Tyler Cassidy

Lecturer in Mathematical Biology
University of Leeds.

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Interests: Mathematical medicine, immunology, treatment response and resistance, dynamical systems, delay differential equations, structured population models

Education

Ph.D. Mathematics and Statistics 2015-2019
McGill University, Montréal, Canada
B.Sc. (Honors) Applied Mathematics, First Class Honors 2011-2015
University of Alberta, Edmonton, Canada

Academic Positions

Lecturer (Assistant Professor) in Mathematical Biology 2022-Present
University of Leeds

Senior Scientist 2021-2022
Pfizer Inc: Oncology Research Unit

Postdoctoral Research Associate 2019-2021
Theoretical Biology and Biophysics, Los Alamos National Laboratory

Junior Fellow 2018
Institut Mittag-Leffler

Publications

1. **Cassidy, T.**, Stephenson K.E, Barouch, D.H., and Perelson, A.S., Modeling resistance to the broadly neutralizing antibody PGT121 in people living with HIV-1, 20(3): e1011518. https://doi.org/10.1371/journal.pcbi.1011518, *PLOS Computational Biology*.
2. **Cassidy, T.**, A continuation technique for maximum likelihood estimators in biological models, 85, 90 (2023). https://doi.org/10.1007/s11538-023-01200-0, *Bulletin of Mathematical Biology*
3. **Cassidy, T.**, Gillich*, P., Humphries, A.R., and van Dorp, C.H., Numerical methods and hypoexponential approximations for Gamma distributed delay differential equations, Volume 87, Issue 6, December 2022, Pages 1043–1089, *The IMA Journal of Applied Mathematics*
4. Sanche, S., **Cassidy, T.**, Chu, P., Perelson, A.S., Ribeiro, R.M., and Ke, R., A simple model of COVID-19 explains disease severity and the effect of treatments, *Scientific Reports*, 12, 14210 (2022), DOI: 10.1038/s41598-022-18244-2
5. Stephenson, K.E., Julg, B., Tan, C.S., Zash, R., Walsh, S.R., Rolle, C-P., Monczor, A.N., Lupo, S., Gelderblom, H.C., Ansel, J.L., Kanhilal, D.G., Maxfield, L.F., Nkolola, J., Borducchi, E.N., Abbink, P., Liu, J., Peter, L., Chandrashekar, A., Nityanandam, R., Lin, Z., Setaro, A., Sapiente, J., Chen, Z., Sunner, L., **Cassidy, T.**, Bennett, C., Sato, A., Mayer, B., Perelson, A.S., deCamp, A., Priddy, F.H., Wagh, K., Giorgi, E.E., Yates, N.L., Arduino, R.C., DeJesus, E., Tomaras, G.D., Seaman, M.S., Korber, B., and Barouch, D.H., Safety, pharmacokinetics, and antiviral activity of PGT121, a broadly neutralizing monoclonal antibody against HIV-1: a randomized, placebo-controlled, phase 1 clinical trial, *Nature Medicine*, 27, 1718–1724 (2021), DOI: 10.1038/s41591-021-01509-0.
6. **Cassidy, T.**, Nichol, D., Robertson-Tessi, M., Craig, M., and Anderson, A.R.A., The role of memory in non-genetic inheritance and its impact on cancer treatment resistance, *PLOS Computational Biology*, 17(8), 2021, e1009348, DOI: 10.1371/journal.pcbi.1009348
7. Ismail, S.D., Riou, C., Joseph, S.B., Archin, N.M., Margolis, D.M., Perelson, A.S., **Cassidy, T.**, Abrahams, M-R., Moeser, M., Council, O.D., McKinnon, L.R., Osman, F., Karim, Q.A., Abdool Karim, S.S., Swanstrom, R., Williamson, C., Garrett, N.J., Burgers, W.A., Immunological correlates of the HIV-1 replication-competent reservoir size, *Clinical Infectious Diseases*, 73, 8 (2021), 1528–1531, https://doi.org/10.1093/cid/ciab587.

8. **Cassidy, T.**, Distributed Delay Differential Equation Representations of Cyclic Differential Equations, *SIAM Journal on Applied Mathematics*, 81(4), 1742–1766, DOI: doi.org/10.1137/20M1351606
9. Jenner, A.L., **Cassidy, T.**, Belaid*, K., Bourgeois-Daigneault, M.C., and Craig, M., In silico trials predict that combination strategies for enhancing vesicular stomatisis oncolytic virus are determined by tumour aggressivity, *Journal for ImmunoTherapy of Cancer* (2021), 9:e001387. doi: 10.1136/jitc-2020-001387
10. **Cassidy, T.**, Humphries, A.R., Craig, M., and Mackey, M.C., Characterizing chemotherapy-induced neutropenia and monocytopenia through mathematical modelling, *Bulletin of Mathematical Biology* 82, 104, (2020), DOI: 10.1007/s11538-020-00777-0
11. **Cassidy, T.** and Craig, M., Determinants of combination GM-CSF immunotherapy and oncolytic virotherapy success identified through in silico treatment personalization, *PLOS Computational Biology*, 15(11), 2020,: e1007495, DOI: 10.1371/journal.pcbi.1007495
12. **Cassidy, T.** and Humphries, A.R., A Mathematical Model Of Viral Oncology As An Immuno-Oncology Instigator, *Mathematical Medicine and Biology: A Journal of the IMA*, 37(1):117-151, (2020), DOI:10.1093/imammb/dqz008.
13. **Cassidy, T.**, Craig, M. and Humphries, A.R., Equivalences Between Age Structured Models and State Dependent Distributed Delay Differential Equations, *Mathematical Biosciences and Engineering*, (2019), 16(5): 5419-5450. DOI: 10.3934/mbe.2019270
14. De Souza, D.C, Craig, M., **Cassidy, T.**, Li, J., Nekka, F., Bélair, J. and Humphries, A.R., Transit and lifespan in neutrophil production: implications for drug intervention, *Journal of Pharmacokinetics and Pharmacodynamics*, (2018) 45: 59. DOI: 10.1007/s10928-017-9560-y
15. **Cassidy, T.**, Gaudreau, P., and Safouhi, H. On the Computation of Eigenvalues of the Anharmonic Coulombic Potential. *Journal of Mathematical Chemistry*, (2018) 56: 477. https://doi.org/10.1007/s10910-017-0801-5

Submitted

A Braniff, N., Joshi, T., **Cassidy, T.**, Trogdon, M., Kumar, R., Poels, K., Allen, R., Musante, C.J., and Shtylla, B., An integrated quantitative systems pharmacology virtual population approach for calibration with oncology efficacy endpoints, *minor revisions requested*.

B Villa, C., Maini, P.K., Browning, A.P., Jenner, A.L., Hamis, S., **Cassidy, T.**, Reducing phenotype-structured PDE models of cancer evolution to systems of ODEs: a generalised moment dynamics approach, arXiv:2406.01505, *submitted*.

C Iyaniwura†, S.A., **Cassidy†, T.**, Ribeiro, R.M., Perelson, A.S., A multiscale model of the action of a capsid assembly modulator for the treatment of chronic hepatitis B, biorXiv: 2024.07.16.603658, *revisions requested*.

D Hamis, S., Browning, A.P., Jenner, A.L., Villa, C., Maini, P.K., **Cassidy, T.**, Growth rate-driven modelling reveals how phenotypic adaptation drives drug resistance in BRAFV600E-mutant melanoma, biorXiv: 2024.08.14.607616, *submitted*.

E Browning, A.P., Crossley, R.M., Villa, C., Maini, P.K., Jenner, A.L., **Cassidy, T.**, Hamis, S., Identifiability of heterogeneous phenotype adaptation from low-cell-count experiments and a stochastic model, biorXiv: 2024.08.19.608540, *submitted*.

Selected Awards

NSERC Postdoctoral fellowship: Wolfson Center for Mathematical Biology, University of Oxford — Declined
Government of Canada
Declined for permanent position at University of Leeds

Institut Mittag-Leffler Junior Fellowship — 2018
Institut Mittag-Leffler

NSERC Postgraduate Scholarships: Doctoral Award — 2018-2021
Government of Canada

FRQNT Doctoral Scholarship — Declined
Government of Quebec
Declined for NSERC PGS award

Sir James Lougheed Award of Distinction — 2015, 2017
Government of Alberta

*Undergraduate student
†Equal contribution

Research Grants

Pending: ICMS Knowledge Exchange Catalyst (£40,602) 2024-25
Viral dynamics modelling towards a cure of chronic hepatitis B infection
Role: Lead. Joint with: Assembly biosciences, Los Alamos National Laboratory
University of Leeds

EPSRC Small Maths Grants (£99 810) 2024-25
The dynamics of waning and boosting of immunity: new modelling and numerical tools
Role: Co-lead. University of Leeds

EPSRC Summer Vacation Internship (£3700) 2024
Mathematical modelling of Antibody Mediated Prevention of HIV-1 Infection
University of Leeds, EPSRC

Heilbronn Small Grant (£1300) 2023
Workshop on continuous adaptation to treatment, University of Leeds
Heilbronn Institute

Student Mentoring

Graduate Students

- Rachel Sousa: Development of resistance in the MAPK pathway, Oncology Research Unit-Boulder, 2022, Pfizer, Inc.
- Merion Flower: Modelling antiviral effects of broadly neutralizing antibodies against HIV-1 (MSc thesis), 2024, University of Leeds

Undergraduate Honours Research Project

- Jean Chillet: Characteristic Roots of Gamma Distributed Delay Differential Equations, McGill University
- Peter Gillich: Numerical Methods for Gamma Distributed Delay Differential Equations, McGill University

Undergraduate Summer Research

- Merion Flower: Mathematical modelling of Antibody Mediated Prevention of HIV-1 Infection, EPSRC Summer Vacation Internship, 2024, University of Leeds
- Harry Coldwell: Dynamics in Structured Epidemic Models with infinite delays, School of Mathematics Summer Bursary, 2024, University of Leeds
- Peter Gillich: Numerical Methods for Gamma Distributed Delay Differential Equations, NSERC USRA, 2019, McGill University
- Katia Belaid: Optimizing Combination Oncolytic Virus Therapies, 2019, Université de Montréal

Teaching

Instructor of Record:

- MATH 1005: Core mathematics (Ordinary differential equations), 2023, University of Leeds
- MATH 2391: Nonlinear differential equations, (2024, 2025), University of Leeds

Supervisor:

- MATH 3001: Mathematical biology, Project in Mathematics, (2023-present), University of Leeds
- MATH 8001: Industrial placement supervision, University of Leeds, (2024-present)

Examiner:

- MATH 3001: Symmetry in Escher's Drawings, Project in Mathematics, (2022-present), University of Leeds
- MATH 5001: MSc dissertation, 2024-present, University of Leeds

Teaching Assistant:

- MATH 141: Calculus II (2017, 2018) [Departmental Teaching Assistant Award, 2017 and 2018], McGill University
- MATH 122: Calculus for Management (2016), McGill University
- STATQ 151: Applied Statistics (2013), University of Alberta
- MATHQ 100: Beginner Calculus I (2013), University of Alberta
- MATHQ 101: Beginner Calculus II (2014, 2015), University of Alberta
- MATHQ 102: Applied Linear Algebra (2013, 2014, 2015), University of Alberta
- MATHQ 113: Introductory Calculus I (2013, 2014), University of Alberta

Invited Talks

1. University of Melbourne Seminar on Mathematical Biology, 09/2024
2. MATRIX Institute Workshop on Parameter Identifiability in Biological Models, 09/2024
3. Queensland University of Technology School of Mathematics Seminar, 09/2024
4. Los Alamos National Laboratory Theoretical Biology and Biophysics Seminar, 08/2024
5. University of Exeter Dynamical Systems Seminar, 06/2024
6. Cornell College Mathematics Seminar, 04/2024
7. University of Iowa Mathematical Biology Seminar, 04/2024
8. University of Oxford Mathematical Biology and Ecology Seminar, 11/2023
9. University of Sheffield Mathematical Biology Seminar, 11/2023
10. City, University of London School of Mathematics Seminar, 10/2023
11. University of Udine Computational Dynamics Seminar, 10/2023
12. British Society of Immunology Mathematical Immunology and Virology Meeting, 05/2023
13. Quantitative T-cell Immunology and Immunotherapy conference, 05/2023
14. Grinnell College Mathematics and Statistics Colloquium, 04/2023
15. LMS workshop on the mathematics of delayed phenomena, 03/2023
16. University of Leeds Applied Mathematics Seminar, 03/2023
17. Pfizer Excellence: Scientific Seminar Series, 07/2022
18. Colorado School of Mines Quantitative Biosciences and Engineering Seminar, 04/2022
19. Symposium Annuel en Mathématiques pour un Avenir en Recherche et en Industrie, 03/2022
20. Creighton University Mathematical Medicine Seminar, 01/2022
21. CRM Computational Modelling of Cancer Biology and Treatments, 07/2021
22. Albion College FURSCA Seminar , 06/2021
23. Pfizer, Inc. Early Clinical Development Seminar, 05/2021
24. SIAM/CAIMS Joint Annual Meeting, 07/2020
25. York University Laboratory of Industrial and Applied Mathematics Seminar, 05/2020
26. Los Alamos National Laboratory Theoretical Biology and Biophysics Seminar, 02/2020
27. Université de Montréal Student Seminar, 10/2019
28. Society for Mathematical Biology Annual Meeting, 07/2019
29. Canadian Applied and Industrial Mathematics Society Annual Meeting, 06/2019
30. Helmholtz Center for Infection Research Systems Immunology Seminar, 03/2019
31. Pfizer Inc. Quantitative Systems Pharmacology in Early Clinical Development Seminar, 02/2019
32. Moffitt Cancer Center Integrated Mathematical Oncology Seminar, 02/2019
33. Université de Montréal Séminaire de biologie quantitative et computationnelle, 01/2019
34. University of Nottingham Centre for Mathematical Medicine and Biology Seminar, 11/2018
35. Center for Applied Mathematics in Biology and Medicine Seminar, 01/2017
36. Society of Industrial and Applied Mathematics Life Sciences Meeting, 07/2016

Professional Service

Committee membership
University of Leeds School of Mathematics Research and Innovation Committee 2023-present
Early career representative

Seminar Organizer
University of Leeds Mathematical Biology Seminar

Workshop Organizer
2.*Workshop on continuous adaptation to treatment*
University of Leeds, 2023

1. *Problems and solutions in lifting individual behaviour to population level dynamics*
CRM-CAMBAM Workshop in Mathematical Biology 2020

Session Organizer
3. *Delay equations in biology*
IFAC-TDS 2024

2. *Numerical methods for population models in biology*
SCICADE 2022

1. *Quantitative approaches to unravel immune function and immunity*
Society for Mathematical Biology Annual Meeting 2019

Reviewer
npj Systems Biology, Infectious Disease Modelling, Royal Society Open Science, Journal of Theoretical Biology, Journal of Biological Systems, Bulletin of Mathematical Biology, eLife, Journal of Pharmacokinetics and Pharmacodynamics, PLOS Computational Biology, Mathematical Medicine and Biology, ImmunoInformatics, Journal of Biological Dynamics, Physical Review E, Frontiers in Oncology, Applied Mathematics and Computation, PLOS One, Computers and Mathematics with Applications, Mathematical Biosciences and Engineering, Chaos: An Interdisciplinary Journal of Nonlinear Science, Journal of Mathematical Biology, Progress in Biophysics and Molecular Biology, International Journal for Numerical Methods in Biomedical Engineering

CAMBAM Student Seminar 2016-2018
Organizer of a Montréal wide weekly mathematical biology student seminar
Montréal, Quebec, Canada