

Jairo Bochi

Curriculum Vitae

Contact Information

Facultad de Matemáticas
Pontificia Universidad Católica de Chile (PUC-Chile)
Avenida Vicuña Mackenna 4860
Santiago Chile
jairo.bochi@mat.uc.cl

Research Interests

Dynamical systems (multiplicative ergodic theory, non-uniform hyperbolicity, ergodic optimization, ...), relations with Control Theory, relations with Geometry, ...

Academic History

- 2001 *Doctor in Mathematics*, IMPA, Rio de Janeiro, Brazil.
Thesis title: *Zero Lyapunov exponents for conservative systems*
Thesis advisor: Marcelo Viana.
- 1997 *M.S. in Mathematics*, UFRGS, Porto Alegre, Brazil.
Advisor: Artur O. Lopes.
- 1996 *B.S. in Mathematics*, UFRGS, Porto Alegre, Brazil.

Employment Record

- 2014– Associate Professor, PUC-Chile.
- 2011–2013 Associate Professor, PUC-Rio.
- 2008–2011 Assistant Professor, PUC-Rio.
- 2005–2007 Assistant Professor, UFRGS, Porto Alegre.
- 2002–2004 Junior Researcher, IMPA, Rio de Janeiro.

Research Grants (individual)

- 2018–2022 *Fondecyt Regular* 1180371, Conicyt, Chile.
- 2014–2017 *Fondecyt Regular* 1140202, Conicyt, Chile.
- 2013 *Produtividade em Pesquisa*, level 1D, CNPq, Brazil.
- 2012–2013 *Jovem Cientista da Nosso Estado*, FAPERJ, Brazil.
- 2008–2011 *Incentivo à Produtividade em Pesquisa para Novos Professores*, PUC–Rio, Brazil.
- 2007–2012 *Produtividade em Pesquisa*, level 2, CNPq, Brazil.

Research Grants (teams)

- 2018– Anillo ACT172001 *New Trends in Ergodic Theory*, Conicyt, Chile; directed by Godofredo Iommi.
- 2014–2016 Anillo ACT1103 *Center for Dynamical Systems and Related Topics*, Conicyt, Chile; directed by Andrés Navas.

2001–2013 Member of several research teams supported by CNPq, CAPES, and FAPERJ.

Honors and Awards

2007–2011 Affiliate Member of the Brazilian Academy of Sciences.

Lectures on International Congresses

- 2018 International Congress of Mathematicians, invited session Dynamical Systems and Differential Equations, Rio de Janeiro, Brazil.
- 2018 Topics in Mathematical Physics. University of São Paulo (USP), São Paulo, Brazil.
- 2018 Workshop on Groups, Geometry and Dynamics, Universidad de la República, Montevideo, Uruguay.
- 2018 Thermodynamical formalism in Dynamical Systems. ICMS, Edinburgh, UK.
- 2018 British Mathematical Colloquium. University of Saint Andrews, UK.
- 2018 New Methods for Zimmer’s Conjecture. UCLA, Los Angeles, USA.
- 2017 Geometry, dynamics, and Anosov representations. USACH, Santiago, Chile.
- 2016 SUMA 2016: First joint meeting of Sociedad de Matemática de Chile and Unión Matemática Argentina. Valparaíso, Chile.
- 2015 International Conference Beyond Uniform Hyperbolicity. Olmué, Chile.
- 2015 Dynamische Systeme. Oberwolfach, Germany.
- 2015 III Palis–Balzan Symposium on Dynamical Systems. Paris, France.
- 2015 Workshop on Random Dynamical Systems and Multiplicative Ergodic Theorem. Banff, Canada.
- 2014 III Brazilian School on Dynamical Systems. Bento Gonçalves, Brazil.
- 2014 Ergodic Theory Workshop. University of North Carolina at Chapel Hill, USA.
- 2013 Ergodic Optimization and Related Fields. USP, São Paulo, Brazil.
- 2013 Mathematical Congress of the Americas. Guanajuato, Mexico.
- 2013 International Conference Beyond Uniform Hyperbolicity. Beedlewo, Poland.
- 2013 Non-positive curvature, isometric actions and dynamics of cocycles. Cajón de Maipo, Chile.
- 2012 II Brazilian School on Dynamical Systems. University of São Paulo, São Carlos, Brazil.
- 2012 Montevideo Dynamical Systems Conference. Universidad de la República, Montevideo, Uruguay.
- 2011 LX Dynamical Systems Colloquium. Celebrating the 60th birthday of Rodrigo Bamón. Pucón, Chile.
- 2011 Workshop on Symplectic Dynamics. Institute for Advanced Study, Princeton, USA.
- 2011 International Conference on Dynamics Beyond Uniform Hyperbolicity. CIRM, Marseille, France.
- 2011 International Conference on Topological Methods on Dynamical Systems. UNICAMP, Campinas, Brazil.
- 2010 Workshop on Ergodic Theory. Institute Mittag-Leffler, Djursholm, Sweden.

- 2009 III CLAM Congreso Latino Americano de Matemáticos, Santiago, Chile.
- 2008 School and Workshop on Dynamics. Universidade de la República, Montevideo, Uruguay.
- 2006 International Symposium on Dynamical Systems, UFBA, Salvador, Brazil.
- 2006 Young Researchers Symposium, IMPA, Rio de Janeiro, Brazil.
- 2006 AMS Spring Meeting of the Western Section. San Francisco State University, USA.
- 2005 XIV Escuela Latinoamericana de Matemática. Solís, Uruguay.
- 2005 International Conference on Dynamical Systems. Angra dos Reis, Brazil.
- 2005 Colloquium of Dynamical Systems and Smooth Ergodic Theory. Bordeaux, France.
- 2004 International Conference on Dynamical Systems in Honor of J. Massera. Universidade de la República, Montevideo, Uruguay.
- 2004 Systèmes dynamiques multidimensionnels non-uniformément hyperboliques. CIRM, Luminy, France.
- 2003 Recent Trends in Dynamics III. Universidade do Porto, Portugal.
- 2003 International Workshop on Robustness and Partial Hyperbolicity. Búzios, Brazil.
- 2003 Research Trimester on Dynamical Systems. Scuola Normale Superiore di Pisa, Italy.
- 2001 Recent Trends in Dynamics. Universidade do Porto, Portugal.
- 2001 School and Workshop on Dynamical Systems. ICTP, Trieste, Italy.
- 2001 International Workshop on Dynamical Systems and Geometry in honor of Prof. Michel Herman. IMPA, Rio de Janeiro, Brazil.
- 2000 International Conference on Dynamical Systems. IMPA, Rio de Janeiro, Brazil.

Research Visits

- Jun. 2018 University of Surrey (Guildford, UK), by invitation of Ian D. Morris.
- Jul. 2016 Yeshiva University (New York), by invitation of Anatole Katok.
- Jun. 2016 Universidad de la República (Montevideo), by invitation of Jana Rodríguez Hertz.
- Feb. 2016 Penn State University (State College), by invitation of Anatole Katok.
- Dec. 2015 Universidad de la República (Montevideo), by invitation of Rafael Potrie.
- Jul. 2015 UNICAMP (Campinas), by invitation of Eduardo Garibaldi.
- May. 2015 Universidad de la República (Montevideo), by invitation of Rafael Potrie.
- Dec. 2014 Universidad de la República (Montevideo), by invitation of Rafael Potrie.
- Sep. 2014 Pontifícia Universidade Católica do Rio de Janeiro, by invitation of Lorenzo J. Díaz.
- Aug. 2013 Universidad de Santiago de Chile, by invitation of Andrés Navas, and Pontificia Universidad Católica de Chile, by invitation of Mario Ponce.
- Feb. 2013 IMPAN, Polish Academy of Sciences (Warsaw), by invitation of Michał Rams.
- Mar. 2011 Universidad de Santiago de Chile, by invitation of Andrés Navas.
- Feb. 2011 Université de Bourgogne (Dijon), by invitation of Christian Bonatti.
- Jan. 2011 Université de Bordeaux, by invitation of Nicolas Gourmelon.

- Feb. 2010 Institute Mittag-Leffler (Djursholm), by invitation of Michael Benedicks.
- Jan.-Feb. 2009 Université de Bourgogne (Dijon), by invitation of Christian Bonatti.
- Jul. 2007 Rice University (Houston), by invitation of David Damanik.
- Jul. 2006 IMPA (Rio de Janeiro), by invitation of Artur Avila.
- Apr. 2006 Caltech (Pasadena), by invitation of Anton Gorodetski.
- Feb. 2006 Collège de France (Paris), by invitation of Jean-Christophe Yoccoz.
- Jun. 2004 Université de Paris 13 – Villetaneuse, by invitation of Bassam Fayad.
- May-Jun. 2003 Université de Paris 13 – Villetaneuse, by invitation of Bassam Fayad.
- Nov. 2002 KTH (Stockholm), by invitation of Michael Benedicks.
- May 2001 Université de Paris 7, by invitation of Håkan Eliasson.

Scientific Production

Published articles:

- Equilibrium states of generalised singular value potentials and applications to affine iterated function systems. With I.D. Morris. *Geometric and Functional Analysis*, 28 (2018), no. 4, 995–1028.
- Dominated Pesin theory: convex sum of hyperbolic measures. With Christian Bonatti and Katrin Gelfert. *Israel Journal of Mathematics*, 226 (2018), no. 1, 387–417.
- On the approximation of convex bodies by ellipses with respect to the symmetric difference metric. *Discrete & Computational Geometry*, 60 (2018), no. 4, 938–966.
- Positivity of the top Lyapunov exponent for cocycles on semisimple Lie groups over hyperbolic bases. With M. Bessa, M. Cambrinha, C. Matheus, P. Varandas, and D. Xu. *Bulletin of the Brazilian Mathematical Society*, 49 (2018), no. 1, 73–87.
- A criterion for zero averages and full support of ergodic measures With C. Bonatti and L.J. Díaz. *Moscow Mathematical Journal*, 18 (2018), no. 1, pp. 15-61.
- The scaling mean and a law of large permanents. With Godofredo Iommi and Mario Ponce. *Advances in Mathematics* 292 (2016), 374-409.
- Robust criterion for the existence of nonhyperbolic measures. With C. Bonatti and L.J. Díaz. *Communications in Mathematical Physics* 344 (2016), no. 3, 751–795.
- Ergodic optimization of prevalent super-continuous functions. With Yiwei Zhang. *International Mathematics Research Notices*, 2016 (2016), no. 19, 5988–6017.
- Peano curves with smooth footprints. With Pedro H. Milet. *Monatshefte für Mathematik* 180 (2016), no. 4, 693–712.
- The entropy of Lyapunov-optimizing measures of some matrix cocycles. With Michał Rams. *Journal of Modern Dynamics* 10 (2016), 255–286.
- Continuity properties of the lower spectral radius. With Ian D. Morris. *Proceedings of the London Mathematical Society* 110 (2015), 477–509.
- Cocycles of isometries and denseness of domination. *Quarterly Journal of Mathematics* 66 (2015), no. 3, 773–798.
- A geometric path from zero Lyapunov exponents to rotation cocycles. With A. Navas. *Ergodic Theory and Dynamical Systems*, 35 (2015), no. 2, 374–402.

- Universal regular control for generic semilinear systems. With N. Gourmelon. *Mathematics of Control, Signals, and Systems*, 26 (2014), no. 4, 481–518.
- Almost reduction and perturbation of matrix cocycles. With Andrés Navas. *Annales de l'Institut Henri Poincaré – Analyse Non linéaire*, 31 (2014), no. 6, 1101–1107.
- Generic linear cocycles over a minimal base. *Studia Mathematica*, 218 (2013), no. 2, 167–188.
- Robust vanishing of all Lyapunov exponents for iterated function systems. With Christian Bonatti and Lorenzo J. Díaz. *Mathematische Zeitschrift*, 176 (2014), 469–503.
- Perturbation of the Lyapunov spectra of periodic orbits. With Christian Bonatti. *Proceedings of the London Mathematical Society*, 105 (2012), no. 1, 1–48.
- Nonuniform hyperbolicity, global dominated splittings and generic properties of volume-preserving diffeomorphisms. With A. Avila. *Transactions of the American Mathematical Society*, 364 (2012), no. 6, 2883–2907.
- Opening gaps in the spectrum of strictly ergodic Schrödinger operators. With A. Avila and D. Damanik. *Journal of the European Mathematical Society*, 14 (2012), no. 1, 61–106.
- Uniformly hyperbolic finite-valued $SL(2, \mathbb{R})$ cocycles. With Artur Avila and Jean-Christophe Yoccoz. *Commentarii Mathematici Helvetici*, 85, no. 4 (2010), 813–884.
- C^1 -generic symplectic diffeomorphisms: partial hyperbolicity and zero center Lyapunov exponents. *Journal of the Institute of Mathematics of Jussieu*, 9, no. 1 (2010), 49–93.
- Nonuniform center bunching and the genericity of ergodicity among C^1 partially hyperbolic symplectomorphisms. With Artur Avila and Amie Wilkinson. *Annales Scientifiques de l'École Normale Supérieure*, 42, n. 6 (2009), 931–979.
- Some characterizations of domination. With Nicolas Gourmelon. *Mathematische Zeitschrift*, 263, no. 1 (2009), 221–231.
- Cantor spectrum for Schrödinger Operators with potentials arising from generalized skew-shifts. With Artur Avila and David Damanik. *Duke Mathematical Journal*, 146, no. 2 (2009), 253–280.
- A uniform dichotomy for generic $SL(2, \mathbb{R})$ cocycles over a minimal base. With A. Avila. *Bulletin de la Société Mathématique de France*, 135 (2007), 407–417.
- Generic expanding maps without absolutely continuous invariant σ -finite measure. With A. Avila. *Mathematical Research Letters*, 14 (2007), 721–730.
- A generic C^1 map has no absolutely continuous invariant probability measure. With A. Avila. *Nonlinearity*, 19 (2006), 2717–2725.
- Dichotomies between uniform hyperbolicity and zero Lyapunov exponents for $SL(2, R)$ cocycles. With B. Fayad. *Bulletin of the Brazilian Mathematical Society*, 37, no. 3 (2006), 307–349.
- A remark on conservative diffeomorphisms. With Bassam Fayad and Enrique Pujals. *Comptes Rendus Acad. Sci. Paris, Ser. I* 342 (2006), 763–766.
- The Lyapunov exponents of generic volume preserving and symplectic maps. With M. Viana. *Annals of Mathematics*, 161 (2005), No. 3, 1423–1485.
- L^p -generic cocycles have one-point Lyapunov spectrum. With Alexander Arbieto. *Stochastics and Dynamics*, 3 (2003), 73–81.

Inequalities for numerical invariants of sets of matrices. *Linear Algebra and its Applications*, 368 (2003), 71–81.

Robust transitivity and topological mixing for C^1 flows. With Flavio Abdenur and Artur Avila. *Proceedings of the American Mathematical Society*, 132 (2003), 699–705.

Uniform (projective) hyperbolicity or no hyperbolicity: a dichotomy for generic conservative maps. With Marcelo Viana. *Annales de l'Institut Henri Poincaré – Analyse non linéaire*, 19 (2002), 113–123.

Genericity of zero Lyapunov exponents. *Ergodic Theory and Dynamical Systems*, 22 (2002), 1667–1696.

A formula with some applications to the theory of Lyapunov exponents. With Artur Avila. *Israel Journal of Mathematics*, 131 (2002), 125–137.

Book chapters:

Ergodic optimization of Birkhoff averages and Lyapunov exponents. *Proceedings of the International Congress of Mathematicians 2018, Rio de Janeiro*, vol. 2, 1821–1842.

Lyapunov exponents: How frequently are dynamical systems hyperbolic? With M. Viana. *Modern dynamical systems and applications*, 271–297, Brin, Hasselblatt, Pesin (eds.) Cambridge Univ. Press, 2004.

Pisa Lectures on Lyapunov Exponents. With M. Viana. *Dynamical Systems – Part II: Topological, Geometrical, and Ergodic Properties of Dynamics*, 23–47. Scuola Normale Superiore, Pisa 2003.

Accepted articles:

Anosov representations and dominated splittings. With Rafael Potrie and Andrés Sambarino. [arXiv:1605.01742](https://arxiv.org/abs/1605.01742) (64 pages). To appear in *Journal of the European Mathematical Society*.

Preprints:

Extremal norms for fiber bunched cocycles. With Eduardo Garibaldi. [arXiv:1808.02804](https://arxiv.org/abs/1808.02804) (61 pages).

Citations: Cited 469 times by 211 authors, H number = 13, according to AMS MathSciNet (November 2018).

Editorial Service

Dec.2014 – Member of the editorial board of *Discrete and Continuous Dynamical Systems - Series A*.

Teaching Experience

Advanced minicourses:

C^1 perturbation techniques in the neighborhood of periodic orbits, Institute of Mathematics, Polish Academy of Sciences (Bedlewo), 2013. 6 hour course, joint with Christian Bonatti.

Quasi-periodic cocycles with Liouvillean frequencies, Scuola Normale Superiore, Pisa, 2010. One week course, joint with Raphaël Krikorian.

Lyapunov exponents, ICTP, Trieste, 2008. Two week course, joint course with Artur Avila.

Lyapunov exponents for generic volume preserving maps, Morningside Center for Mathematics, Chinese Academy of Sciences, Beijing, 2007. One week course.

Deterministic products of matrices, Scuola Normale Superiore, Pisa, 2002. Joint course with Marcelo Viana.

Graduate Teaching:

Ergodic Theory, PUC-Chile (2017), PUC-Rio (2012), UFRGS (2006), IMPA (2003, 2002).
Complex Analysis, PUC-Chile (2016).
Measure Theory, PUC-Rio (2013, 2011), IMPA (2004).
Differential Topology, PUC-Rio (2011).
Analysis in \mathbb{R}^n , PUC-Rio (2010), IMPA (2003).
Dynamical Systems, PUC-Rio (2009, 2008).
General Topology, UFRGS (2006).
Algebraic Topology, UFRGS (2005).
Hyperbolic Dynamics, IMPA (2002).

Undergraduate Teaching:

Precalculus, PUC-Chile (2018, 2017).
Differential Equations, PUC-Chile (2018), PUC-Rio (2011, 2010), UFRGS (2005).
Introduction to Dynamical Systems, PUC-Chile (2018, 2015).
Univariate Calculus, PUC-Chile (2017, 2016), PUC-Rio (2009), UFRGS (2007).
Real Analysis, PUC-Chile (2016), PUC-Rio (2013, 2011, 2009), UFES Summer School (2006).
Lebesgue Integration, PUC-Chile (2015), UFRGS (2007).
Multivariate Calculus, PUC-Chile (2015, 2014), PUC-Rio (2012).
Differential Geometry, PUC-Chile (2014).
Discrete Mathematics, PUC-Rio (2013, 2010, 2009).
Linear Algebra, PUC-Rio (2012, 2008), UFRGS (2006).
Introduction to Probability, PUC-Rio (2012, 2010).
Analytical Geometry, UFRGS (2007, 2006).

Undergraduate Advising: 2 students at PUC-Chile, 3 students at PUC-Rio, 1 student at UFRGS.

School-level Teaching:

Leader of the project *Mathematics for Highly Capable Students*, Anne Frank High School, Porto Alegre (2006).

Graduate Students Advising

Current students: 1 MSc (PUC-Chile).

Former students:

Eduardo Oregón. MSc, PUC-Chile. Dissertation: “Negative curvature, matrix products, and ergodic theory” (2018).
Renato Velozo. MSc, PUC-Chile. Dissertation: “Characterization of uniform hyperbolicity for fiber-bunched cocycles” (2018).
Paulo N. Orenstein. MSc, PUC-Rio. (Co-advised by Carlos Tomei). Dissertation: “Optimal transport and the Wasserstein metric” (2014).
Cong Zhou. MSc, PUC-Rio. Dissertation: “Multiplicative ergodic theorem in non-positively curved spaces” (2013).
Miguel K. Schnoor. PhD, PUC-Rio. Thesis: “The non-existence of absolutely continuous invariant probabilities is C^1 -generic for flows” (2012).
Pedro H. Milet. MSc, PUC-Rio. Dissertation: “Peano curves and line fields” (2011).

Academic Service

- 2017 Member of the hiring committee, Mathematics Department, PUC-Chile.
- 2011–2013 Director of Graduate Studies, Mathematics Department, PUC-Rio.
- 2009 Member of the hiring committee, Applied Mathematics Department, Universidade Federal Fluminense (UFF).

Event Organization

- 2018 Dynamics in Valparaíso, PUC-V. ima.ucv.cl/congreso/dynamics-in-valparaiso
- 2013 Dynamical Systems Session of the 29th Brazilian Mathematical Colloquium (IMPA).
- 2010–2012 EDAI (monthly Dynamical Systems joint seminar of PUC-Rio, UFRJ and UFF universities).
www.mat.puc-rio.br/edai
- 2010 VIII Oktobermat, PUC-Rio. www.mat.puc-rio.br/oktober2010

Supplementary Information

Born June 12, 1975 in Porto Alegre, Brazil.

Married, one daughter.

December 6, 2018