

Razvan C. Fetecau

Department of Mathematics
Simon Fraser University
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Education

California Institute of Technology	Applied and Computational Mathematics	PhD 2003 (GPA 4.0/4.0) <i>Advisor:</i> Jerrold E. Marsden <i>Thesis:</i> Variational methods for nonsmooth classical and continuum mechanics
University of Bucharest, Romania	Mathematics (Fluid and Solid Mechanics)	MSc 1998 (GPA 9.83/10.00) <i>Thesis:</i> Eigenvalue problems for hemivariational inequalities
University of Iasi, Romania	Mathematics and Mechanics	BSc 1997 (GPA 10.00/10.00)

Academic Appointments

2018-present	Professor , Department of Mathematics, Simon Fraser University
2012-2018	Associate Professor , Department of Mathematics, Simon Fraser University
2006-2012	Assistant Professor , Department of Mathematics, Simon Fraser University
2003-2006	Szegő Assistant Professor , Department of Mathematics, Stanford University
2003 July-Aug	Postdoctoral Scholar in Control and Dynamical Systems, Caltech

Research Interests

- Mathematical models for self-collective and swarming behaviour
- Regularizations of fluid dynamics equations, Kuramoto-Sivashinsky and other related equations
- Numerical methods and mathematical modeling and analysis for multi-scale phenomena, with emphasis on fluid dynamics; particle methods
- Geometric mechanics and its relation to numerical algorithms for mechanical systems, symplectic integration, variational methods for collisions

Honours and awards

- William Carey Prize for best doctoral disertation in applied mathematics, Caltech (2003)
- Special Institute Fellowship, Caltech (1998-99)
- Tempus Programme Visiting Fellowship, Aristotle University, Greece (1998)
- Award for Undergraduate Academic Excellence, Dept. of Mathematics, University of Iasi (1993-98)
- Undergraduate Student Conference Award, Dept. of Mathematics, University of Iasi (1996-97)

Refereed journal publications

(published or accepted)

1. D.A. Messenger and R.C. Fetecau [2020], Equilibria of an aggregation model with linear diffusion in domains with boundaries, *Math. Models Methods Appl. Sci. (M3AS)*, (accepted)
2. V.T. Nguyen, P.L. Brantingham and R.C. Fetecau [2020], Urban Crime: Offender Mobility on Street Networks, *Kriminologie - Das Online-Journal* (accepted)
3. R.C. Fetecau and B. Zhang [2019], Self-organization on Riemannian manifolds, *J. Geom. Mech.*, Vol. 11, No. 3 , pp. 397-426.
4. R.C. Fetecau, H. Huang and W. Sun [2019], Propagation of chaos for the Keller-Segel equation over bounded domains, *J. Differential Equations*, Vol. 266, Issue 4, pp. 2142-2174.
5. R.C. Fetecau, M. Kovacic and I. Topaloglu [2019], Swarming in domains with boundaries: approximation and regularization by nonlinear diffusion, *Discrete Contin. Dyn. Syst. Ser. B*, Vol. 24, No. 4, pp. 1815-1842.
6. J.H.M. Evers, R.C. Fetecau and T. Kolokolnikov [2017], Equilibria for an aggregation model with two species, *SIAM J. Appl. Dyn. Syst.*, Vol. 16, No. 4, pp. 2287-2338.
7. J.H.M. Evers, R.C. Fetecau and W. Sun [2017], Small inertia regularization of an anisotropic aggregation model, *Math. Models Methods Appl. Sci. (M3AS)*, Vol. 27, No. 10, pp. 1795-1842.
8. R.C. Fetecau and M. Kovacic [2017], Swarm equilibria in domains with boundaries, *SIAM J. Appl. Dyn. Syst.*, Vol. 16, No. 3, pp. 1260-1308.
9. C. Innes, R.C. Fetecau and R. Wittenberg [2017], Modelling heterogeneity and an open-mindedness social norm in opinion dynamics, *Networks and Heterogeneous Media*, Vol. 12, Issue 1, pp. 59-92.

10. R.C. Fetecau, W. Sun and C. Tan [2016], First-order aggregation models with alignment, *Physica D*, Vol. 325, pp. 146-163.
11. R.C. Fetecau and W. Sun [2015], First-order aggregation models and zero inertia limits, *J. Differential Equations*, Vol. 259, Issue 11, pp. 6774-6802.
12. J.H.M. Evers, R.C. Fetecau and L. Ryzhik [2015], Anisotropic interactions in a first-order aggregation model, *Nonlinearity*, Vol. 28, No. 8, pp. 2847-2871.
13. R. Choksi, R.C. Fetecau and I. Topaloglu [2015], On minimizers of interaction functionals with competing attractive and repulsive potentials, *Ann. Inst. H. Poincaré Anal. Non Linéaire*, Vol. 32, Issue 6, pp. 1283-1305.
14. M. Burger, R.C. Fetecau and Y. Huang [2014], Stationary states and asymptotic behaviour of aggregation models with nonlinear local repulsion, *SIAM J. Appl. Dyn. Syst.*, Vol. 13, Issue 1, pp. 397-424.
15. R.C. Fetecau and J. Meskas [2013], A nonlocal kinetic model for predator-prey interactions, *Swarm Intelligence*, Vol. 7, Issue 4, pp. 279-305.
16. R.C. Fetecau and Y. Huang [2013], Equilibria of biological aggregations with nonlocal repulsive-attractive interactions, *Physica D*, Vol. 260, pp. 49-64.
17. R.C. Fetecau and A. Guo [2012], A mathematical model for flight guidance in honeybee swarms, *Bull. Math. Biol.*, Vol. 74, Issue 11, pp. 2600-2621.
18. J.C. Bronski and R.C. Fetecau [2012], An alternative energy bound derivation for a generalized Hasegawa-Mima equation, *Nonlinear Analysis Ser. B*, Vol. 13, Issue 3, pp. 1362-1368.
19. R.C. Fetecau and D.J. Muraki [2011], A dispersive regularization of the modulational instability of stratified gravity waves, *Wave Motion*, Vol. 48, Issue 7, pp. 667-679.
20. R.C. Fetecau, Y. Huang and T. Kolokolnikov [2011], Swarm dynamics and equilibria for a nonlocal aggregation model, *Nonlinearity*, Vol. 24, No. 10, pp. 2681-2716 (featured article).
21. R.C. Fetecau [2011], Collective behavior of biological aggregations in two dimensions: a nonlocal kinetic model, *Math. Models Methods Appl. Sci. (M3AS)*, Vol. 21, No. 7, pp. 1539-1569.
22. R.C. Fetecau and D.J. Muraki [2010], Dispersive Corrections to a Modulation Theory for Stratified Gravity Waves, *Wave Motion*, Vol. 47, Issue 7, pp. 395-408.
23. R.C. Fetecau and R. Eftimie [2010], An investigation of a nonlocal hyperbolic model for self-organization of biological groups, *J. Math. Biol.*, Vol. 61, No. 4, pp. 545-579.
24. H.S. Bhat and R.C. Fetecau [2009], On a regularization of the compressible Euler equations for an isothermal gas, *J. Math. Anal. Appl.*, Vol. 358, Issue 1, pp. 168-181.
25. H.S. Bhat and R.C. Fetecau [2009], The Riemann problem for the Leray-Burgers equation, *J. Differential Equations*, Vol. 246, Issue 10, pp. 3957-3979.

26. H.S. Bhat and R.C. Fetecau [2008], Stability of fronts for a regularization of the Burgers equation, *Quart. Appl. Math.*, Vol. 66, No. 3, 473-496.
27. H.S. Bhat, R.C. Fetecau and J. B. Goodman [2007], A Leray-type regularization for the isentropic Euler equations, *Nonlinearity*, Vol. 20, pp. 2035-2046.
28. J.C. Bronski, R.C. Fetecau and T.N. Gambill [2007], A note on a non-local Kuramoto-Sivashinsky equation, *Discrete Contin. Dyn. Syst. Ser. A*, Vol. 18, No. 4, pp. 701-707.
29. H.S. Bhat and R.C. Fetecau [2006], A Hamiltonian regularization of the Burgers equation, *J. Nonlinear Sci.*, Vol. 16, No. 6, pp. 615-638 .
30. H.S. Bhat and R.C. Fetecau [2006], Lagrangian averaging for the 1D compressible Euler equations, *Discrete Contin. Dyn. Syst. Ser. B*, Vol. 6, No. 5, pp. 979-1000.
31. R.C. Fetecau and D. Levy [2005], Approximate Model Equations for Water Waves, *Comm. Math. Sci.*, Vol. 3, Issue 2, pp. 159 - 170.
32. H.S. Bhat, R.C. Fetecau, J.E. Marsden, K.Mohseni and M.West [2005], Lagrangian Averaging for Compressible Fluids, *SIAM J. Multiscale Modeling and Simulation*, Vol. 3, No. 4, pp. 818 - 837.
33. R.C. Fetecau and T.Y. Hou [2004], A modified particle method for semilinear hyperbolic systems with oscillatory solutions, *Methods and Applications of Analysis*, Vol. 11, No. 4, pp. 573-604.
34. R.C. Fetecau, J.E. Marsden, M. Ortiz and M.West [2003], Nonsmooth Lagrangian Mechanics and Variational Collision Integrators, *SIAM J. Appl. Dyn. Syst.*, Vol. 2, No. 3, pp. 381-416.
35. R.C. Fetecau, J.E. Marsden and M.West [2003], Variational Multisymplectic Formulations of Nonsmooth Continuum Mechanics, In Kaplan et al., editors, *Perspectives and Problems in Nonlinear Science*, pp. 229-261, Springer-Verlag.
36. R.C. Fetecau [1998], Existence of Unidirectional Spherical Gap Flows of Some Non-Newtonian Fluids, *Rev. Roumaine Sci. Tech. Sér. Méc. Appl.*, Vol. 43, No. 5, pp. 551-555.
37. R.C. Fetecau and C. Fetecau [1997], Cone and plate flow of a second grade fluid, *Acta Mech.*, Vol. 122, No. 1-4, pp. 225-230.

Invited publications

1. R. C. Fetecau [2015], Self-Collective Behaviour in Biological Aggregations, CMS Research Notes, Vol. 47, No. 1, pp. 10-11.
2. T. Kolokolnikov, J. Carrillo, A. Bertozzi, R. C. Fetecau and M. Lewis [2013], Emergent behaviour in multi-particle systems with non-local interactions, *Physica D: Nonlinear Phenomena*, Vol. 260, pp. 1-4.

Refereed conference proceedings

(published or accepted)

1. J. Chacon, M. Chen and R.C. Fetecau [2020], Safe Coverage of Compact Domains For Second Order Dynamical Systems, *21st International Federation of Automatic Control (IFAC) World Congress, Berlin 2020* (accepted)

Works submitted to publication

1. R.C. Fetecau, H. Huang, D.A. Messenger and W. Sun [2020], Zero-diffusion limit for aggregation equations over bounded domains, arXiv preprint: <https://arxiv.org/abs/1809.01763> (submitted)
2. R. C. Fetecau, H. Park and F. S. Patacchini [2020], Well-posedness and asymptotic behaviour of an aggregation model with intrinsic interactions on sphere and other manifolds, arXiv preprint: <https://arxiv.org/abs/2004.06951> (submitted)

Teaching at Simon Fraser University (2006-present)

- **Undergraduate lower division courses**

Calculus for Social Sciences II (MATH 158), Calculus III: Multivariable Calculus (MATH 251), Linear Algebra (MATH 240)

- **Undergraduate upper division courses**

Basic Set Theory (MATH 303), Introduction to Fourier Methods and Partial Differential Equations (MATH 314), Non-Euclidean Geometry (MATH 381W), Elementary Differential Geometry (MATH 398), Dynamical Systems (MATH 467/ 767), Differential Geometry (MATH 496), Partial Differential Equations (MATH 418/718),

- **Graduate courses**

Advanced Mathematical Methods II (APMA 901), Analysis and Computation of Models (APMA 935)

Teaching at Stanford University (2003-2006)

- **Undergraduate lower division courses**

Multivariable Calculus (Math 52)

- **Undergraduate upper division courses**

Numerical Analysis (Math 118), Partial Differential Equations I (Math 131), Partial Differential Equations II (Math 132), Fundamental Concepts of Analysis (Math 171), Nonlinear Dynamics and Chaos (Math 135)

New course development

(Simon Fraser University)

- I redesigned the content of APMA 935 and I taught it in Spring 2016 as a graduate-level course in dynamical systems. The course presented the rigorous mathematical foundations of various fundamental concepts in nonlinear dynamics, such as stable, unstable and centre manifolds, nonlinear stability and Lyapunov functions, Hartman-Grobman Theorem, limit sets and attractors, Poincare-Bendixson theory. The course blended proof-style theory with computer explorations (e.g., compute numerically stable/unstable manifolds).
- I designed a basic set theory course aimed for non-math majors; I taught this course in Fall 2014 and Fall 2018 as Math 303. The ultimate goal of the course was to present the thought-provoking Cantor's transfinite numbers and how they changed the understanding of infinite sets and of the concept of "infinity" in general. The students were asked to participate in team projects, with themes covering a wide range of areas, including pedagogy, philosophy, history and arts.
- I designed a course on non-Euclidean geometry that I taught in Spring 2011 as a writing course under Math 381W, "Mathematics Undergraduate Seminar". The course presented a rigorous, axiomatic and proof-oriented, treatment of the foundations of neutral and hyperbolic geometries. Non-Euclidean geometry poses a fundamental challenge to the concept of space and it has far-reaching implications in Physics (general theory of relativity), as well as Philosophy. Students were asked to prepare and present a project on a related topic of their choice.
- I designed a course on elementary differential geometry that I taught in Spring 2010 and Spring 2012 as Math 398, "Selected Topics in Mathematics". The course is an introduction to the differential geometry of curves and surfaces in three-dimensional space and covers fundamental geometrical concepts such as curvature, first and second fundamental forms and geodesics.
- I designed a course on differential geometry that I taught in Spring 2008 as Math 496, "Selected Topics in Mathematics" and in Spring 2017 as Math 495, "Selected Topics in Applied Mathematics". The course is an introduction to the differential geometry of curves, surfaces and manifolds and it covers most geometrical concepts and tools that are helpful in understanding classical and modern physics and engineering. The abstract concepts of manifolds, Riemannian metrics and tensors were illustrated with applications to the general theory of relativity.

Other teaching activities

- Math Outside the Box, talks to lower-division students (SFU, Mar 2014 and Nov 2016)
- Research Experiences for Undergraduates, talk to REU participants (Stanford, Jul 2013)
- Taste of Pi, outreach activity for high school students (SFU, Nov 2008)

Senior supervisory duties

(Simon Fraser University)

- **Supervision of postdoctoral scholars**

Yanghong Huang (2010-2012)

– currently research faculty in the School of Mathematics, Univ. of Manchester

Joep Evers (2015-2016)

– currently Design Engineer at ASML, Netherlands

Hui Huang (2017-2019)

– currently Postdoctoral Fellow at Technical University of Munich, Germany

- **Supervision of graduate students**

Name	Degree	Began	Completed
Negin Karimani	M.Sc.	Fall 2019	in progress
Juan Chacon	M.Sc.	Fall 2018	in progress
Daniel Messenger	M.Sc.	Fall 2017	Summer 2019
Fatemeh Shafie	M.Sc.	Fall 2017	transferred (Summer '18)
Mitchell Kovacic	Ph.D.	Fall 2013	Summer 2018
Xinyi Wang	M.Sc.	Fall 2014	Summer 2016
Reem Bolis	M.Sc.	Fall 2012	Spring 2016
Yinhe Zhu	M.Sc.	Fall 2012	Fall 2014
Clinton Innes	M.Sc.	Fall 2012	Fall 2014
Justin Meskas	M.Sc.	Fall 2010	Summer 2012
Sareh Nabi-Abdolyousefi	M.Sc.	Fall 2009	Summer 2011
Behnam Torabi	M.Sc.	Fall 2008	Summer 2010

- **Supervision of undergraduate students**

Name	Program	Began	Completed
Vincent Nguyen	USRA	May 2019	August 2019
Beril Zhang	USRA	May 2017	August 2017
Ningxin Wei	USRA	May 2016	August 2016
Darshan Crout	USRA	May 2015	August 2015
Darshan Crout	USRA	May 2014	August 2014
Angela Guo	USRA	May 2011	August 2011
Justin Meskas	USRA	May 2009	August 2009

Other supervisory duties

- **Member of supervisory committees**

Name	Degree	Began	Completed
Lee Safranek	M.Sc.	Fall 2012	Fall 2014
Menolly Lysne	M.Sc.	Fall 2008	Summer 2010
Kevin Mitchell	Ph.D.	Fall 2008	Summer 2013
Gordon Hiscott	M.Sc.	Fall 2010	Summer 2012
Bedanta Chhetri	M.Sc.	Fall 2010	Summer 2012

University service

(Simon Fraser University)

- Teaching Assignments Committee (Sep 2019 - Aug 2020)
- Coordinated the CSC/ Applied mathematics seminar (Jan-Apr 2019)
- Tenure and Promotion Committee (May 2018 - Apr 2019)
- Co-chair of the Mathematics Graduate Studies Committee (Sep 2015 - Aug 2017)
- Tenure and Promotion Committee (Sep 2014 - Aug 2015)
- Coordinated the CSC/ Applied mathematics seminar (Sep-Dec 2014)
- Faculty hire committee – applied analysis (Jan 2012 - Apr 2012)
- Co-chair of the Mathematics Graduate Studies Committee (Sep 2009 - Aug 2011)
- Defence/ examination committees: Conor Doyle (Fall 2019, chair), Aniket Mane (Summer 2018, chair), Hans Oeri (Spring 2018, examiner), Juan Garcia (Spring 2018, chair), Parinaz Salari (Spring 2017, chair), Maryam Zarrinderakht (Spring 2017, chair), Ali Nadaf (Summer 2016, chair), Jeremy Chiu (Fall 2015, examiner), Natalia Iwanski (Summer 2015, chair), Lee Safranek (Fall 2014, examiner), Gordon Hiscott (Spring 2012, examiner), Benjamin Crestel (Summer 2011, chair), Ashok Rajaraman (Summer 2011, chair), Jeff Wiens (Summer 2011, examiner), Thomas Humphries (Summer 2011, chair), Bobak Shahriari (Fall 2010, chair), Menolly Lysne (Summer 2010, examiner), Kevin Mitchell (Spring 2010 and Spring 2013, examiner), Allan Majdanac (Fall 2008, chair), Badri Ratnam (Fall 2008, chair)

Other service activities

- External PhD thesis examiner (Joep Evers, Eindhoven Institute of Technology, Jun 2015)
- External MSc thesis examiner (Mario Palasciano, McGill University, Jul 2013)

Professional activities

Invited lectures

a. Seminar/ Colloquium • University of Washington (May 2005) • University of California, Davis (Jun 2006) • University of Pittsburgh (Jan 2007) • University of Maryland (Feb 2007 & Jan 2013) • University of British Columbia (Oct 2006 & Feb 2007) • Stanford University (Jul 2008 & Oct 2012) • University of California, Los Angeles (Feb 2010) • McGill University (Jan 2013) • University of California, Irvine (Mar 2013)

b. Conference/ Workshop • Workshop on Kinetic Theory and Conservation Laws (Stanford, Jul 2004 and Jun 2007) • Workshop on Dynamical Systems Methods in Fluid Dynamics (Oberwolfach, Aug 2005) • Pacific Northwest Conference on Numerical Analysis (Vancouver, Sep 2006) • Workshop on Nonlinear Conservation Laws and Related Problems (BIRS, Banff, Nov 2006 and Oct 2009) • Pacific Northwest Conference on PDE's (Victoria, Sep 2008) • Workshop on Nonlocal PDE's, Variational Problems and their Applications (IPAM, Los Angeles, Feb 2012) • ESF Conference on Applied Partial Differential Equations (CRM, Barcelona, Sep 2012) • Workshop on Kinetic Theory in honour of the retirement of R. Illner (Victoria, Nov 2014) • Workshop on Collective Dynamics in Gradient Flows and Entropy Driven Structures (Gran Sasso Science Institute, L'Aquila, Jun 2015) • KI-Net Conference on Collective Dynamics in Biological and Social Systems (Duke University, Nov 2015) • Workshop on Non-Local Variational Problems and PDEs (PIMS, UBC, Jun 2016) • Workshop on Coherent Structures in PDEs and Their Applications (CMO, Oaxaca, Jun 2016) • AIM Workshop on Nonlocal Differential Equations in Collective Behaviour (San Jose, Jun 2018) • Recent Advances in Nonlocal Kinetic, Fluid and Diffusive PDE's (Jeju, Korea, Aug 2019)

c. Conference session • International Conference on Scientific Computation and Differential Equations (Vancouver, 2001) • SIAM Conference on Applications of Dynamical Systems (Snowbird, May 2007) • AMS Sectional Meeting (Vancouver, Oct 2008) • CAIMS Annual Meeting (St. John's, Jul 2010) • CMS Winter Meeting (Vancouver, Dec 2010) • AMS Annual Meeting (New Orleans, Jan 2011) • ICIAM (Vancouver, Jul 2011) • CAIMS Annual Meeting (Toronto, Jun 2012) • AIMS Conference on Dynamical Systems, Differential Equations and Applications (Orlando, Jul 2012) • EquaDiff Conference 2015 (Lyon, Jul 2015) • SIAM Conference on Analysis of PDE's (Scottsdale, Dec 2015) • CAIMS annual meeting (Whistler, Jun 2019)

Organizer

a. Conference/ Workshop • “Emergent behaviour in multi-particle systems with non-local interactions”, 40 participants (BIRS, Banff, Jan 2012)

b. Conference session • SIAM Conference on Nonlinear Waves and Coherent Structures (Seattle, Sep 2006) • SIAM Conference on Emerging Topics in Dynamical Systems and PDE's (Barcelona, Jun 2010) • SIAM Conference on Analysis of PDE's (San Diego, Nov 2011) • AIMS Conference on Dynamical Systems, Differential Equations and Applications (Madrid, Jul 2014) • CMS Winter Meeting (Vancouver, Dec 2018)

Editorships & Peer Review

a. Journal editor • Physica D, guest editor for the 2013 special issue on "Emergent behaviour in multi-particle systems with non-local interactions"

b. Grant reviewer • NSERC Discovery Grant

c. Journal reviewer • Various science and PDE/applied mathematics journals: SIAM Journal on Applied Dynamical Systems, Nature, Naturwissenschaften, Science Advances, Archive for Rational Mechanics and Analysis, SIAM Journal on Mathematical Analysis, Indiana University Mathematics Journal, SIAM Journal on Multiscale Modeling and Simulation, Journal of Nonlinear Science, Nonlinearity, Physica D, Communications in Mathematical Sciences, Journal of Mathematical Biology, Journal of Theoretical Biology, Journal of Biological Dynamics, Journal of Computational Physics, Advances in Differential Equations, Discrete and Continuous Dynamical Systems - Series B, Nonlinear Analysis: Real World Applications, Applied Mathematics Letters, Quarterly of Applied Mathematics, Journal of Physics A: Mathematical and Theoretical, International Journal of Inequalities and Applications, IMA Journal of Numerical Analysis, Foundations of Computational Mathematics, Canadian Applied Mathematics Quarterly, Communications on Pure and Applied Analysis, Journal of Geometry and Physics

Research Funding

- NSERC Discovery Grant (2018 - 2023), \$90,000, Principal Investigator, type: External
- NSERC Discovery Grant (2012 - 2017), \$55,000, Principal Investigator, type: External
- NSERC Discovery Grant (2007 - 2012), \$65,000, Principal Investigator, type: External
- SFU- Endowed Research Fellowship (2007-2008), \$5,000, Principal Investigator, type: Internal
- SFU - President's Research Grant (2006-2008), \$10,000, Principal Investigator, type: Internal
- SFU - Startup grant (2006 - 2007), \$15,000, type: Internal