# CURRICULUM VITAE

**Justin C. Tzou**

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## Citizenship and Permanent Residency

- Canada (citizen), Australia (permanent resident)

## 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 (lead CI, extended through February 2027) *Microlocal Analysis - A Unified Approach for Geometric Models in Biology*; $405,000 over 3 years

## Student supervision

- Caitlin Jankiewicz, Master's of Research project, July 2025 - November 2025
- Rhett Masters, undergraduate scholar, December 2024 - February 2025
- Zahid Amin, PhD, June 2023 - present (principal supervisor)
- Siwen Deng, PhD, March 2022 - present (principal supervisor)
- Venkata Rama Raju, PhD, March 2024 - present (associate supervisor)
- Aaron Moston-Duggan, PhD, February 2021 - March 2025 (associate supervisor)

## Preprints and publications

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

30. J. C. Tzou, *Green's functions of the fractional Laplacian on a square - boundary considerations and applications to the Lévy flight narrow capture problem*, Physical Review Research, 7(3) (2025), p.033099.

29. M. Nursultanov, W. Trad, J. C. Tzou, L. Tzou, *Eigenvalue Variations of the Neumann Laplace Operator Due to Perturbed Boundary Conditions*, Research in the Mathematical Sciences, 12(1) (2025), pp. 1–27.

28. J. C. Tzou, L. Tzou, *A counterexample to the Lévy Flight Foraging Hypothesis in the narrow capture framework*, Physical Review Research, 6(2) (2024), p.023274.

27. M. Nursultanov, W. Trad, J. C. Tzou, L. Tzou, *The narrow capture problem on general Riemannian surfaces*, Differential and Integral Equations, 36(11/2) (2023), pp. 877–906.

26. J. C. Tzou, S. Xie, *Oscillatory translational instabilities of localized spot patterns in the Schnakenberg reaction-diffusion system on general 2-D domains*, Nonlinearity, (36)(5) (2023), pp. 2473–2513.

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.

**Select talks (since 2018)**

- *Curved vegetation stripes on a curved terrain* (invited mini-symposium speaker), Third Joint SIAM-CAIMS Annual Meetings, Montreal, Canada, July 2025.
- **Mini-symposium co-organizer**, session title "Dynamics of Anomalous Stochastic Processes," SIAM Conference on Applications of Dynamical Systems, Denver, USA, May 2025.
- *Levy Flight Search Processes in 2D Geometries and the Corresponding Green's Functions* (invited mini-symposium speaker), SIAM Conference on Applications of Dynamical Systems, Denver, USA, May 2025.
- *Asymptotic method for Lévy flight searches in 2-D domains* (mini-symposium speaker), Australia and New Zealand Industrial and Applied Mathematics 2025, Coffs Harbor, NSW, Australia, February 2025.
- *Asymptotic methods for random search and pattern formation* (invited seminar speaker), University of Amsterdam, Amsterdam, The Netherlands, October 2024.
- *Green's functions in pattern formation and random search* (invited seminar speaker), University of New South Wales, Sydney, NSW, Australia, April 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.
- *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).
- *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.

## 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 7907 (Asymptotic and Perturbation Methods for Ordinary and Partial Differential Equations), Macquarie University and **AMSI ACE Network** (2018,21)
- Instructor, **AMSI Summer School 2019**, University of New South Wales, "PDE Methods and Models in Mathematical Biology" (co-taught with Peter Kim)
- Instructor, FOSE 790x (Asymptotic and Perturbation Methods for Ordinary and Partial Differential Equations), Macquarie University (2025)

- Instructor, Math 3906 (Partial Differential Equations), Macquarie University (2021,22,23,24,25)
- Instructor, Math 2010 (Linear Algebra and Calculus III), Macquarie University (2018,19,21,22,23,24,25)
- Instructor, Math 1020 (Linear Algebra and Calculus II), Macquarie University (2021)
- **Unit Developer**, Math 1015 (Mathematics IA Advanced), Macquarie University (2020, 2021)
- Instructor, Math 1015 (Mathematics IA Advanced), Macquarie University (2020)
- Instructor, Math 1010 (Linear Algebra and Calculus I), Macquarie University (2019,20,21,23,24,25)
- 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)