DAVID J.W. SIMPSON School of Mathematical and Computational Sciences Massey University Palmerston North, 4442, New Zealand *d.j.w.simpson@massey.ac.nz http://www.massey.ac.nz/~djwsimps*

Education

- Ph.D. Applied Mathematics, University of Colorado at Boulder, December 2008
- M.Sc. Applied Mathematics, University of Auckland, May 2004
- B.Sc. Mathematics and Statistics, University of Auckland, May 2002

Employment

Senior Lecturer of Mathematics	January 2017 – present
Lecturer of Mathematics School of Mathematical and Computational Sciences, Massey University, Palmerston North, New Zealand	August 2012 – December 2016
• Post-Doctoral Fellow Department of Mathematics and Institute of Applied Mathematics, University of British Columbia, Vancouver, Canada	August 2009 – August 2012
• Lecturer and Research Associate Department of Applied Mathematics, University of Colorado, Boulder, Colorado, USA	January – August 2009
Awards and Invitations	
• Marsden Grant (MAU2209)	November 2022
 Principal Investigator for NZ\$602,000 project titled: Minimal massystems with abrupt events. 	thematical models for dynamical
• NZMS Research Award	December 2019
– Given to (usually) one NZ mathematician per year for excellence	in research.
• Marsden Grant (MAU1809)	November 2018
 Principal Investigator for NZ\$500,000 project titled: Organised constraints of the second systems. 	haos: Using geometry to explain
• ICTS Invited Lecturer	June 2018
 Awarded travel, accommodation, and living costs to give a series Summer Program on Dynamics of Complex Systems held at ICTS Theoretical Sciences), Bangalore, India. 	of lectures and tutorials in the S (International Centre for
• Massey University International Visitors Research Fund	May 2017
 Awarded NZ\$2976 to host Prof. Paul Glendinning (University of research. 	Manchester) for collaborative
• Simons Visiting Researcher	February–March 2016
 Awarded travel, accommodation, and living costs for five weeks by participate in the research program Advances in Nonsmooth Dyne Matematica, Barcelona, Spain. 	by the Simon's Foundation to amics held at the Centre de Recerca
• NZMS Early Career Award	December 2014
– Given to one NZ early career mathematician per year for exceller	nce in research.
• Massey University Early Career Researcher Award	March 2013
 Awarded NZ\$5000 to visit the University of Bristol to establish a project. 	n on-going collaborative research

BOOKS

• D.J.W. Simpson. Bifurcations in Piecewise-Smooth, Continuous Systems. Volume 70 of *Nonlinear Science*. World Scientific, Singapore, 2010.

RESEARCH PUBLICATIONS

- H.O. Fatoyinbo and D.J.W. Simpson. A Synopsis of the Non-Invertible, Two-Dimensional, Border-Collision Normal Form with Applications to Power Converters. To appear: Int. J. Bifurcation Chaos.
- 2) P.A. Glendinning and D.J.W. Simpson. Normal Forms, Differentiable Conjugacies and Elementary Bifurcations of Maps. To appear: *SIAM J. Appl. Math.*
- 3) D.J.W. Simpson. Detecting Invariant Expanding Cones for Generating Word Sets to Identify Chaos in Piecewise-Linear Maps. To appear: J. Difference Eq. Appl.
- 4) P.A. Glendinning and D.J.W. Simpson. Normal Forms for Saddle-Node Bifurcations: Takens' Coefficient and Applications in Climate Models. *Proc. R. Soc. A*, 478:20220548, 2022.
- P.A. Glendinning and D.J.W. Simpson. Chaos in the Border-Collision Normal Form: A Computer-Assisted Proof Using Induced Maps and Invariant Expanding Cones. *Appl. Math. Comput.*, 434:127357, 2022.
- I. Ghosh and D.J.W. Simpson. Renormalisation of the Two-Dimensional Border-Collision Normal Form. Int. J. Bifurcation Chaos, 32(12):2250181, 2022.
- H.O. Fatoyinbo, R.G. Brown, D.J.W. Simpson and B. van Brunt. Pattern Formation in a Spatially-Extended Model of Pacemaker Dynamics in Smooth Muscle Cells. *Bull. Math. Biol.*, 84(8):86, 2022.
- D.J.W. Simpson. Dimension Reduction for Slow-Fast, Piecewise-Linear ODEs and Obstacles to a General Theory. *Phys. D*, 439:133368, 2022.
- S.S. Muni and R.I. McLachlan and D.J.W. Simpson. Unfolding Globally Resonant Homoclinic Tangencies. *Discrete Contin. Dyn. Syst.*, 42(8):4013-4030, 2022.
- D.J.W. Simpson. Twenty Hopf-Like Bifurcations in Piecewise-Smooth Dynamical Systems. *Phys. Rep.*, 970:1–80, 2022.
- I. Ghosh and D.J.W. Simpson. Robust Devaney Chaos in the Two-Dimensional Border-Collision Normal Form. Chaos, 32:043120, 2022.
- D.J.W. Simpson. On the Stability of Boundary Equilibria in Filippov Systems. Commun. Pure Appl. Anal., 20(9):3093–3111, 2021.
- S.S. Muni, R.I. McLachlan and D.J.W. Simpson. Homoclinic Tangencies with Infinitely Many Asymptotically Stable Single-Round Periodic Solutions. *Discrete Contin. Dyn. Syst.*, 41(8):3629–3650, 2021.
- 14) P.A. Glendinning and D.J.W. Simpson. A Constructive Approach to Robust Chaos using Invariant Manifolds and Expanding Cones. Discrete Contin. Dyn. Syst., 41(7):3367–3387, 2021.
- P.A. Glendinning and D.J.W. Simpson. Robust Chaos and the Continuity of Attractors. *Trans. Math. Appl.*, 4(1):tnaa002, 2020.
- 16) D.J.W. Simpson. Chaotic Attractors from Border-Collision Bifurcations: Stable Border Fixed Points and Determinant-Based Lyapunov Exponent Bounds. NZJM, 50:71–91, 2020.
- 17) D.J.W. Simpson, V. Avrutin and S. Banerjee. The Nordmark Map and the Problem of Large-Amplitude Chaos in Impact Oscillators. *Phys. Rev. E*, 102:022211, 2020.
- D.J.W. Simpson. The Stability of Fixed Points on Switching Manifolds of Piecewise-Smooth Continuous Maps. J. Dyn. Diff. Equat., 32(3):1527–1552, 2020.
- 19) H.O. Fatoyinbo, R.G. Brown, D.J.W. Simpson and B. van Brunt. Numerical Bifurcation Analysis of Pacemaker Dynamics in a Model of Smooth Muscle Cells. Bull. Math. Biol., 82(7):95, 2020.
- D.J.W. Simpson. Unfolding Codimension-Two Subsumed Homoclinic Connections in Two-Dimensional Piecewise-Linear Maps. Int. J. Bifurcation Chaos, 30(3):2030006, 2020.

- D.J.W. Simpson. Hopf-Like Boundary Equilibrium Bifurcations involving Two Foci in Filippov Systems. J. Diff. Eq., 267(11):6133–6151, 2019.
- 22) H.A. Al Fran, D.J.W. Simpson and C.P. Tuffley. Characterisation and Classification of Signatures of Spanning Trees of the n-Cube. Australas. J. Combin., 75(3):259–295, 2019.
- D.J.W. Simpson. A General Framework for Boundary Equilibrium Bifurcations of Filippov Systems. Chaos, 28(10):103114, 2018.
- D.J.W. Simpson. A Compendium of Hopf-Like Bifurcations in Piecewise-Smooth Dynamical Systems. *Phys. Lett. A.*, 382(35):2439–2444, 2018.
- 25) M.R. Jeffrey, G. Kafanas and D.J.W. Simpson. Jitter in Dynamical Systems with Intersecting Discontinuity Surfaces. Int. J. Bifurcation Chaos, 28(6):1830020, 2018.
- 26) D.J.W. Simpson. The Structure of Mode-Locking Regions of Piecewise-Linear Continuous Maps: II. Skew Sawtooth Maps. *Nonlinearity*, 31(5):1905–1939, 2018.
- 27) D.J.W. Simpson and R. Kuske. The Influence of Localised Randomness on Regular Grazing Bifurcations with Applications to Impacting Dynamics. J. Vib. Contr., 24(2):407–426, 2018.
- D.J.W. Simpson. Grazing-Sliding Bifurcations Creating Infinitely Many Attractors. Int. J. Bifurcation Chaos, 27(12):1730042, 2017.
- 29) D.J.W. Simpson and C.P. Tuffley. Subsumed Homoclinic Connections and Infinitely Many Coexisting Attractors in Piecewise-Linear Maps. Int. J. Bifurcation Chaos, 27(2):1730010, 2017.
- 30) D.J.W. Simpson. The Structure of Mode-Locking Regions of Piecewise-Linear Continuous Maps: I. Nearby Mode-Locking Regions and Shrinking Points. *Nonlinearity*, 30(1):382–444, 2017.
- 31) D.J.W. Simpson. The Instantaneous Local Transition of a Stable Equilibrium to a Chaotic Attractor in Piecewise-Smooth Systems of Differential Equations. *Phys. Lett. A*, 380(38):3067–3072, 2016.
- 32) D.J.W. Simpson. Unfolding Homoclinic Connections formed by Corner Intersections in Piecewise-Smooth Maps. Chaos, 26:073105, 2016.
- 33) D.J.W. Simpson. Border-Collision Bifurcations in \mathbb{R}^N . SIAM Rev., 58(2):177–226, 2016.
- 34) D.J.W. Simpson and M.R. Jeffrey. Fast Phase Randomisation via Two-Folds. Proc. R. Soc. A, 472(2186):20150782, 2016.
- 35) D.J.W. Simpson and R. Kuske. Stochastic Perturbations of Periodic Orbits with Sliding. J. Nonlin. Sci., 25(4):967–1014, 2015.
- 36) D.J.W. Simpson and R. Kuske. The Positive Occupation Time of Brownian Motion with Two-Valued Drift and Asymptotic Dynamics of Sliding Motion with Noise. *Stoch. Dyn.*, 14(4):1450010, 2014.
- 37) D.J.W. Simpson and R. Kuske. Stochastically Perturbed Sliding Motion in Piecewise-Smooth Systems. Discrete Contin. Dyn. Syst. Ser. B, 19(9):2889–2913, 2014.
- D.J.W. Simpson. On the Relative Coexistence of Fixed Points and Period-Two Solutions near Border-Collision Bifurcations. Appl. Math. Lett., 38:162–167, 2014.
- 39) D.J.W. Simpson. Scaling Laws for Large Numbers of Coexisting Attracting Periodic Solutions in the Border-Collision Normal Form. Int. J. Bifurcation Chaos, 24(9):1450118, 2014.
- 40) D.J.W. Simpson. Sequences of Periodic Solutions and Infinitely Many Coexisting Attractors in the Border-Collision Normal Form. *Int. J. Bifurcation Chaos*, 24(6):1430018, 2014.
- 41) M.R. Jeffrey and D.J.W. Simpson. Non-Filippov Dynamics Arising from the Smoothing of Nonsmooth Systems, and its Robustness to Noise. *Nonlinear Dyn.*, 76(2):1395–1410, 2014.
- 42) D.J.W. Simpson. On Resolving Singularities of Piecewise-Smooth Discontinuous Vector Fields via Small Perturbations. Discrete Contin. Dyn. Syst., 34(9):3803–3830, 2014.
- 43) D.J.W. Simpson, J. Hogan and R. Kuske. Stochastic Regular Grazing Bifurcations. SIAM J. Appl. Dyn. Sys., 12(2):533-559, 2013.
- 44) D.J.W. Simpson and J.D. Meiss. Aspects of Bifurcation Theory for Piecewise-Smooth, Continuous Systems. *Phys. D*, 241(22):1861–1868, 2012.
- 45) D.J.W. Simpson, R. Kuske and Y.-X. Li. Dynamics of Simple Balancing Models with State Dependent Switching Control. J. Nonlin. Sci., 22(2):135–167, 2012.

- 46) D.J.W. Simpson and R. Kuske. Mixed-Mode Oscillations in a Stochastic Piecewise-Linear System. Phys. D, 240:1189–1198, 2011.
- 47) D.J.W. Simpson and J.D. Meiss. Resonance near Border-Collision Bifurcations in Piecewise-Smooth, Continuous Maps. Nonlinearity, 23(12):3091–3118, 2010.
- 48) D.J.W. Simpson and J.D. Meiss. Simultaneous Border-Collision and Period-Doubling Bifurcations. Chaos, 19(3):033146, 2009.
- 49) D.J.W. Simpson and J.D. Meiss. Shrinking Point Bifurcations of Resonance Tongues for Piecewise-Smooth, Continuous Maps. Nonlinearity, 22(5):1123–1144, 2009.
- D.J.W. Simpson, D.S. Kompala and J.D. Meiss. Discontinuity Induced Bifurcations in a Model of Saccharomyces cerevisiae. Math. Biosci., 218(1):40–49, 2009.
- 51) D.J.W. Simpson and J.D. Meiss. Unfolding a Codimension-Two Discontinuous Andronov-Hopf Bifurcation. *Chaos*, 18(3):033125, 2008.
- 52) D.J.W. Simpson and J.D. Meiss. Neimark-Sacker Bifurcations in Planar, Piecewise-Smooth, Continuous Maps. SIAM J. Appl. Dyn. Sys., 7(3):795–824, 2008.
- 53) B. Marts, D.J.W. Simpson, A. Hagberg and A.L. Lin. Period Doubling in a Periodically Forced Belousov-Zhabotinsky Reaction. *Phys. Rev. E*, 76(2):026213, 2007.
- 54) D.J.W. Simpson and J.D. Meiss. Andronov-Hopf Bifurcations in Planar, Piecewise-Smooth, Continuous Flows. *Phys. Lett. A*, 371(3):213–220, 2007.
- 55) D.J.W. Simpson, V. Kirk and J. Sneyd. Complex Oscillations and Waves of Calcium in Pancreatic Acinar Cells. *Phys. D*, 200:303–324, 2005.

CONFERENCE PROCEEDINGS, THESES, AND OTHER RESEARCH OUTPUTS

- 1) I. Belykh, R. Kuske, M. Porfini and D.J.W. Simpson. Beyond the Bristol Book: Advances and Perspectives in Non-Smooth Dynamics and Applications. *Chaos*, 33(1):010402, 2023.
- M.E. Roberts, C. Kueh, E. Greenbank, D. Clarke, S. van Hove, D.J.W. Simpson, A. Williams and J. Williams. Modelling the Mechanical Action of a Front Loading Washing Machine. ANZIAM J., 59: M30–M62, 2019.
- D.J.W. Simpson. Open Problems on Border-Collision Bifurcations. In: A. Colombo, M. Jeffrey, J. Lázaro, J. Olm (eds). Extended Abstracts Spring 2016. 8:163–166, 2017.
- 4) D.J.W. Simpson. Piecewise-Linear Maps: Intricate Dynamics with Explicit Solvability. NZMS Newsletter, 125:8–10, 2015.
- 5) D.J.W. Simpson. DSWeb Media Gallery. 2014. http://www.dynamicalsystems.org/pi/fr/detail?item=140
- 6) D.J.W. Simpson and D.S. Kompala. Mathematica Demonstrations. 2008-2009. http://demonstrations.wolfram.com/author.html?author=David+J.+W.+Simpson
- D.J.W. Simpson. Bifurcations in Piecewise-Smooth, Continuous Systems. PhD thesis, University of Colorado. 2008.
- D.J.W. Simpson. A Bifurcation Analysis of a Mathematical Model of Intracellular Calcium Waves. Master's thesis, University of Auckland. 2004.

SUPERVISORY EXPERIENCE

• Primary supervisor of PhD students

Indranil Ghosh, January 2021 – present Sishu Muni, November 2018 – November 2021

• Cosupervisor of PhD students

Sidra Zafar, January 2022 – present Hammed Fatoyinbo, January 2017 – March 2021 Christian Offen, November 2016 – July 2020 Howida al Fran, May 2013 – 2017

- Host of post-doctoral fellows
- Supervised summer students on projects involving original research on dynamical systems
 - Jack Sandford, November 2021 February 2022

Hammed Fatoyinbo, May 2021 – May 2022

- Edward Chen, November 2017 February 2018
- Liam Bignell, November 2016 February 2017
- Sam Irvine, November 2015 February 2016
- Harjinder Pal, December 2014 February 2015

• Supervised graduate students for honours-level projects

Edward Chen, February 2018 – June 2018 Alex Gibbs, July 2017 – October 2017 Sangeetha Basnayake, March 2013 – November 2013

TEACHING EXPERIENCE

•

Instructor	
Linear Mathematics, 160.102, Massey University	Semester 1, $2016 - 2019$
Methods of Mathematics, 160.103, Massey University	Semester 1, $2013 - 2015$
Discrete Mathematics, 160.212, Massey University	Semester 1, 2023
Differential Equations II, 160.318, Massey University	Semester 1, $2013 - 2019$, $2021 - 2023$
Studies in Applied Differential Equations, 160.734, Massey University	Semester 1 or 2, $2013 - 2019$
Differential Equations I, 160.204, Massey University	Semester 2, 2021
Linear Algebra, 160.211, Massey University	Semester 2, $2013 - 2023$
Classical Fields, 124.332, Massey University	Semester 2, $2013 - 2021$
Methods of Mathematical Physics, 160.317, Massey University	Semester 2, 2012, 2013
Linear Differential Equations, University of British Columbia	Fall 2011
Partial Differential Equations, University of British Columbia	Fall 2009, 2010
Complex Variables and Applications, University of Colorado at Bould	ler Spring 2009
Differential Equations and Linear Algebra, University of Colorado at	Boulder Summer 2008

 Responsible for class instruction, lecture planning, course structure, writing and grading exams, writing homework assignments, maintaining a course webpage, holding office hours, coordinating with other instructors and supervising teaching assistants.

Selected Presentations

• SIAM Conference on Applications of Dynamical Systems	May 17, 2023
Portland, OR, USA The Unexpected Helpfulness of Adding Noise to Nonsmooth ODEs.	
NZMS Colloquium	Dec 8, 2022
University of Canterbury, Christchurch, NZ	
 Applied Mathematics Seminar 	June 2, 2022
University of Auckland, Auckland	,
Bifurcations for Dynamical Systems with Switches, Jumps, or Thresholds.	
• Department of Electrical Engineering and Information Technology Seminar University of Naples (virtual)	October 27, 2021
Stability of Piecewise-Linear Systems.	
• SIAM Conference on Applications of Dynamical Systems (virtual)	May 21, 2021
Constructing Robust Chaos: Power Converters Revisited.	
• ANZIAM	February 5, 2021
(virtual) Constructing Robust Chaos: Power Converters Revisited	
Constructing notasi Chuos. I ower Conterts netristica.	

• NZMS Colloquium (Plenary speaker) Massey University, Palmerston North, NZ	Dec. 5, 2019
Border-Collision Bifurcations of Switched Dynamical Systems: From Fixed Points to Robu	st Chaos
• SIAM Conference on Applications of Dynamical Systems Snowbird, UT, USA	May 22, 2019
Towards a General Bifurcation Theory for Equilibria of Piecewise-Smooth ODEs	
Mathematics Department Seminar	May 13, 2019
University of Manchester, UK New Developments in the Dynamics of Multi Dimensional Piecewise Linear Mans	
• • • NIZIAM	Fab. 4 2010
• ANZIAM Nelson NZ	reb. 4, 2019
Stability in Piecewise-Smooth Mans: Fixed Points, Fractals, and Friction	
Workshop on Complex Networks	June 26 2018
ICTS. Bangalore. India	5 dile 20, 2010
Fractal Structures in Multi-Dimensional Piecewise-Linear Maps	
• ANZIAM	Feb. 8, 2018
Hobart, Australia	,
The Sausage-String Structure of Mode-Locking Regions of Piecewise-Linear Maps	
• Dynamics Days	Jan. 6, 2018
Denver, CO, USA	
The Sausage-String Structure of Mode-Locking Regions of Piecewise-Linear Maps	
• SIAM Conference on Applications of Dynamical Systems	May 22, 2017
Snowbird, UT, USA	
Desynchronising Collections of Oscillators by using Two-Fold Singularities	
• School/Workshop on Applicable Theory of Switched Systems	June 10, 2016
The University of Texas at Dallas, TX, USA	
Using Two-Fold Singularities to Desynchronise Collections of Oscillators	
• CRM Research Program on Advances in Nonsmooth Dynamics	Feb. 11, 2016
Autonomous University of Barcelona, Spain Native Cliffing Mattice and a Declabilistic Nation of Fernmand Fuglistics through a Two Fold	
Noisy Stiaing Motion and a Probabilistic Notion of Forwara Evolution through a Two-Fola	D 1 0010
Conference on Open Problems in Nonsmooth Dynamics Autonomous University of Parcelona, Spain	Feb. 1, 2016
Revelation Reference in the sector and Open Problems	
• Applied Mathematics Department Seminar	May 28 2015
University of Colorado at Boulder CO USA	May 20, 2015
Noisu Sliding Motion	
• SIAM Conference on Applications of Dynamical Systems	May 20, 2015
Snowbird, UT, USA	
Infinitely Many Coexisting Attractors in the Border-Collision Normal Form	
• ANZIAM	Feb. 5, 2014
Rotorua, NZ	
Effects of Noise on Nonsmooth Dynamical Systems	
NZMS Colloquium	Dec. 5, 2013
Tauranga, NZ	
Probabilistic Forward Evolution through Singularities of Discontinuous Vector Fields	
Engineering Mathematics Department Colloquium	July 5, 2013
University of Bristol, Bristol, England	
Stochastic Perturbations of Sliding Motion and Periodic Orbits with Sliding Segments	
• SIAM Conterence on Applications of Dynamical Systems	May 19, 2013
Showbird, UI, USA Stochastic Crazing Bifurgations	

• The 9 th AIMS Conference on Dynamical Systems, Differential Equations and Applications	July 1, 2012
Orlando, FL, USA The Effects of Noise on Sliding Motion	
• Engineering Methometics Department Collectium	Ian 97 9019
• Engineering Mathematics Department Conoquium	Jan. 27, 2012
Resonance in Piecewise-Smooth Continuous Maps	
• Maps, Gaps and Noise Workshop (Keynote speaker)	Jan. 17 & 18, 2012
University of Bath, Bath, England	
Noisy Sliding Motion	
• 7 th European Nonlinear Dynamics Conference	July 26, 2011
Sapienza - Università di Roma, Rome, Italy	
Dynamics of a Prototypical Balancing Model with Switching Control	
• International Council for Industrial and Applied Mathematics	July 21, 2011
Vancouver, Canada	
Noise-Induced Mixed-Mode Oscillations via Canards in a PWL FitzHugh-Nagumo Mo	odel
• International Workshop on Resonance, Oscillations and Stability of	June 19, 2009
Nonsmooth Systems	
London Imperial College, London, England	
Shrinking Point Bifurcations of Resonance Tongues for PWS, Continuous Maps	

ACADEMIC SERVICE

- Guest Editor for Chaos and Physica D for special issues on Nonsmooth Dynamics, 2022
- Associate Editor for the Book Review section of *SIAM Review* since January 2018
- Webmaster for the NZMS, December 2018 December 2022
- Minisymposium organiser for the SIAM Conferences on Applications of Dynamical Systems, Snowbird, Utah, USA, May 2013, 2015, 2017, and 2019
- Co-organiser of the NZMS Colloquium, Massey University, Palmerston North, December 2–5, 2019
- Co-organiser of the 17th Manawatu-Wellington Applied Maths Conference (MWAM-15), Massey University, Palmerston North, July 9, 2015
- Refereed research articles for 28 different journals since January 2016

- "Outstanding Reviewer" for Nonlinearity, 2017

- SMCS Research Committee member and Emerging Researcher Representative, since March 2022
- Postgraduate Advisor for the Mathematics Group, Massey University, Manawatu Campus, Aug 2020 -- December 2021
- Composed questions for the Massey University Mathematics and Statistics Quiz (M3S) for Year 12 students since 2014.
- Member of NZMS, ANZIAM & SIAM

Computer Language Capabilities

• AUTO, HTML, Java, LATEX, MatContM, Mathematica, Matlab, Octave, Python