
- **Co-lecturer** at the **AMSI Summer School 2019**, University of New South Wales, Sydney, NSW, Australia. Course title: *PDE Methods and Models in Mathematical Biology*, January 2019.
- *Localized pattern dynamics and mean first passage time optimization - analysis techniques and surprising connections* (invited workshop speaker), Advanced Asymptotics of PDEs and Applications (invited workshop speaker), Pisa, Italy, September 2018.
- *Stability analysis of localized patterns in two and three spatial dimensions* (invited seminar speaker), University of Sydney, Sydney, NSW, Australia, September 2018.
- *Anomalous scaling of Hopf bifurcation thresholds of localized spot patterns in 2-D* (invited mini-symposium speaker), SIAM Conference on Nonlinear Waves & Coherent Structures, Anaheim-Orange County, California, USA, June 2018.
- *Localized pattern dynamics and mean first passage time optimization - analysis techniques and surprising connections* (invited seminar speaker), Queensland University of Technology, Brisbane, QLD, Australia, May 2018.
- *Localized pattern dynamics and mean first passage time optimization - analysis techniques and surprising connections* (invited seminar speaker), University of Sydney, Sydney, NSW, Australia, March 2018.
- *Mean first passage time problems and localized pattern formation - analysis, results, and surprising connections* (mini-symposium speaker), Australia and New Zealand Industrial and Applied Mathematics 2018, Hobart, Australia, February 2018.
- *Narrow escape optimization and localized pattern formation - are they related?*, (invited workshop speaker), SDG - Blackheath Workshop on Dynamical Systems - Theory and Applications, Blackheath, NSW, Australia, November 2017.
- *Mean first passage time problems and localized pattern formation - analysis, results, and surprising connections* (invited seminar speaker), Macquarie University, Sydney, NSW, Australia, October 2017.
- *The Stability and slow dynamics of localized spot patterns for the 3-D Schnakenberg reaction-diffusion model* (invited mini-symposium speaker), Canadian Applied and Industrial Mathematics Annual Meeting, Halifax, Canada, July 2017.
- *The Stability and slow dynamics of localized spot patterns for the 3-D Schnakenberg reaction-diffusion model* (invited mini-symposium speaker), SIAM Conference on Applications of Dynamical Systems, Snowbird, Utah, USA, May 2017.
- **Mini-symposium co-organizer**, session title "Stochastic transport in heterogeneous environments," SIAM Conference on Applications of Dynamical Systems, Snowbird, Utah, USA, May 2017.

- *First passage times: The mean and full distributions* (invited mini-symposium speaker), Canadian Applied and Industrial Mathematics Annual Meeting, Edmonton, Canada, June 2016.
- *Quantitative and qualitative effects of delayed bifurcations in reaction-diffusion systems* (invited workshop speaker), BIRS workshop on Coherent Structures in PDEs and Their Applications (16w5050), Oaxaca, Mexico, June 2016.
- *Effect of trap mobility on first passage times in one and two dimensions* (invited seminar speaker), University of Notre Dame, Notre Dame, IN, USA, October 2015.
- *First passage times with mobile traps in one and two dimensions* (invited workshop speaker), Workshop on Pattern Formation, Dalhousie University, Halifax, Nova Scotia, Canada, July 2015.
- **Mini-symposium co-organizer**, session title “First passage times in discrete and continuous systems,” SIAM Conference on Applications of Dynamical Systems, Snowbird, Utah, USA, May 2015.
- *Mean first passage time for a small rotating trap inside a reflective disk* (invited mini-symposium speaker), SIAM Conference on Applications of Dynamical Systems, Snowbird, Utah, USA, May 2015.
- **Featured session:** *Homoclinic snaking near a codimension two Turing-Hopf bifurcation point* (invited mini-symposium speaker), SIAM Conference on Applications of Dynamical Systems, Snowbird, Utah, USA, May 2015.
- *Slowly varying control parameters, delayed bifurcations, and the stability of spikes in reaction-diffusion systems* (invited mini-symposium speaker), SIAM Conference on Nonlinear Waves & Coherent Structures, University of Cambridge, United Kingdom, August 2014.
- *Mean first passage time for a small rotating trap inside a reflective disk* (invited mini-symposium speaker), SIAM Conference on Nonlinear Waves & Coherent Structures, University of Cambridge, United Kingdom, August 2014.
- *Mean first passage time for a small rotating trap inside a reflective disk* (invited mini-symposium speaker), AIMS Conference on Dynamical Systems, Differential Equations and Applications, Madrid, Spain, July 2014.
- *Slowly varying control parameters, delayed bifurcations, and the stability of spikes in reaction-diffusion systems* (invited mini-symposium speaker), Canadian Applied and Industrial Mathematics Annual Meeting, Saskatoon, Canada, June 2014.
- *Slowly varying control parameters, delayed bifurcations, and the stability of spikes in reaction-diffusion systems*, Dalhousie University Mathematics Colloquium, March 2014.
- *Homoclinic snaking near a codimension two Turing-Hopf bifurcation point in the superdiffusive Brusselator model* (invited mini-symposium speaker), SIAM Conference on Applications of Dynamical Systems, Snowbird, Utah, USA, May 2013.
- *Homoclinic snaking near a codimension two Turing-Hopf bifurcation point in the Brusselator model* (invited mini-symposium speaker), AMS Fall Southeastern Sectional Meeting, New Orleans, USA, October 2012.
- *The stability of localized spikes for the 1-D Brusselator reaction-diffusion model* (invited mini-symposium speaker), Canadian Applied and Industrial Mathematics Annual Meeting, Toronto, Canada, June 2012.

Honors and awards

- Pacific Institute for the Mathematical Sciences Post-Doctoral Fellowship (CRG: Applied PDE’s), Sept. 2015 – Sept. 2017
- Early-Career Travel Award – SIAM Conference on Nonlinear Waves & Coherent Structures, Aug. 2014
- Atlantic Association for Research in the Mathematical Sciences Post-Doctoral Fellowship, Sept. 2013 – Sept. 2015
- Northwestern University Cabell Terminal Year Fellowship 2011–2012
- Natural Sciences and Engineering Council of Canada (NSERC) Postgraduate Doctoral Fellowship, 2009–2011
- NSERC Alexander Graham Bell Canada Graduate Master’s Fellowship, 2008–2009

- Royal E. Cabell Fellowship, Northwestern University, 2007–2008

Teaching

- Instructor, Math 1020 (Mathematics IB), Macquarie University (2021)
- Instructor, Math 3906 (Partial Differential Equations), Macquarie University (2021)
- Instructor, Math 7907 (Asymptotic and Perturbation Methods for Ordinary and Partial Differential Equations), Macquarie University and **AMSI ACE Network** (2021)
- Instructor, Math 2010 (Mathematics IIA), Macquarie University (2021, 2022)
- **Unit Developer**, Math 1015 (Mathematics IA Advanced), Macquarie University (2020, 2021)
- Instructor, Math 1015 (Mathematics IA Advanced), Macquarie University (2020)
- Instructor, Unit Convenor, Math 1010 (Mathematics IA), Macquarie University (2020)
- Instructor, Unit Convenor, Math 135 (Mathematics IA), Macquarie University (2019)
- Instructor, **AMSI Summer School 2019**, University of New South Wales, “PDE Methods and Models in Mathematical Biology” (co-taught with Peter Kim)
- Instructor, Math 235 (Mathematics IIA), Macquarie University (2018 & 2019)
- Instructor, Math 707 (Asymptotic Methods for Applied Differential Equations), Macquarie University and **AMSI ACE Network** (2018)
- Instructor, Math 307 (Applied Linear Algebra), University of British Columbia (2017)
- Instructor, Math 317 (Calculus IV), University of British Columbia (2016)
- Instructor, Math 221 (Matrix Algebra), University of British Columbia (2015 & 2016)
- Instructor, Math 2120 (Methods for Ordinary Differential Equations), Dalhousie University (2013 & 2014)
- Teaching assistant, Math 234 (Vector and Multivariable Integration), Northwestern University (Winter 2012)

Service

- Journal referee for: SIAM Journal on Applied Dynamical Systems, SIAM Journal on Applied Mathematics, Physical Review E, Physical Review E Rapid Communications, Physical Review Letters, Physica D: Nonlinear Phenomena, Journal of Mathematical Biology, Bulletin of Mathematical Biology, Journal of Nonlinear Science, Chaos: An Interdisciplinary Journal of Nonlinear Science, Proceedings of the Royal Society A, Philosophical Transactions of the Royal Society A, European Journal of Applied Mathematics, Australia and New Zealand Industrial and Applied Mathematics Journal
- Co-organizer of Department Colloquium at Macquarie University (2021)
- Co-organizer of School Colloquium Series at Macquarie University (2022)
- Member of Department Research Committee (2021)
- Associate supervisor for PhD student Aaron Moston-Duggan, with Christopher Lustri (principal supervisor) (2021-present)