Jean-Philippe Lessard

Professor

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Research

I develop computer-assisted proofs in nonlinear analysis and dynamical systems. Combining functional analysis, fixed-point theory, spectral methods and interval arithmetic, my group proves the existence of equilibria, periodic orbits, connecting orbits, invariant manifolds and bifurcations in ordinary, partial and delay differential equations, and in problems from celestial mechanics, fluid dynamics and mathematical biology. The computer programs completing these proofs are publicly available; links are given with the publications below.

Employment

2022– **Professor**, *McGill University*, Department of Mathematics and Statistics, Montréal, Canada

2017–2022 **Associate Professor**, *McGill University*, Department of Mathematics and Statistics, Montréal, Canada

2015–2017 **Associate Professor**, *Université Laval*, Department of Mathematics and Statistics, Québec, Canada

2011–2015 **Assistant Professor**, *Université Laval*, Department of Mathematics and Statistics, Québec, Canada

2010–2011 **Group Leader, Computational Mathematics**, *Basque Center for Applied Mathematics (BCAM)*, Bilbao, Spain

2009–2010 **NSF Mathematical Sciences Institutes Postdoctoral Fellow**, *Institute for Advanced Study (IAS)*, Princeton, USA

2008, 2009 **Postdoctoral Associate**, *Rutgers University*, New Brunswick, USA

2007–2008 **Postdoctoral Researcher**, *Vrije Universiteit Amsterdam*, Amsterdam, The Netherlands

Education

2007 **Ph.D. Mathematics**, *Georgia Institute of Technology*, Atlanta, USA
Advisor: Konstantin Mischaikow
Thesis: *Validated Continuation for Infinite Dimensional Problems*

2002 **M.Sc. Mathematics**, *Université de Montréal*, Montréal, Canada
Advisor: Christiane Rousseau
Thesis: *Bifurcation et Chaos dans le Système de Lorenz*

2000 **B.Sc. Mathematics**, *Université de Sherbrooke*, Sherbrooke, Canada

Awards

2018–2021 NSERC Accelerator Supplement Award, $120,000.

2016–2017 Professeur Étoile de la Faculté des Sciences et de Génie de l'Université Laval.

2016 CAIMS/PIMS Early Career Award in Applied Mathematics.

2015–2016 Professeur Étoile de la Faculté des Sciences et de Génie de l'Université Laval.

2004 John Festa Fellowship, Georgia Institute of Technology.

Funded Research

2024–2029 NSERC Discovery Grants Program (Individual), $190,000 (38K/year).

2018–2024 NSERC Discovery Grants Program (Individual), $210,000 (35K/year).

2013–2015 FAPEPS-CALDO Grant, $25,000.

2012–2018 NSERC Discovery Grants Program (Individual), $156,000 (26K/year).

2012–2014 FQRNT Programme *Établissement de Nouveaux Chercheurs*, $40,000.

2012–2014 MICINN Grant, Spain. Co-applicant. €38,500.

2010–2011 Basque Excellence Research Centers (BERC) program from Ikerbasque, $95,000.

2009–2010 NSF Mathematical Sciences Institutes Postdoctoral Fellowship, $52,000.

Editorial Activity

Editor Member of the Editorial Board of *Journal of Dynamics and Differential Equations*, Springer.

Editor Member of the Editorial Board of *Applications of Mathematics*, Springer.

Professional Activities

2027 Coordinator, with Dimitri Breda, of the CISM Advanced School *Computer-Assisted Proofs in Delayed and Infinite-Dimensional Dynamical Systems*, International Centre for Mechanical Sciences (CISM), Udine, Italy (May 2027).

2024 Main organizer of the Semester long program *Computational Dynamics – Analysis, Topology & Data* at the CRM in Montreal, Canada (September-December 2024).

2024 Main organizer of the tutorial *Constructive study of nonlinear equations via computer-assisted proofs* at the CRM in Montreal, Canada (September 2024).

2024 Co-organizer of the 5 Days Workshop *Towards rigorous results in state-dependent delay equations* at the Lorentz Center in Leiden, The Netherlands (March 2024).

2024 Main organizer of the workshop *Computer-assisted proofs in nonlinear analysis* at the CRM in Montreal, Canada (September 2024).

2023 Co-organizer of the mini-symposium *Computer-assisted proofs in differential equations* the 2023 International Congress on Industrial and Applied Mathematics (ICIAM 2023), Tokyo, Japan (August 2023).

2021 Main organizer of the CRM CAMP activities, namely weekly seminars, colloquia, spotlight on graduate research and open problem series, (June 2020 - June 2021).
See `http://www.crm.umontreal.ca/camp-nonlinear`

2021 Organizer of the *École Langlands du Centre de Recherches Mathématiques* at the CRM in Montreal, Canada (August 2021).

2019–2021 Deputy director of scientific programs at the Centre de Recherche Mathématiques (CRM), Montreal (2019–2021).

2020 Co-organizer of the 5 Days Workshop *Connections in Infinite Dimensional Dynamics* at BIRS, Banff, Alberta, Canada (May 2020).

2019 Co-organizer of the special session *Computer-assisted proofs in dynamics* at the Equadiff 2019 Conference in Leiden, The Netherlands (July 2019).

2019 Main organizer of the Monthly Program *Topological and Rigorous Computational Methods for High Dimensional Dynamics* at the CRM in Montreal, Canada (April 2019).

2017 Co-organizer of the 5 Days Workshop *Rigorous Numerics for Infinite Dimensional Nonlinear Dynamics* at BIRS, Banff, Alberta, Canada (May 2017).

2017–2020 Main organizer of the CRM Applied Math Seminar, McGill University, Montreal (2017–2020)

2016 Co-organizer of the 5 Days Workshop *Computational Proofs for Dynamics in PDEs* at the Lorentz Center in Leiden (June 2016).

2016 Co-organizer of the AMS Short Course *Rigorous Numerics in Dynamics* at the AMS National Meeting in Seattle (January 2016).

2015 Co-organizer of the special session *Computational and Topological Methods in Dynamical Systems* at the CMS Winter Meeting in Montreal, Canada (December 2015).

2015 Co-organizer of the *PIMS-SFU Summer School on Rigorous Computing: Analysis, Scientific Computing & Dynamical Systems* held at Simon Fraser University, BC, Canada (June 2015).

2014 Co-organizer of the 5 Days Workshop *Rigorously Verified Computing for Infinite Dimensional Nonlinear Dynamics* at BIRS, Banff, Alberta, Canada (September 2014).

2014 Organizer of the special session *Rigorous computations for nonlinear PDEs* at the SIAM Annual Meeting in Chicago, USA (July 2014).

2013–2016 Member of the local scientific committee of the *Centre de Recherches Mathématiques* (CRM) in Montreal (2013–2016).

2014–2016 Member of the evaluation committee of the 2014–2016 M.Sc. grant program in applied mathematics of the *Fonds de Recherche du Québec - Nature et Technologies* (FRQNT).

2011–2016 External Scientific Member of the Basque Center for Applied Mathematics (BCAM), Spain (2011–2016).

2013 Co-organizer of the *2013 CAIMS Annual Meeting*, Quebec City, Canada, June 2013.

2013 Co-organizer of the mini-symposium *Rigorous Numerics for ODEs and PDEs* (MS25) at the SIAM Conference on Applications of Dynamical Systems, Snowbird, 2013.

2012 Organizer of the *Workshop on rigorous computations in dynamical systems*, Université Laval, Mai 2012.

2011–present Member of the *Groupe Interdisciplinaire de Recherche en Éléments Finis* (GIREF) at Université Laval, 2011–present.

2011 Organizer of the one week intensive course *Rigorous computations for the study of dynamical systems* at the Basque Center for Applied Mathematics (BCAM), Spain, June 2011.

2010–2011 Member of the reading committee of the scientific journal *Nature* in 2010–2011.

2011 Co-organizer of the *BCAM mini-symposium on Computational Mathematics*, Spain, February 2011.

2010 Referee for the program *Project Grant Schemes* of the *Portuguese Foundation of Science and Technology*, 2010.

2010 Co-organizer of the special session *Topological and Computational Dynamics* at the 2010 Spring Eastern Sectional AMS Meeting, Newark, NJ, 2010.

2009 Co-organizer of the mini-symposium *Topology and Computations in Dynamics* (MS9) at the SIAM Conference on Applications of Dynamical Systems, Snowbird, 2009.

Supervision

Ph.D. Students

Ph.D. Kevin Constantineau, *Title TBD*, 2025–present.

Ph.D. Gabriel Remond-Tiedrez, *Title TBD*. 2024–present. (co-supervised with Jason Bramburger, Concordia)

Ph.D. Dominic Blanco, *Extensions in Computer-Assisted Analysis for Partial Differential Equations Posed on Unbounded Domains*. 2022–2026. (Starting in September 2026, Hill Assistant Professor of Mathematics at Rutgers University, New Jersey, USA)

Ph.D. Miguel Ayala, *Computer-assisted proofs for geometry optimization and gap solitons*. 2019–2026. (co-supervised with Rustum Choksi, McGill)

Ph.D. Gabriel Duchesne, *Rigorous computer-assisted methods for global structures in dynamical systems*. 2019–2025 (currently working as a Decision Analytics & Modeling Consultant at Direxyon, Montreal, Canada).

Ph.D. Matthieu Cadiot, *Computer-Assisted Analysis for Partial Differential Equations and Nonlocal Equations on Euclidean Spaces*. 2020–2025. (co-supervised with J.-C. Nave, McGill) (Currently a FMJH post-doc at the Center for Applied Mathematics in École Polytechnique Paris, France)

Ph.D. Olivier Hénot, *Advances in computer-assisted proofs: invariant manifolds and connecting orbits*. 2018–2023. (Currently a Tenure-Track Assistant Professor in the Department of Mathematics of National Taiwan University, Taipei, Taiwan)

Ph.D. Maxime Breden, *Équations aux dérivées partielles et systèmes dynamiques appliqués à des problèmes issus de la physique et de la biologie*. 2014–2017. (co-supervised with Laurent Desvillettes, ENS Cachan) (Currently a Tenured Assistant Professor of Mathematics at École Polytechnique, France)

Ph.D. Tahmineh Azizi, *Neuroscience computationelle et systèmes dynamiques*. 2015–2017. (Currently a Postdoc Research Associate at Washington University in St. Louis, USA)

Ph.D. Andréa Deschênes, *Méthode de calcul rigoureux pour les ondes progressives pour les EDP*. 2014–2017.

Ph.D. Pierre-Olivier Vallerand Beaudry, *Théorie Computationelle de Morse-Floer*. 2011–2013. (Development tester for Ubisoft, Montreal)

Master's Students

M.Sc. Geoffrey Kelly, *Topic TBD*, 2026–2028. (co-supervised with Adam Oberman, McGill)

M.Sc. Marco Mignacca, *Rigorous proof of one-dimensional steady-states in a neural field model*, 2023–2025.

M.Sc. Kevin Constantineau, *Spatially inhomogeneous two-cycles in ecological integrodifference equations*, 2023–2025.

M.Sc. Matthieu Cadiot, *Bifurcations towards periodic solutions in quadratic semilinear partial differential equations*, 2018–2020. (co-supervised with Jean-Christophe Nave, McGilll)

M.Sc. Yann Ricaud, *Rigorous parameterization of stable and unstable manifolds of fixed points from ODEs with polynomial vector field depending on parameters*, 2017–2020.

M.Sc. Gabriel Duchesne, *Computer-assisted proofs of nonlinear Laplace-Beltrami equations on the sphere*, 2017–2019.

M.Sc. Olivier Hénot, *Configurations centrales en toile d'araignée*, 2017–2018. (co-supervised with Christiane Rousseau, UdeM)

M.Sc. Francis Desjardins, *Construction axiomatique des ensembles de nombres: des naturels aux réels*, 2014–2016.

M.Sc. Maxime Murray, *Preuve rigoureuse d'une connection homocline pour l'équation du pont suspendu*, 2013–2015.

M.Sc. Abdoulaye Thiam, *A rigorous numerical method for the proof of Galaktionov's conjecture*, 2013–2015.

M.Sc. Andréa Deschênes, *Fronts stationnaires pour l'EDP de Swift-Hohenberg via le calcul rigoureux*, 2012–2014.

M.Sc. Maxime Breden, *Calcul rigoureux d'un diagramme de bifurcation d'un système d'EDPs* (Internship for the Masters I of ENS Cachan, France), May-July 2012.

M.Sc. Matthieu Vanicat, *Calcul rigoureux d'un diagramme de bifurcation d'un système d'EDPs* (Internship for the Masters I of ENS Cachan, France), May-July 2012.

Postdoctoral Fellows

Postdoc Kevin Church, McGill (NSERC Postdoc & CRM-Simons Postdoc), 2019–2022.

Postdoc Roberto Castelli, Basque Center for Applied Mathematics (BCAM) (Postdoc), 2010–2011. Title of the project: *Rigorous numerics in Floquet theory: computing (un)stable bundles of periodic orbits*.

Postdoc Gabor Kiss, Basque Center for Applied Mathematics (BCAM) (Postdoc), 2010–2011. Title of the project: *Computational fixed-point theory for delay equations with multiple time lags*.

International Interns

Intern Joan Gimeno (University of Barcelona). Title of the project: *Delay differential equations and celestial mechanics*. Fall 2018 and Fall 2019.

Intern Elena Queirolo (VU University Amsterdam). Title of the project: *Rigorous computation of Hopf bifurcations in ODEs*. Fall 2016.

Intern Chris Groothedde (VU University Amsterdam). Title of the project: *Rigorous computing of periodic solutions for delay equations*. Fall 2014.

Intern Maxime Breden (ENS Cachan). Title of the project: *Calcul rigoureux d'un diagramme de bifurcation d'un système d'EDPs*. Spring 2012.

Intern Matthieu Vanicat (ENS Cachan). Title of the project: *Calcul rigoureux d'un diagramme de bifurcation d'un système d'EDPs*. Spring 2012.

Undergraduate Research Students

B.Sc. RA Moeez Mohammad (McGill), *Energy landscape characterization via computer-assisted proofs and machine learning*. SURA Undergraduate Student Research Project, Summer 2023.

B.Sc. RA Kevin Constantineau (McGill), *Standing 2-cycles in an integrodifference equation model from spatial ecology*. SURA Undergraduate Student Research Project, Summer 2022.

B.Sc. RA Kevin Constantineau (McGill), *Relative equilibria and periodic solutions from platonic solids of vortices on the sphere*. NSERC Undergraduate Student Research Project, Summer 2021.

B.Sc. RA Kevin Constantineau (McGill), *Relative equilibria, bifurcations and periodic orbits in Thomson's problem via computer-assisted proofs*. ISM Undergraduate Scholarships, Summer 2020.

B.Sc. RA Clément Fortin (McGill), *Gravitational billiards in a vibrating or rotating parabolic domain*. Paid Research Assistant, Summer 2020.

B.Sc. RA Jordan Paillé (McGill), *Computation of two-dimensional manifolds of relative equilibria in the circular restricted four-body problem*. Paid Research Assistant, Fall 2019.

B.Sc. RA Nathan Maves-Moore (McGill), *Computation of two-dimensional manifolds of relative equilibria in the circular restricted four-body problem*. Paid Research Assistant, Fall 2019.

B.Sc. RA Yvonne Bronsard Alama (McGill), *Existence and uniqueness of a periodic solution to a* 4^{th} *order nonlinear ODE*. NSERC Undergraduate Student Research Project, Summer 2018.

B.Sc. RA Jordan Paillé (McGill), *Computation of two-dimensional manifolds of relative equilibria in the circular restricted four-body problem*. SURA Research Award, Summer 2018.

B.Sc. RA Nathan Maves-Moore (McGill), *Computation of two-dimensional manifolds of relative equilibria in the circular restricted four-body problem*. Arts Undergraduate Research Internship Award (ARIA), Summer 2018.

B.Sc. RA Yann Ricaud (Laval), *Chaos de Shilnikov*. FSG Research Summer Scholarships, Summer 2016.

B.Sc. RA Yann Ricaud (Laval), *Calcul rigoureux de solutions périodiques du problème à quatre corps restreint*. ISM-CRM Undergraduate Summer Scholarships, Summer 2015.

B.Sc. RA Rosalie Bentz-Moffett (Laval), *Solution périodique d'une EDO se ramenant à une solution des équations de Navier-Stokes*. NSERC Undergraduate Student Research Project, Summer 2014.

B.Sc. RA Julian Ransford (Laval), *Calcul rigoureux de solutions périodiques du problème à trois corps restreint*. NSERC Undergraduate Student Research Project, Summer 2014.

B.Sc. RA Yann Ricaud (Laval), *Méthodes numériques rigoureuses pour l'étude des systèmes de Filippov*. NSERC Undergraduate Student Research Project, Summer 2014.

B.Sc. RA Karine Larouche (Laval), *L'étude des systèmes d'EDOs à l'aide du calcul numérique*. NSERC Undergraduate Student Research Project, Summer 2013.

B.Sc. RA Anaïs Correc (Laval), *Calculs de solutions d'une EDP de type gradient*. NSERC Undergraduate Student Research Project, Summer 2012.

B.Sc. RA Andréa Deschênes (Laval), *Calcul rigoureux de connexions hétéroclines d'une EDO*. NSERC Undergraduate Student Research Project, Summer 2012.

Undergraduate Theses

B.Sc. Thesis Gabriel Duchesne, *Les méthodes de preuves assistées par ordinateur pour l'étude des EDO non linéaires*, Spring 2017.

B.Sc. Thesis Yann Ricaud, *Méthode de continuation et détection de bifurcations*, Spring 2016.

B.Sc. Thesis Francis Desjardins, *Calcul rigoureux d'une variété stable de l'équation de Fisher-Kolmogorov*, Spring 2014.

B.Sc. Thesis Maxime Murray, *Théorie du chaos et dynamique symbolique*, Spring 2013.

B.Sc. Thesis Anaïs Correc, *Calcul d'un diagramme de bifurcations de solutions du BVP de Ginzburg-Landau*, Spring 2013.

B.Sc. Thesis Cynthia Paquet, *Théorie des bifurcations et calcul pour les solutions stationnaires des EDPs*, Spring 2012.

B.Sc. Thesis Andréa Deschênes, *Méthodes de calcul des connexions homoclines et hétéroclines des EDOs*, Spring 2012.

Teaching

McGill University (2017–present)

MATH 263 Ordinary Differential Equations for Engineers (course coordinator). Fall 2022, Fall 2023, Summer 2025, Fall 2025, Fall 2026.

MATH 325 Honours Ordinary Differential Equations. Winter 2019, Winter 2020, Winter 2025, Winter 2026.

MATH 574 Dynamical Systems. Fall 2017, Winter 2021.

MATH 578 Numerical Analysis 1. Fall 2023.

MATH 317 Numerical Analysis. Fall 2022.

MATH 326 Nonlinear Dynamics and Chaos (MATH 326/376). Fall 2018.

MATH 315 Ordinary Differential Equations. Winter 2018.

Université Laval (2011–2017)

MAT 7440 Systèmes dynamiques. 2013, 2015, 2017.

MAT 7220 Équations aux dérivées partielles. 2013, 2014, 2015.

MAT 7230 Résolution numérique des EDO et des EDP. 2016.

MAT 3110 Équations différentielles. 2014, 2015, 2016, 2017.

MAT 3600 Projets de fin d'études (coordinator). 2016, 2017.

MAT 2420 Modélisation mathématique. 2016.

MAT 2110 Équations différentielles et calcul vectoriel. 2012, 2014.

MAT 1920 Mathématiques pour scientifiques. 2011, 2012.

Publications

Preprints

2026

[85] **Computer-assisted proofs of periodic solutions of state-dependent delay equations beyond perturbative regimes**
J.B. van den Berg, M. Breden, M. Cadiot, K. Church and J.-P. Lessard
Preprint, 2026 arXiv:2610.36216 Codes on GitHub

[84] **Rigorous integration of semilinear parabolic PDEs: forward evolution bounds and projected boundary value problems**
J.-P. Lessard and A. Takayasu
Preprint, 2026 arXiv:2610.29871 Codes on GitHub

[83] **Rigorous verification of period-doubling bifurcations in maps**
O. Hénot and J.-P. Lessard
Preprint, 2026 arXiv:2610.22986 Codes on GitHub

[82] **Platonic constellations of periodic motions in the $(n+1)-$ body problem**
K. Constantineau, C. García-Azpeitia and J.-P. Lessard
Preprint, 2026 arXiv:2609.10242 Codes on GitHub

[81] **Rigorous Validation of Cusp Bifurcations of Stationary Periodic Patterns in Partial Differential Equations**
D. Blanco and J.-P. Lessard
Preprint, 2026 arXiv:2608.15613 Codes on GitHub

Accepted

2026

[80] **From the Lagrange Triangle to the Figure Eight Choreography: Proof of Marchal's Conjecture**
R. Calleja, C. García-Azpeitia, O. Hénot, J.-P. Lessard and J.D. Mireles James
To appear in the *Transactions of the American Mathematical Society*, 2026 arXiv:2406.17564 Codes on GitHub

Published

2026

[79] **Spatially inhomogeneous two-cycles in an integrodifference equation**
K. Church, K. Constantineau and J.-P. Lessard
SIAM Journal on Applied Dynamical Systems 25(4): 2686–2736, 2026 arXiv:2510.21134 doi:10.1137/25m1814347 Codes on GitHub

[78] **From heteroclinic loops to homoclinic snaking in reversible systems: rigorous forcing through computer-assisted proofs**
J.B. van den Berg, G. Duchesne and J.-P. Lessard
SIAM Journal on Applied Dynamical Systems, 25(3): 2355–2400, 2026 arXiv:2507.16798 doi:10.1137/25m1781851 Codes on GitHub

[77] **Recent advances about the rigorous integration of parabolic PDEs via fully spectral Fourier-Chebyshev expansions**
M. Cadiot and J.-P. Lessard
Numerische Mathematik, 158(4): 1237–1289, 2026 arXiv:2502.20644 doi:10.1007/s00211-026-01546-2 Codes on GitHub

[76] **Computer-Assisted Proofs of Solitons in Bose-Einstein Condensates**
M. Ayala, C. García-Azpeitia and J.-P. Lessard
Journal of Nonlinear Science, 36(2), Paper No. 28, 2026 arXiv:2503.04701 doi:10.1007/s00332-026-10242-2 Codes on GitHub

2025

[75] **Periodic localized traveling waves in the two-dimensional suspension bridge equation**
L. van der Aalst, J.B. van den Berg and J.-P. Lessard
Nonlinearity, 38(7), Paper No. 075029, 2025 arXiv:2405.19759 doi:10.1088/1361-6544/ade5e5 Codes on GitHub

[74] **Validated matrix multiplication transform for orthogonal polynomials with applications to computer-assisted proofs for PDEs**
M. Cadiot, J. Jaquette, J.-P. Lessard and A. Takayasu
Communications in Nonlinear Science and Numerical Simulation, Volume 151, Paper No. 109063, 2025 arXiv:2411.18361 doi:10.1016/j.cnsns.2025.109063 Codes on GitHub

[73] **Cusp bifurcations: numerical detection via two-parameter continuation and computer-assisted proofs of existence**
J.-P. Lessard and A. Pugliese
Discrete and Continuous Dynamical Systems - Series B, 30(6): 2135–2158, 2025 arXiv:2404.00535 doi:10.3934/dcdsb.2024181

[72] **Determination of stable branches of relative equilibria of the N-vortex problem on the sphere**
K. Constantineau, C. García-Azpeitia, L.C. García-Naranjo and J.-P. Lessard
Communications in Mathematical Physics, 406(2), 47 pages, 2025 arXiv:2309.04320 doi:10.1007/s00220-024-05220-2 Codes on GitHub

[71] **A rigorous integrator and global existence for higher-dimensional semilinear parabolic PDEs via semigroup theory**
G. Duchesne, J.-P. Lessard and A. Takayasu
Journal of Scientific Computing, 102(3), Paper No. 62, 66 pages, 2025 arXiv:2402.00406 doi:10.1007/s10915-024-02785-x Codes on GitHub

[70] **Stationary non-radial localized patterns in the planar Swift-Hohenberg PDE: constructive proofs of existence**
M. Cadiot, J.-P. Lessard and J.-C. Nave
Journal of Differential Equations, Volume 414, 555–608, 2025 arXiv:2403.10450 doi:10.1016/j.jde.2024.09.015 Codes on GitHub

2024

[69] **Rigorous computation of solutions of semi-linear PDEs on unbounded domains via spectral methods**
M. Cadiot, J.-P. Lessard and J.-C. Nave
SIAM Journal on Applied Dynamical Systems, 23(3): 1966–2017, 2024 arXiv:2302.12877 doi:10.1137/23m1607507 Codes on GitHub

[68] **Towards computational Morse-Floer homology: forcing results for connecting orbits by computing relative indices of critical points**
J.B. van den Berg, M. Gameiro, J.-P. Lessard and R.C. Vandervorst
Foundations of Computational Mathematics, 24(5): 1739–1776, 2024 arXiv:2206.09205 doi:10.1007/s10208-023-09623-w Code

2023

[67] **Numerical computation of transverse homoclinic orbits for periodic solutions of delay differential equations**
O. Hénot, J.-P. Lessard and J.D. Mireles James
SIAM Journal on Applied Dynamical Systems, 22(4): 3093–3129, 2023 arXiv:2304.00318 doi:10.1137/23m1562858

[66] **Constructive proofs for localized radial solutions of semilinear elliptic systems on $\mathbb{R}^d$**
J.B. van den Berg, O. Hénot and J.-P. Lessard
Nonlinearity, 36(12): 6476–6512, 2023 arXiv:2211.16445 doi:10.1088/1361-6544/ad0278

[65] **Worrisome properties of neural network controllers and their symbolic representations**
J. Cyranka, K. Church and J.-P. Lessard
Proceedings of the 2023 European Conference on Artificial Intelligence (ECAI 2023), Volume 372, pages 517-525, 2023 arXiv:2307.15456 doi:10.3233/faia230311 Codes on GitHub

[64] **Persistence of periodic orbits under state-dependent delayed perturbations: computer-assisted proofs**
J. Gimeno, J.-P. Lessard, J.D. Mireles James and J. Yang
SIAM Journal on Applied Dynamical Systems, 22(3): 1743–1779, 2023 arXiv:2111.06391 doi:10.1137/22m1499418

[63] **Saddle-type blow-up solutions with computer-assisted proofs: validation and extraction of global nature**
J.-P. Lessard, K. Matsue and A. Takayasu
Journal of Nonlinear Science, 33(1), Paper No. 46, 2023 arXiv:2103.12390 doi:10.1007/s00332-023-09900-6 Codes on GitHub

[62] **Periodic orbits in Hořava-Lifshitz cosmologies**
K. Church, O. Hénot, P. Lappicy, J.-P. Lessard and H. Sprink
General Relativity and Gravitation, 55(1), Paper No. 2, 2023 arXiv:2203.03763 doi:10.1007/s10714-022-03054-8 Codes on GitHub

2022

[61] **Rigorous numerics for nonlinear heat equations in the complex plane of time**
A. Takayasu, J.-P. Lessard, J. Jaquette and H. Okamoto
Numerische Mathematik, 151(3), 693–750, 2022 arXiv:1910.12472 doi:10.1007/s00211-022-01291-2 Code

[60] **Rotation invariant patterns for a nonlinear Laplace-Beltrami equation: a Taylor-Chebyshev series approach**
J.B. van den Berg, G. Duchesne and J.-P. Lessard
Journal of Computational Dynamics, 9(2): 253–278, 2022 PDF doi:10.3934/jcd.2022005 Code

[59] **Global dynamics in nonconservative nonlinear Schrödinger equations**
J. Jaquette, J.-P. Lessard and A. Takayasu
Advances in Mathematics, Volume 398, Paper 108234, 2022 arXiv:2012.09734 doi:10.1016/j.aim.2022.108234 Codes on GitHub

[58] **Microscopic patterns in the 2D phase-field-crystal model**
G. Martine La Boissonière, R. Choksi and J.-P. Lessard
Nonlinearity, 35(3), 1500–1520, 2022 arXiv:2102.02338 doi:10.1088/1361-6544/ac4d91

[57] **Validated forward integration scheme for parabolic PDEs via Chebyshev series**
J. Cyranka and J.-P. Lessard
Communications in Nonlinear Science and Numerical Simulation, Volume 109, Paper No. 106304, 2022
arXiv:2101.00684 doi:10.1016/j.cnsns.2022.106304

[56] **Singularities and heteroclinic connections in complex-valued evolutionary equations with a quadratic nonlinearity**
J. Jaquette, J.-P. Lessard and A. Takayasu
Communications in Nonlinear Science and Numerical Simulation, Volume 107, Paper No. 106188, 2022
arXiv:2109.00159 doi:10.1016/j.cnsns.2021.106188 Codes on GitHub

[55] **Rigorous verification of Hopf bifurcations in functional differential equations**
K. Church and J.-P. Lessard
Physica D, Volume 429, Paper No. 133072, 2022 PDF doi:10.1016/j.physd.2021.133072 Code

[54] **Spatial relative equilibria and periodic orbit of the Coulomb $(n+1)$ body problem**
K. Constantineau, C. García-Azpeitia and J.-P. Lessard
Qualitative Theory of Dynamical Systems, 21(3): 1–19, 2022 arXiv:2107.05118 doi:10.1007/s12346-021-00532-3

[53] **Parameterization of unstable manifolds for DDEs: formal series solutions and validated error bounds**
O. Hénot, J.-P. Lessard and J.D. Mireles James
Journal of Dynamics and Differential Equations, 34(2): 1285–1324, 2022 PDF doi:10.1007/s10884-021-10002-8 Code

[52] **A general method for computer-assisted proofs of periodic solutions in delay differential problems**
J.B. van den Berg, C. Groothedde and J.-P. Lessard
Journal of Dynamics and Differential Equations, 34(2):853–896, 2022 PDF doi:10.1007/s10884-020-09908-6 Code

2021

[51] **Rigorous verification of Hopf bifurcations via desingularization and continuation**
J.B. van den Berg, J.-P. Lessard and E. Queirolo
SIAM Journal on Applied Dynamical Systems, 20(2):573–607, 2021 arXiv:2006.13373 doi:10.1137/20m1343464 Code

[50] **Spontaneous periodic orbits in the Navier-Stokes flow**
J.B. van den Berg, M. Breden, J.-P. Lessard and L. van Veen
Journal of Nonlinear Science, 31(2): paper No. 41 (61 pages), 2021 arXiv:1902.00384 doi:10.1007/s00332-021-09695-4

[49] **From the Lagrange polygon to the figure eight I: Numerical evidence extending a conjecture of Marchal**
R. Calleja, C. Garcıa-Azpeitia, J.-P. Lessard and J.D. Mireles James
Celestial Mechanics and Dynamical Astronomy, 133 (10): 1–20, 2021 arXiv:2012.10759 doi:10.1007/s10569-021-10009-9

[48] **Torus knot choreographies in the n-body problem**
R. Calleja, C. Garcıa-Azpeitia, J.-P. Lessard and J.D. Mireles James
Nonlinearity, 34 (1): 313–349, 2021 arXiv:1901.03738 doi:10.1088/1361-6544/abcb08

[47] **A rigorous implicit C^1 Chebyshev integrator for delay equations**
J.-P. Lessard and J.D. Mireles James
Journal of Dynamics and Differential Equations, 33(4): 1959–1988, 2021 PDF doi:10.1007/s10884-020-09880-1

2020

[46] **Free vibrations in a wave equation modeling MEMS**
C. Garcıa-Azpeitia and J.-P. Lessard
SIAM Journal on Applied Dynamical Systems, 19 (4): 2749–2782, 2020 arXiv:2003.01365 doi:10.1137/20m1332530

[45] **A functional analytic approach to validated numerics for eigenvalues of delay equations**
J.-P. Lessard and J.D. Mireles James
Journal of Computational Dynamics, 7(1): 123–158, 2020 PDF doi:10.3934/jcd.2020005 Code

[44] **Traveling wave oscillatory patterns in a signed Kuramoto-Sivashinsky equation with absorption**
Y. Alama and J.-P. Lessard
Journal of Computational and Applied Mathematics, 372 (112608), 2020 PDF arXiv:1812.01166 doi:10.1016/j.cam.2019.112608 Code

2019

[43] **Spatial periodic orbits in the equilateral circular restricted four body problem: computer assisted proofs of existence**
J. Burgos-Garcia, J.-P. Lessard and J.D. Mireles James
Celestial Mechanics and Dynamical Astronomy, 131(1): 1–36, 2019 PDF doi:10.1007/s10569-018-9879-8

2018

[42] **Computer-assisted proofs for radially symmetric solutions of PDEs**
I. Balazs, J.B. van den Berg, J. Courtois, J. Dudas, J.-P. Lessard, A. Vörös- Kiss, JF Williams and X.Y. Yin
Journal of Computational Dynamics, 5(1-2): 61–80, 2018 PDF doi:10.3934/jcd.2018003

[41] **Continuation of solutions and studying delay differential equations via rigorous numerics**
J.-P. Lessard
Rigorous numerics in dynamics, 81–122, *Proc. Sympos. Appl. Math.*, 74, Amer. Math. Soc., Providence, RI, 2018 PDF doi:10.1090/psapm/074/03 Code

[40] **Parameterization of invariant manifolds for periodic orbits (II): a-posteriori analysis and computer assisted error bounds**
R. Castelli, J.-P. Lessard and J.D. Mireles James
Journal of Dynamics and Differential Equations, 30(4): 1525–1581, 2018 PDF doi:10.1007/s10884-017-9609-z

[39] **Computing discrete convolutions with verified accuracy via Banach algebras and the FFT**
J.-P. Lessard
Applications of Mathematics, 63(3), 219–235, 2018 PDF doi:10.21136/am.2018.0082-18

[38] **Polynomial interpolation and a priori bootstrap for computer-assisted proofs in nonlinear ODEs**
M. Breden and J.-P. Lessard
Discrete and Continuous Dynamical Systems - Series B, 23(7):2825–2858, 2018 PDF arXiv:1704.03128 doi:10.3934/dcdsb.2018164 Code

[37] **Rigorous numerics for ill-posed PDEs: periodic orbits in the Boussinesq equation**
R. Castelli, M. Gameiro and J.-P. Lessard
Archive for Rational Mechanics and Analysis, 228(1):129–157, 2018 PDF arXiv:1509.08648 doi:10.1007/s00205-017-1186-0 Code

[36] **Continuation of homoclinic orbits in the suspension bridge equation: a computer-assisted proof**
J.B. van den Berg, M. Breden, J.-P. Lessard and M. Murray
Journal of Differential Equations, 264(5): 3086–3130, 2018 PDF arXiv:1702.07412 doi:10.1016/j.jde.2017.11.011

2017

[35] **Rigorous continuation of bifurcation points in the diblock copolymer equation**
J.-P. Lessard, E. Sander and T. Wanner
Journal of Computational Dynamics, 4(1-2), 71–118, 2017 PDF doi:10.3934/jcd.2017003 Code

[34] **Rapidly and slowly oscillating periodic oscillations of a delayed van der Pol oscillator**
G. Kiss and J.-P. Lessard
Journal of Dynamics and Differential Equations, 29(4): 1233–1257, 2017 PDF doi:10.1007/s10884-017-9599-x Code

[33] **Stability and uniqueness of slowly oscillating periodic solutions to Wright's equation**
J. Jaquette, J.-P. Lessard and K. Mischaikow
Journal of Differential Equations, 263(11): 7263–7286, 2017 PDF arXiv:1705.02432 doi:10.1016/j.jde.2017.08.018 Code

[32] **A framework for the numerical computation and a posteriori verification of invariant objects of evolution equations**
R. de la Llave, J.-L. Figueras, M. Gameiro and J.-P. Lessard
SIAM Journal on Applied Dynamical Systems 16(2): 1070–1088, 2017 PDF arXiv:1605.01086 doi:10.1137/16m1073777

[31] **A posteriori verification of invariant objects of evolution equations: periodic orbits in the Kuramoto-Sivashinsky PDE**
M. Gameiro and J.-P. Lessard
SIAM Journal on Applied Dynamical Systems, 16(1): 687–728, 2017 PDF doi:10.1137/16m1073789 Code

[30] **Computer assisted Fourier analysis in sequence spaces of varying regularity**
J.-P. Lessard and J.D. Mireles James
SIAM Journal on Mathematical Analysis, 49(1), 530–561, 2017 PDF doi:10.1137/16m1056006 Code

2016

[29] **Rigorous verification of saddle-node bifurcations in ODEs**
J.-P. Lessard
Indagationes Mathematicae, 27(4): 1013–1026, 2016 PDF doi:10.1016/j.indag.2016.06.012 Code

[28] **Automatic differentiation for Fourier series and the radii polynomial approach**
J.-P. Lessard, J.D. Mireles James and J. Ransford
Physica D, 334: 174–186, 2016 PDF doi:10.1016/j.physd.2016.02.007 Code

[27] **Rigorous numerics for analytic solutions of differential equations: the radii polynomial approach**
A. Hungria, J.-P. Lessard and J.D. Mireles James
Mathematics of Computation, 85(299): 1427–1459, 2016 PDF doi:10.1090/mcom/3046

[26] **Computation of smooth manifolds via rigorous multi-parameter continuation in infinite dimensions**
M. Gameiro, J.-P. Lessard and A. Pugliese
Foundations of Computational Mathematics, 16(2): 531–575, 2016 PDF doi:10.1007/s10208-015-9259-7 Code

[25] **Computation of maximal local (un)stable manifold patches by the parameterization method**
M. Breden, J.-P. Lessard and J.D. Mireles James
Indagationes Mathematicae, 27(1): 340–367, 2016 PDF arXiv:1508.02615 doi:10.1016/j.indag.2015.11.001 Code

[24] **Rigorous numerics for piecewise-smooth systems: a functional analytic approach based on Chebyshev series**
M. Gameiro, J.-P. Lessard and Y. Ricaud
Journal of Computational and Applied Mathematics, 292, 654–673, 2016 PDF doi:10.1016/j.cam.2015.05.016

2015

[23] **Analytic enclosure of the fundamental matrix solution**
R. Castelli, J.-P. Lessard and J.D. Mireles James
Applications of Mathematics, 60(6): 617–636, 2015 PDF doi:10.1007/s10492-015-0114-6

[22] **Rigorous numerics in dynamics**
J.B. van den Berg and J.-P. Lessard
Notices of the American Mathematical Society, 62(9): 1057–1061, 2015 PDF doi:10.1090/noti1276

[21] **Stationary coexistence of hexagons and rolls via rigorous computations**
J.B. van den Berg, A. Deschênes, J.-P. Lessard and J.D. Mireles James
SIAM Journal on Applied Dynamical Systems, 14 (2), 942–979, 2015 PDF doi:10.1137/140984506 Code

[20] **Blow-up profile for solutions of a fourth order nonlinear equation**
L. D'Ambrosio, J.-P. Lessard and A. Pugliese
Nonlinear Analysis: Theory, Methods and Applications, 121, 280–335, 2015 PDF doi:10.1016/j.na.2014.12.026

[19] **Rigorous numerics for nonlinear operators with tridiagonal dominant linear parts**
M. Breden, L. Desvillettes and J.-P. Lessard
Discrete and Continuous Dynamical Systems - Series A, 35 (10), 4765–4789, 2015 PDF arXiv:1503.06315 doi:10.3934/dcds.2015.35.4765

[18] **Parameterization of invariant manifolds for periodic orbits (I): efficient numerics via the Floquet normal form**
R. Castelli, J.-P. Lessard and J.D. Mireles James
SIAM Journal on Applied Dynamical Systems, 14(1), 132–167, 2015 PDF doi:10.1137/140960207

[17] **Coexistence of nontrivial solutions of the one-dimensional Ginzburg-Landau equation: a computer-assisted proof**
A. Correc and J.-P. Lessard
European Journal of Applied Mathematics, 26(1): 33–60, 2015 PDF doi:10.1017/s0956792514000308

2014

[16] **Computer assisted proof of transverse saddle-to-saddle connecting orbits for first order vector fields**
J.-P. Lessard, J.D. Mireles James and C. Reinhardt
Journal of Dynamics and Differential Equations, 26(2): 267–313, 2014 PDF doi:10.1007/s10884-014-9367-0

[15] **Rigorous numerics for nonlinear differential equations using Chebyshev series**
J.-P. Lessard and C. Reinhardt
SIAM Journal on Numerical Analysis, 52(1): 1–22, 2014 PDF doi:10.1137/13090883x

2013

[14] **Global bifurcation diagram of steady states of systems of PDEs via rigorous numerics: a 3-component reaction-diffusion system**
M. Breden, J.-P. Lessard and M. Vanicat
Acta Mathematicae Applicandae, 128(1): 113–152, 2013 PDF arXiv:1511.01414 doi:10.1007/s10440-013-9823-6

[13] **A method to rigorously enclose eigenpairs of complex interval matrices**
R. Castelli and J.-P. Lessard
Applications of Mathematics 2013. Institute of Mathematics, Academy of Sciences of the Czech Republic, Prague, 2013. ISBN 978-80-85823-61-5 PDF arXiv:1112.5052

[12] **Rigorous numerics in Floquet theory: computing stable and unstable bundles of periodic orbits**
R. Castelli and J.-P. Lessard
SIAM Journal on Applied Dynamical Systems, 12 (1): 204–245, 2013 PDF arXiv:1112.4874 doi:10.1137/120873960

[11] **Efficient rigorous numerics for higher-dimensional PDEs via one-dimensional estimates**
M. Gameiro and J.-P. Lessard
SIAM Journal on Numerical Analysis, 51(4), 2063–2087, 2013 PDF doi:10.1137/110836651

2012

[10] **Computational fixed point theory for differential delay equations with multiple time lags**
G. Kiss and J.-P. Lessard
Journal of Differential Equations, 252 (4): 3093–3115, 2012 PDF doi:10.1016/j.jde.2011.11.020

2011

[9] **Rigorous numerics for symmetric connecting orbits: even homoclinics of the Gray-Scott equation**
J.B. van den Berg, J.-P. Lessard, J.D. Mireles James and K. Mischaikow
SIAM Journal on Mathematical Analysis, 43 (4): 1557–1594, 2011 PDF doi:10.1137/100812008

[8] **Existence of secondary bifurcations or isolas for PDEs**
M. Gameiro and J.-P. Lessard
Nonlinear Analysis: Theory, Methods and Applications, 74 (12): 4131–4137, 2011 PDF doi:10.1016/j.na.2011.03.046

[7] **Rigorous computation of smooth branches of equilibria for the three-dimensional Cahn-Hilliard equation**
M. Gameiro and J.-P. Lessard
Numerische Mathematik, 117 (4): 753–778, 2011 PDF doi:10.1007/s00211-010-0350-3

2010

[6] **Analytic estimates and rigorous continuation for equilibria of higher-dimensional PDEs**
M. Gameiro and J.-P. Lessard
Journal of Differential Equations, 249 (9): 2237–2268, 2010 PDF doi:10.1016/j.jde.2010.07.002

[5] **Global smooth solution curves using rigorous branch following**
J.B. van den Berg, J.-P. Lessard and K. Mischaikow
Mathematics of Computation, 79 (271), 1565–1584, 2010 PDF doi:10.1090/s0025-5718-10-02325-2

[4] **Recent advances about the uniqueness of the slowly oscillating periodic solutions of Wright's equation**
J.-P. Lessard
Journal of Differential Equations, 248 (5): 992–1016, 2010 PDF arXiv:0909.4107 doi:10.1016/j.jde.2009.11.008

2008

[3] **Chaotic braided solutions via rigorous numerics: chaos in the Swift-Hohenberg equation**
J.B. van den Berg and J.-P. Lessard
SIAM Journal on Applied Dynamical Systems, 7(3): 988–1031, 2008 PDF doi:10.1137/070709128

[2] **Validated continuation over large parameter ranges for equilibria of PDEs**
M. Gameiro, J.-P. Lessard and K. Mischaikow
Mathematics and Computers in Simulation, 79 (4), 1368–1382, 2008 PDF doi:10.1016/j.matcom.2008.03.014

2007

[1] **Validated continuation for equilibria of PDEs**
S. Day, J.-P. Lessard and K. Mischaikow
SIAM Journal on Numerical Analysis, 45 (4), 1398–1424, 2007 PDF doi:10.1137/050645968

Books and Notes

J.B. van den Berg, M. Gameiro, J.-P. Lessard, J.D. Mireles James and K. Mischaikow. Ordinary Differential Equations: A Constructive Approach. *Preliminary version available upon request.*

J.-P. Lessard. Computer-Assisted Proofs in Discrete Dynamical Systems: (in progress - 200 pages).

2018 J.B. van den Berg and J.-P. Lessard. *Rigorous Numerics in Dynamics*, Proceedings of Symposia in Applied Mathematics, Volume 74, 2018. ISBN: 978-1-4704-2814-3

Invited Presentations as a Plenary or Main Speaker

2027 Minicourse lecturer at *SDS2027 – Structural Dynamical Systems: Computational Aspects* (13th SDS Meeting), held in Monopoli, Italy, June 15–17, 2027. Minicourse: *From Numerical Approximations to Rigorous Proofs in Dynamical Systems*.

2026 Invited Speaker at the Conference *Mathematical Modeling & Dynamics with Delay* (In honour of the 60th birthday of Tony Humphries) held at Queen's University in June 2026. Title: *Computer-Assisted and Constructive Methods for Periodic Orbits in Differential Equations with Large State-Dependent Delays*.

2025 Keynote Speaker at *2025 Applied Analysis Day* held at University of Ottawa in October 2025. Title: *The Path from Lagrange's Triangle to the Figure Eight: Resolving Marchal's Conjecture*.

2025 Invited Speaker at the *2025 Gene Golub SIAM Summer School on Frontiers in multi-dimensional pattern formation* held at Concordia University, Montreal, Canada, in August 2025.
Talk 1: *Computer-Assisted Proofs in Nonlinear Analysis: Motivations and Philosophy*.
Talk 2: *Interval Arithmetic: Introduction and Examples*.
Talk 3: *Equilibria in the Swift-Hohenberg PDE on the interval: CAPs of existence*.

2024 Invited Speaker at the conference *From Topology to Computations in Dynamical Systems* held at Jagiellonian University in Krakow, Poland in June 2024. Title: *Dynamics of delay maps (part I): periodic orbits and their Morse indices*.

2023 Invited Speaker at the workshop *Computer assisted proofs for stability analysis of nonlinear waves* held at the *American Institute of Mathematics* in Palo Alto, California, USA in June 2023. Title: *Computer-assisted proofs for semi-linear PDEs on $\mathbb{R}^n$ via spectral methods*.

2023 Plenary speaker at the *XIII Americas Conference on Differential Equations and Nonlinear Analysis* at the University of São Paulo in São Carlos in February 2023. Title: *Localized radial and non-radial solutions of elliptic equations on unbounded domains: computer-assisted proofs of existence*

2022 Invited Speaker at the *Equadiff 2022* Conference held in Brno, Czech Republic in July 2022. Title: *Recent developments of computer-assisted proofs in differential equations*.

2022 Plenary speaker at the *International Workshop on Reliable Computing and Computer-Assisted Proofs* (ReCAP 2022), Japan (virtual) in March 2022. Title: *The parameterization method: an overview, rigorous numerics and applications*.

2021 Main speaker at the Workshop on Controlling Error and Efficiency of Numerical Models, Fields Institute, Toronto, Canada (virtual) in December 2021. Title: *Computer-assisted proofs of existence of periodic motions in fluids*.

2021 Main speaker at the Workshop MFO Dynamics of Waves and Patterns, Oberwolfach, Germany (virtual) in August 2021. Title: *Rigorous validated numerics for the study of patterns in the Phase-Field-Crystal (PFC) model*.

2021 Plenary speaker at the *SIAM Conference on Applications of Dynamical Systems (DS21)* in Portland, Oregon, USA in May 2021. Title: *Recent developments of computer-assisted proofs in infinite dimensional dynamical systems*.

2019 Plenary speaker at the *11th Colloquium on the Qualitative Theory of Differential Equations* at the University of Szeged (Hungary) in June 2019. Title: *Recent developments of computer-assisted proofs in infinite dimensional dynamical systems*.

2019 Main speaker of the tutorial entitled *A Computer-Assisted Constructive Approach to Nonlinear Dynamical Systems* at the CRM in Montreal in April 2019. Title of talks: *Periodic orbits via Fourier series* and *Applications in PDEs*.

2019 Speaker in the *Lefschetz Center for Dynamical Systems Seminar* at Brown University, Rhode Island in March 2019. Title: *Spontaneous periodic orbits in the Navier-Stokes flow*.

2018 Main speaker in the 3-days course *Computer assisted proofs in Nonlinear Dynamics* held at Universidad Nacional Auónoma de México (UNAM), Mexico, August 1–3, 2018. Titles: *Radially symmetric solutions of PDEs*, *Dynamics of delay equations* and *Applications & Results*.

2018 Invited speaker at the conference *Algebraic Topology in Data and Dynamics* held at Montana State University, Bozeman, USA in July 2018. Title: *Towards computational Morse-Floer homology.*

2018 Invited speaker at the *Third International Conference on the Dynamics of Differential Equations In Memory of Professor Jack K. Hale* held at Hiroshima University, Japan in March 2018. Title: *Toward a proof of Jones conjecture in delay equations*.

2018 Plenary speaker at the *Winter Workshop on Dynamics, Topology and Computations* at the Stefan Banach International Mathematical Center (Poland) in January 2018. Title: *Rigorously verified numerics for infinite dimensional nonlinear problems: a functional analytic approach.*

2017 Plenary speaker at the *XI Americas Conference on Differential Equations and Nonlinear Analysis* at the University of Alberta in August 2017. Title: *Rigorously verified computing for infinite dimensional nonlinear dynamics: a functional analytic approach*.

2016 Speaker at the *Coloquios del Departamento de Matemática* of the Universidad de Buenos Aires in November 2016. Title: *Rigorously verified computing for infinite dimensional nonlinear dynamics: a functional analytic approach.*

2016 Plenary speaker at the conference *International Symposium on Scientific Computing, Computer Arithmetic and Verified Numerics* held at Uppsala University in Sweden in September 2016. Title: *Rigorously verified computing for infinite dimensional nonlinear dynamics: a functional analytic approach.*

2016 Invited speaker at the *Colloque des sciences mathématiques du Québec* to be held at Université de Montréal on October 14th, 2016. Title: *Rigorously verified computing for infinite dimensional nonlinear dynamics: a functional analytic approach.*

2016 Plenary speaker at the *CAIMS Annual Meeting* held at the University of Alberta in Edmonton in June 2016. Title: *Rigorously verified computing for infinite dimensional nonlinear dynamics: a functional analytic approach*.

2016 Plenary speaker at the conference *Structural Dynamical Systems: Computational Aspects* held in Monopoli in Italy in June 2016. Title: *Computer-assisted proofs for periodic orbits of dissipative and ill-posed PDEs.*

2016 Main speaker at the workshop *Computation in Dynamics* held at the Institute for Computational and Experimental Research in Mathematics (ICERM) at Brown University in Providence, USA in April 2016. Title: *Computer-assisted proofs for periodic orbits of PDEs.*

2016 Main speaker at the workshop *Advanced Computing and Theoretical Fluid Mechanics* held at the Fields Institute in Toronto in January 2016. Title: *Computer-assisted proofs for periodic orbits of PDEs.*

2015 Main lecturer at the *PIMS-SFU Summer School on Rigorous Computing: Analysis, Scientific Computing & Dynamical Systems* held at Simon Fraser University in June 2015.

2014 Main speaker at the workshop *From Topological to Stochastic Techniques in Dynamical Systems* held at the Lorentz Center in Leiden in the Netherlands in June 2014. Title: *Rigorous computations of solutions of continuous dynamical systems.*

2013 Main speaker at the workshop *IMA Special Workshop Joint US-Japan Conference for Young Researchers on Interactions among Localized Patterns in Dissipative Systems* held at the IMA in Minneapolis, USA in June 2013. Title: *Periodic orbits of dissipative PDEs via rigorous numerics: the Kuramoto-Sivashinsky equation*.

2013 Main speaker at the *Southern Ontario Dynamics Day* held at the Fields Institute, Toronto in April 2013. Title: *Rigorous computations for infinite dimensional dynamical systems.*

2013 Invited speaker at the *First International Conference on Dynamics of Differential Equations in honour of Jack Hale* held at Georgia Institute of Technology, Atlanta, USA in Mars 2013. Title: *Rigorous numerics for nonlinear differential equations using Chebyshev series.*

2009 Invited speaker at workshop *State-Dependent Delay Equations International Workshop* held at the Max-Planck Institute in Dresden, Germany in October 2009. Title: *Computer-assisted proofs for delay differential equations.*

2009 Main speaker at the conference *Dynamics, Topology and Computations 2009* held at the Mathematical Research and Conference Center in Bedlewo, Poland in June 2009. Title: *Rigorous computation of smooth branches of periodic solutions of delay equations.*

2006 Main speaker at the workshop *Computational and Topological Aspect of Dynamics* held at the Lorentz Center in Leiden in the Netherlands in May 2006. Title: *Getting a rigorous skeleton of equilibria of nonlinear PDEs using path-following techniques.*

Other Selected Invited Talks

2026 *Existence of Stationary Non-Radial Localized Patterns in the Planar Swift-Hohenberg Equation*, SIAM Conference on Nonlinear Waves and Coherent Structures (NWCS26), Concordia University, Montreal, 05/2026.

A constructive approach for proving existence of periodic orbits in differential equations with state-dependent delays, Colloquium of the Department of Mathematics and Statistics, Florida Atlantic University, USA, 04/2026.

How an equilateral triangle becomes an eight: symmetry and proof in the three-body problem, *Seminar of the Group of Nonlinear Mathematical Analysis*, Nicolaus Copernicus University, Toruń, Poland, 03/2026.

2025 *Recent advances about the rigorous integration of parabolic PDEs via fully spectral Fourier-Chebyshev expansions*, *Dynamics, Topology and Computations Conference (DyToComp 2025)*, Mathematical Research and Conference Center, Bedlewo, Poland, 06/2025.

Periodic localized traveling waves in the two-dimensional suspension bridge equation: computer-assisted proofs of existence, Seminar on Partial Differential Equations, Institute of Mathematics of the Czech Academy of Sciences, Prague, Czech Republic, 06/2025.

Cusp bifurcations: numerical detection via two-parameter continuation and computer-assisted proofs of existence, Current Problems in Numerical Analysis Seminar, Institute of Mathematics of the Czech Academy of Sciences, Prague, Czech Republic, 06/2025.

From the Lagrange Triangle to the Figure Eight Choreography: Proof of Marchal's Conjecture, Numerical Analysis Seminar, University of Bari, Italy, 04/2025.

An Introduction to Computer-Assisted Proofs in Nonlinear Analysis. Lecture I - Newton-Kantorovich Theorem, Finite dimensional problems and Interval Arithmetic, Nicolaus Copernicus University, Toruń, Poland, 04/2025.

An Introduction to Computer-Assisted Proofs in Nonlinear Analysis. Lecture II - Initial value problems via Taylor Methods, Nicolaus Copernicus University, Toruń, Poland, 04/2025.

An Introduction to Computer-Assisted Proofs in Nonlinear Analysis. Lecture III - Invariant manifolds and Radially Symmetric Solutions of Reaction-Diffusion PDEs, Nicolaus Copernicus University, Toruń, Poland, 04/2025.

2024 *From the Lagrange triangle to the figure eight: a proof of Marchal's conjecture*, Dynamical Systems Seminar, Jagiellonian University, Poland, 11/2024.

Investigating Differential Equations with Non-Polynomial Nonlinearities: Utilizing FFT in Computer-Assisted Proofs, PDEs Seminar, Jagiellonian University, Poland, 11/2024.

From the Lagrange triangle to the figure eight choreography: proof of Marchal's conjecture, Current Problems in Numerical Analysis Seminar, Institute of Mathematics of the Czech Academy of Sciences, Prague, Czech Republic, 06/2024.

Exploring Differential Equations with Non-Polynomial Nonlinearities: Leveraging the FFT for Computer-Assisted Proofs, Equadiff 2024, Karlstad University, Sweden, 06/2024.

Computer Assisted Studies in Fluid Mechanics and Spectral Geometry, Uppsala University, Sweden, 06/2024.

Validated enclosures of Fourier coefficients in Banach spaces of analytic functions, CDSNS Colloquium, Georgia Tech, Atlanta, USA, 05/2024.

Computer-assisted proofs for differential equations with non-polynomial nonlinearities via the FFT, Analysis and Applications Seminar, Florida Atlantic University, USA, 04/2024.

Computer-assisted proofs for differential equations with non-polynomial nonlinearities via the FFT, Applied and Computational Mathematics Seminar, Rutgers University, USA, 04/2024.

2023 *Stationary non-radial localized patterns in the planar Swift-Hohenberg PDE: computer-assisted proofs of existence*, Foundation of Computational Mathematics (FoCM) 2023, Paris, France, 06/2023.

Existence constructive de solutions d'EDP semi-linéaires dans $\mathbb{R}^n$ via des méthodes spectrales et des preuves assistées par ordinateur. SMAI2023 Conference, La Guadeloupe, France. 05/2023.

Localized radial solutions of elliptic equations on unbounded domains: computer-assisted proofs of existence, SIAM Conference on Applications of Dynamical Systems. Portland, Oregon, USA. 05/2023.

Localized radial and non-radial solutions of elliptic equations on unbounded domains: computer-assisted proofs of existence. Seminar on Analysis and Applications, Florida Atlantic University, Boca Raton, USA. 04/2023.

2022 *Towards computational Morse-Floer homology: forcing results for connecting orbits by computing relative indices of critical points*. Dynamics, Topology and Computations 2022. Stephan Banach International Math Center, Bedlewo, Poland. 06/2022.

Radially symmetric equilibria of PDEs on $\mathbb{R}^d$: computer-assisted proofs of existence. Structural Dynamical Systems 2022: Computational Aspects. Rosa Marina, Ostuni. 06/2022.

Computing invariant manifolds via the parameterization method: an overview, rigorous numerics and applications. Current Problems in Numerical Analysis Seminar of the Institute of Mathematics of the Czech Academy of Sciences, Prague, Czech Republic. 04/2022.

Computer-assisted proofs for stable and unstable manifolds via the parameterization method. Nonlinear Dynamics Seminar, Free University Berlin, Germany. 04/2022.

Computer-assisted proofs of existence of periodic motions in fluids. (Online) Webinar on Nonlinear Evolutionary Dynamics, National Center for Theoretical Sciences (NCTS), Math Division, Taipei, Taiwan. 03/2022.

Periodic motions in fluids: computer-assisted proofs of existence. Mathematics Colloquium of University of Bari, Italy, 02/2022.

Rigorous validated numerics for the study of patterns in the Phase-Field-Crystal (PFC) model, Jagiellonian University, Krakow, Poland, 02/2022.

A rigorous implicit C^1 Chebyshev integrator for delay equations, Jagiellonian University, Krakow, Poland, 02/2022.

2021 *Computer-assisted proofs of existence of periodic motions in fluids*. Seminar in Numerical Mathematics, Charles University, Prague, 12/2021.

Recent developments of computer-assisted proofs in the Navier-Stokes equations. Geometry, Dynamics and Mechanics Seminar, Università degli Studi di Padova, Italy (Virtual), 10/2021.

Recent developments of computer-assisted proofs in the Navier-Stokes equations. University of Warsaw, Poland, 10/2021.

Spontaneous periodic orbits in the Navier-Stokes flow. Webinar on Evolution Equations and Dynamical Systems, University of São Paulo, Brazil. 04/2021.

A functional analytic approach to rigorous numerics in dynamics: an introduction. (Online) AGH Seminar - Krakow, Poland. 04/2021.

Computer-assisted proofs for Cauchy problems of delay equations and PDEs via Chebyshev series. CRM CAMP Seminar, Montreal, Canada. 03/2021.

A fully spectral validated forward integration scheme for parabolic PDEs via Fourier/Chebyshev series. 2021 AMS Spring Southeastern Sectional Meeting, Georgia Tech, USA (virtual). 03/2021.

A rigorous implicit C^1 Chebyshev integrator for delay equations. 2021 AMS Spring Southeastern Sectional Meeting, Georgia Tech, USA (virtual). 03/2021.

Preuves assistées par ordinateur pour l'existence de solutions périodiques spontanées dans les équations de Navier-Stokes. Séminaire de l'équipe modélisation et calcul scientifique, Université Sorbonne Paris Nord, France (virtual). 02/2021.

Spontaneous periodic orbits in the Navier-Stokes flow via computer-assisted proofs. Computational Mathematics and Applications Seminar, University of Oxford, UK (virtual). 01/2021.

2020 *Spontaneous periodic orbits in the Navier-Stokes flow*. Workshop 2020 Partial Differential Equations, Charles University, Prague, Czech Republic. 09/2020.

Rigorous integration of infinite dimensional dynamical systems via Chebyshev series. CAPA (Virtual) Seminar, Uppsala, Sweden. 06/2020.

2019 *Rigorous numerics for Complex Ginzburg-Landau equations*. The 9th International Congress on Industrial and Applied Mathematics (ICIAM 2019), Valencia, Spain. 07/2019.

Rigorous integration for some infinite dimensional dynamical systems. Equadiff 2019, Leiden, The Netherlands. 07/2019

Recent Developments for Infinite Dimensional Dynamical Systems. SIAM Conference on Applications of Dynamical Systems. Snowbird, Utah, USA. 05/2019.

2018 *A proof of Jones' conjecture.* The 18th International Symposium on Scientific Computing, Computer Arithmetic, and Verified Numerical Computations, Waseda University, Tokyo, Japan. 09/2018.

Spatial periodic orbits in the equilateral circular restricted four body problem: computer-assisted proofs of existence. APPLICATIONS OF MATHEMATICS 2018 Conference, Institute of Mathematics, Prague, Czech Republic. 08/2018.

2017 *Infinite dimensional dynamical systems and the Navier-Stokes equations: a rigorous computational approach.* Numerical Analysis Seminar of the Czech Academy of Science, Prague, Czech Republic. 06/2017.

Existence of non trivial time periodic orbits in the forced 2D Navier-Stokes equations: a computer-assisted proof. SIAM Conference on Applications of Dynamical Systems. Snowbird, Utah, USA. 05/2017.

Infinite dimensional dynamical systems and the Navier-Stokes equations: a rigorous computational approach. Special Lecture, University of Ottawa, Ottawa, Canada. 01/2017.

2016 *Infinite dimensional dynamical systems and the Navier-Stokes equations: a rigorous computational approach.* Applied Math Seminar, McGill University, Montreal, Canada. 12/2016.

Rigorously verified computing for infinite dimensional nonlinear dynamics: a functional analytic approach. Dynamical Systems Seminar, Cornell University, Ithaca, USA. 11/2016.

Halo periodic orbits in the spatial circular restricted four body problem: a computer-assisted proof. Dynamics Days Latin America and the Caribbean, Puebla, Mexico, 10/2016.

Computer-assisted proofs for long periodic orbits of parabolic PDEs and their stability. The 11th AIMS Conference on Dynamical Systems, Differential Equations and Applications, Orlando, USA, 7/2016.

Periodic orbits of strongly indefinite ill-posed PDEs via rigorous numerics. The 11th AIMS Conference on Dynamical Systems, Differential Equations and Applications, Orlando, USA, 7/2016.

2015 *Rigorously verified computing for infinite dimensional nonlinear dynamics: a functional analytic approach*. X Americas Conference on Differential Equations and Nonlinear Analysis, Buenos Aires, Argentina, 2/2015.

2014 *Coexistence of hexagons and rolls*. Computational Dynamics workshop at the Foundations of Computational Mathematics conference, Montevideo, Uruguay, 12/2014.

2013 *Rigorous computation for infinite dimensional nonlinear dynamics: some difficulties and challenges.* American Institute of Mathematics, Palo Alto, California. Workshop Rigorous computation for infinite dimensional nonlinear dynamics. 08/2013

Computation of solutions of nonlinear differential equations using Chebyshev series and rigorous numerics. Applied and Computational Math Seminar, George Mason University, Fairfax, Virginia, USA. 04/2013.

Méthodes de preuve assistée par ordinateur pour l'étude de systèmes d'EDP de type réaction-diffusion. Séminaire du Laboratoire Jacques-Louis Lions, Université Pierre et Marie Curie (Paris VI), Paris, France. 01/2013.

2012 *Rigorous computations for infinite dimensional dynamical systems*. 2012 CMS Winter Meeting - Canadian Mathematical Society, Montreal, Canada. 12/2012.

An integration-free approach to rigorously compute time-periodic solutions of PDEs. Dynamics, Topology and Computations 2012. Stephan Banach International Math Center, Bedlewo, Poland. 06/2012.

2011 *Rigorous numerics in Floquet theory: computing stable and unstable bundles of periodic orbits*. Foundation of Computational Mathematics (FoCM) 2011, Budapest, Hungary, 7/2011.

Curse of dimensionality free validating methods for PDEs. Euskadi-Kyushu 2011 Workshop on Applied Mathematics, Basque Center for Applied Mathematics, Spain, 3/2011.

2010 *Rigorous computation of connecting orbits for flows*. Emerging Topics in Dynamical Systems and Partial Differential Equations (DSPDEs'10), Barcelona, Spain, 6/2010.

Topology and computations for high dimensional PDEs. Emerging Topics in Dynamical Systems and Partial Differential Equations (DSPDEs'10), Barcelona, Spain, 6/2010.

Toward a computational Morse theory: rigorous computations of equilibria and connecting orbits. Workshop on Topology: Identifying Order in Complex Systems, IAS, Princeton, 4/2010.

2008 *A general fixed point method for the study of dynamical systems*. Conference on Boundary Value Problems. Santiago de Compostela, Spain. 09/2008.

Recent advances about the uniqueness of the slowly oscillating periodic solutions of Wright's equation. 7th International Conference on Dynamical Systems, Differential Equations and Applications. Arlington, Texas, USA. 05/2008.

2007 *Validated continuation for infinite dimensional problems*. 6th International Congress on Industrial and Applied Mathematics (ICIAM 2007). Zürich, Switzerland. 07/2007.

Chaotic braided solutions via rigorous numerics. SIAM Conference on Applications of Dynamical Systems. Snowbird, Utah, USA. 05/2007.

2006 *Toward rigorous computation of global dynamics of gradient PDEs*. 4th International Workshop on Taylor Methods. Boca Raton, Florida, USA. 12/2006.

Other Talks

59 further talks at conferences, seminars and workshops, 2004–2015 (list available on request).

Reviewer for Journals

Applications of Mathematics (Springer), Communications in Nonlinear Science and Numerical Simulation (Elsevier), Discrete and Continuous Dynamical Systems, Foundations of Computational Mathematics (Springer), Indagationes Mathematicae (Elsevier), Journal of Computational Dynamics (AIMS), Journal of Differential Equations (Elsevier), Journal of Nonlinear Science (Springer), Nonlinearity (London Mathematical Society), SIAM Journal on Applied Dynamical Systems (SIAM), SIAM Journal on Numerical Analysis (SIAM), Physica D: Nonlinear Phenomena (Elsevier), Transactions on Mathematical Software.