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, *submitted*.

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†, 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, *submitted*.

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

EPSRC Small Maths Grants (£99 810) 2024-25
The dynamics of waning and boosting of immunity: new modelling and numerical tools
Lead: Francesca Scarabel, 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, Pfizer, Inc.

Undergraduate Honours Research Project
Jean Chillet: Characteristic Roots of Gamma Distributed Delay Differential Equations, Fall 2018-Winter 2019, McGill University
Peter Gillich: Numerical Methods for Gamma Distributed Delay Differential Equations, Fall 2019, McGill University

Undergraduate Summer Research
Merion Flower: Mathematical modelling of Antibody Mediated Prevention of HIV-1 Infection, EPSRC Summer Vacation Internship, 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, Université de Montréal

Teaching

Instructor of Record:
MATH 1005: Core mathematics, 2023, University of Leeds
MATH 2391: Nonlinear differential equations, 2024, University of Leeds

Supervisor:
MATH 3001: Mathematical biology, Project in Mathematics, 2023-2024, University of Leeds

Examiner:
MATH 3001: Symmetry in Escher's Drawings, Project in Mathematics, 2022-2024, 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

Los Alamos National Laboratory Theoretical Biology and Biophysics Seminar 08/2024
Long-term viral control, target mediated clearance, and combinations of broadly neutralizing antibodies against HIV-1
University of Exeter Dynamical Systems Seminar 06/2024
Improving transit compartment models of delayed processes throughout mathematical biology

Cornell College Mathematics Seminar 04/2024
Developing mathematical models to understand and improve HIV-1 treatments

University of Iowa Mathematical Biology Seminar 04/2024
Mathematical modelling identifies serum hepatitis B RNA as an informative biomarker of anti-viral treatment efficacy

University of Oxford Mathematical Biology and Ecology Seminar 11/2023
Mathematical modelling identifies serum hepatitis B RNA as an informative biomarker of anti-viral treatment efficacy

University of Sheffield Mathematical Biology Seminar 11/2023
Multiscale modelling identifies serum hepatitis B RNA concentrations as a biomarker of anti-viral efficacy

City, University of London School of Mathematics Seminar 10/2023
Improving transit compartment models of delayed processes throughout mathematical biology

University of Udine Computational Dynamics Seminar 10/2023
Numerics and approximations for gamma distributed delay differential equations

British Society of Immunology Mathematical Immunology and Virology Meeting 05/2023
Serum Hepatitis B RNA is an informative biomarker of capsid protein allosteric modulator efficacy

Quantitative T-cell Immunology and Immunotherapy conference 05/2023
Early warning signals to avoid chemotherapy induced neutropenia

Grinnell College Mathematics and Statistics Colloquium 04/2023
Developing mathematical models to understand and improve HIV-1 treatments

LMS workshop on the mathematics of delayed phenomena 03/2023
Numerics and approximations for gamma distributed delay differential equations

University of Leeds Applied Mathematics Seminar 03/2023
Modelling across scales in viral dynamics

Pfizer Excellence: Scientific Seminar Series 07/2022
Quantitative systems pharmacology virtual population simulations to examine efficacy of SHP2i + lorlatinib inhibition for ALK+ NSCLC

Colorado School of Mines Quantitative Biosciences and Engineering Seminar 04/2022
Early warning signals to avoid chemotherapy induced neutropenia

Symposium Annuel en Mathématiques pour un Avenir en Recherche et en Industrie 03/2022
Mathématiques en Médincine et Industrie

Creighton University Mathematical Medicine Seminar 01/2022
Understanding and avoiding resistance to anti-cancer therapies

CRM Computational Modelling of Cancer Biology and Treatments 07/2021
Modelling intra- and inter- patient heterogeneity: Structured equations and virtual clinical trials

Albion College FURSCA Seminar 06/2021
Avoiding failure of targeted anti-cancer therapies

Pfizer, Inc. Early Clinical Development Seminar 05/2021
Quantitative approaches to treatment personalization and optimization

SIAM/CAIMS Joint Annual Meeting 07/2020
Insights from phenotype and age structured equations to avoid chemotherapeutic drug resistance

York University Laboratory of Industrial and Applied Mathematics Seminar 05/2020
Using Structured Equations to Control Tumour Evolution and Avoid Chemotherapeutic Resistance

Los Alamos National Laboratory Theoretical Biology and Biophysics Seminar 02/2020
Insights from phenotype and age structured equations to avoid chemotherapeutic drug resistance

Université de Montréal Student Seminar 10/2019
Structured Equations and Cancer Therapies

Society for Mathematical Biology Annual Meeting 07/2019
Innate Immune System Regulation in Health and Disease

Canadian Applied and Industrial Mathematics Society Annual Meeting 06/2019
The Linear Chain Trick in Modelling Drug Effects on Neutrophil Response

Helmholtz Center for Infection Research Systems Immunology Seminar 03/2019
Modelling and Optimizing Immune Support of Cancer Virotherapy

Pfizer Inc. Quantitative Systems Pharmacology in Early Clinical Development Seminar 02/2019
Understanding and Exploiting Immune Support of Cancer Virotherapy

Moffitt Cancer Center Integrated Mathematical Oncology Seminar 02/2019
Understanding and Optimizing Cancer Virotherapy

Université de Montréal Séminaire de biologie quantitative et computationnelle 01/2019
Understanding and Optimizing Cancer Virotherapy

University of Nottingham Centre for Mathematical Medicine and Biology Seminar 11/2018
Modelling Viral Therapy and Immune Recruitment

Center for Applied Mathematics in Biology and Medicine Seminar 01/2017
Mathematical Modelling of Cyclic Neutropenia

Society of Industrial and Applied Mathematics Life Sciences Meeting 07/2016
Treating and Avoiding Hematological Disease: Better Medicine Through Mathematics?

Selected Poster Presentations

Workshop on Mathematical Ecology: Modeling Structured Populations 06/2019
Does Heterogeneity in Infection Duration Matter?
Fields Institute Travel Award
Winner of Student Poster Award

McGill Physiology Research Day 05/2018
Can Viruses Fight Cancer for Us?
Winner of Student Poster Award

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
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