Curriculum Vitae

Edmilson Roque dos Santos

Research interests: Dynamical Systems, Ergodic Theory, Synchronization, Sparse Recovery methods, Reservoir Computing.

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https://github.com/edmilson-roque-santos

Professional Appointments

Postdoctoral Researcher
Nonlinear Dynamics and Time Series analysis
Sep 2025 – to date — Max Planck Institute for the Physics of Complex Systems
Project: *Learning sparse network dynamics from data*

Research Associate
Clarkson Center for Complex Systems Science
Feb 2023 – May, 2025 — Clarkson University
NSF-NIH CRCNS: *Functional Brain Networks with Tensioned Stability for Optimal Processing*

Education

PhD. in Applied Mathematics
Feb 2018 – Jan 2024 — ICMC-USP and Imperial College London (partially supported by Royal Society).
Project Title: *Reconstruction of Complex Networks from Data*
Supervisor: Prof. Dr. Tiago Pereira
Co-Supervisor: Prof. Dr. Sebastian van Strien

MSc. in Physics
Feb. 2016 – Feb. 2018 — IFSC-USP
Thesis title: *Discontinuous transitions to collective dynamics in star motifs of coupled oscillators*
Supervisor: Prof. Dr. Tiago Pereira
Co-Supervisor: Dr. Jaap Eldering

Bachelor in Physics
Feb. 2012 – Dec. 2015 — IFSC-USP
Undergraduate research title: *Models in Explosive Synchronization*
Supervisor: Prof. Dr. Francisco Aparecido Rodrigues

Publications

Preprints and in preparation

1. Edmilson Roque dos Santos. *Reconstruction of bursting network dynamics from data.* (2024). Under review in Physica D.
2. Edmilson Roque dos Santos, Sebastian van Strien, and Tiago Pereira. *"Ergodic Basis Pursuit induces Divide-and-Conquer Network Reconstruction"*. In preparation.

Journal Publications

1. Edmilson Roque dos Santos and Erik Bollt. *"On the emergence of numerical instabilities in Next Generation Reservoir Computing"*. https://doi.org/10.1063/5.0278709. Chaos 35, 123102 (2025).
2. Yuanzhao Zhang, Edmilson Roque dos Santos, Huixin Zhang, and Sean P. Cornelius. *"How more data can hurt: Instability and regularization in next-generation reservoir computing"*. https://doi.org/10.1063/5.0262977. Chaos 35, 073102 (2025).
3. Tiago Pereira, Edmilson Roque dos Santos, Sebastian van Strien. *"Robust reconstruction of sparse network dynamics"*. https://iopscience.iop.org/article/10.1088/1361-6544/add3b0, Nonlinearity 38 055031 (2025).

4. Anil Kumar, Edmilson Roque dos Santos, Paul J. Laurienti, and Erik Bollt. *"Symmetry breaker governs synchrony patterns in neuronal inspired networks"*. Chaos 34, 113115 (2024). https://doi.org/10.1063/5.0209865

5. Erik Bollt, Jeremie Fish, Anil Kumar, Edmilson Roque dos Santos, and Paul J. Laurienti. *"Fractal Basins as a Mechanism for the Nimble Brain"*. Sci Rep 13, 20860 (2023). https://doi.org/10.1038/s41598-023-45664-5.

6. Juliano Genari, Guilherme T. Goedert, Sérgio H.A. Lira, Krerley Oliveira, Adriano Barbosa, et al. "Quantifying protocols for safe school activities". PLoS ONE 17(9): e0273425 (2022). https://doi.org/10.1371/journal.pone.0273425

7. Marcel Novaes, Edmilson Roque dos Santos, Tiago Pereira. *"Recovering sparse networks: Basis adaptation and stability under extensions"*. Physica D: Nonlinear Phenomena 424 132895, (2021). https://doi.org/10.1016/j.physd.2021.132895

8. Jaap Eldering, Jeroen Lamb, Tiago Pereira, Edmilson Roque dos Santos. *"Chimera states through invariant manifold theory"*. Nonlinearity 34-5344, (2021). https://dx.doi.org/10.1088/1361-6544/ac0613

Grants and Honors

2025	SIAM Travel Awards - Life Sciences and Dynamical Systems Travel Fund by Dr. Simone Bianco.
2018 - 2022	Doctoral Scholarship: The São Paulo Research Foundation, FAPESP.
2016 - 2018	Grant: Coordination for the Improvement of Higher Education Personnel, CAPES.
2015	Garfield's Medal: Best Oral Presentation in the Symposium of Mathematics for the Undergraduate course (SiM 2015) at ICMC-USP.
July 2015	Research internship at PIK under the supervision of Prof. Jurgen Kurths - The São Paulo Research Foundation, FAPESP.
2014 - 2015	Undergraduate Scientific Initiation Scholarship: The São Paulo Research Foundation, FAPESP.

Conferences and Invited talks

Oct, 9. 2025	Math Seminar at Center for Systems Biology Dresden. *Ergodic Basis Pursuit leads to exact reconstruction of sparse network dynamics.* (Invited talk)
May, 11. 2025	MS41 - Invariant Sets in Dynamics: Applications and Future Directions. SIAM Conference on Applications of Dynamical Systems 2025. *Switching Between Multiple Invariant Sets in Neuronal-Inspired Network Dynamics.* (Invited talk)
Dec, 18. 2024	(Network) Dynamical Systems. University of São Paulo, São Carlos. *Symmetry breaker governs synchrony patterns in neuronal inspired networks.* (Contributed talk)
Oct, 7. 2024	Applied Math Seminars. University of Ottawa, Canada. *Metastability of chimeras states in coupled networks.* (Invited talk)
July, 8 - 12. 2024	Fourth Symposium of Machine Learning on Dynamical Systems. Fields Institute, Toronto - Canada *Ergodic Basis Pursuit induces exact (and robust) sparse network reconstruction.* (Contributed talk)
Mar, 20 - 22. 2024	NERCCS 2024: Seventh Northeast Regional Conference on Complex Systems. Potsdam, NY - USA. *Dynamics of synchrony patterns on networks.* (Contributed talk)
Feb, 5. 2024	Oberseminar Dynamics. TUM, Munich - Germany. *Ergodic Basis Pursuit induces robust reconstruction of sparse network dynamics.* (invited talk - online format)
Oct, 27. 2023	C3S2 Seminars. The Clarkson Center for Complex Systems Science, Potsdam, NY - USA. *Reconstruction of coupled sparse networks from data.* (invited talk)

Mar, 22 - 24. 2023	NERCCS 2023: Sixth Northeast Regional Conference on Complex Systems. *Ergodic Basis Pursuit induces robust network reconstruction.* (contributed talk)
Jan, 9 - 11. 2023	Dynamics Days US 23. *Ergodic basis pursuit induces robust reconstruction of weakly coupled sparse networks. (contributed talk - online format)*
Dec, 17-18. 2022	Mathematical Physics Days 2022. *Reconstruction of Weakly Coupled Sparse Networks from Data. (invited talk - online format)*
Sep, 12 - 21. 2022	Inverse Network Dynamics - NETDAT22. MPI for the Physics of Complex Systems, Dresden - Germany. *Ergodic basis pursuit induces robust reconstruction of sparse networks.* (contributed talk)
Jun, 20 - 23. 2022	Rényi 100. Hungarian Academy of Sciences, Budapest - Hungary. *Ergodic basis pursuit induces robust reconstruction of sparse networks.* (poster presentation)
May, 6. 2022	Free University of Berlin (FUB). Berlin - Germany. *Ergodic basis pursuit induces robust reconstruction of sparse networks.* (presentation)
May, 5. 2022	Potsdam Institute for Climate Impact Research (PIK). Potsdam - Germany. *Ergodic basis pursuit induces robust reconstruction of sparse networks.* (presentation)
May, 5. 2022	Weierstrass Institute for Applied Analysis and Stochastic (WIAS). Berlim - Germany. *Ergodic basis pursuit induces robust reconstruction of sparse networks.* (presentation)
May, 4. 2022	University of Potsdam. Potsdam - Germany. *Ergodic basis pursuit induces robust reconstruction of sparse networks.* (presentation)
May, 23 - 27. 2021	SIAM Conference on Applications of Dynamical Systems (DS21). *Ergodicity implies stable reconstruction of sparse network dynamics.* (invited talk - online format)
April, 29. 2021	Dynamical Systems and Networks Seminars. Courant Institute of Mathematical Sciences, New York - USA. *Chimera states through invariant manifold theory.* (invited talk - online format)
Oct, 07 - 11. 2019	V Escola Brasileira de Sistemas Dinâmicos. UFMG - Belo Horizonte, MG - Brazil. *Chimera states through invariant manifold theory.* (poster presentation)
Aug, 26 - Sep, 01. 2018	V Workshop and School on Dynamics, Transport and Control in Complex Networks - ComplexNet. INPE, Cachoeira Paulista, SP - Brazil. *Discontinuous transitions to collective dynamics in star motifs of coupled oscillators.* (poster presentation)
Jul, 27 - 31. 2015	International Workshop on Dynamics of Coupled Oscillators: 40 years of the Kuramoto Model. MPI for the Physics of Complex Systems, Dresden - Germany. Title: *Influence of frequency distribution on the discontinuous phase transition in networks of Kuramoto oscillators.* (poster presentation)
Sep, 17 - 19. 2014	Undergraduate Research Project Highlights 22° SIICUSP -The University of São Paulo's International Symposium of Undergraduate Research (SIICUSP) São Paulo - Brazil. Title: *Influence of frequency distribution on the discontinuous phase transition in networks of Kuramoto oscillators.* (poster presentation)
Oct, 6 - 11. 2014	III Workshop and School on Dynamics, Transport and Control in Complex Networks - ComplexNet. São José dos Campos, SP - Brazil. Title: *Influence of frequency distribution on the discontinuous phase transition in networks of Kuramoto oscillators.* (contributed talk)

Visiting

August 2025	University of São Paulo, ICMC-USP, Brazil Prof. Dr. Tiago Pereira, Dr. Thomas Peron and Dr. Eddie Nijholt
Mar - Jun 2022	Imperial College London, London, UK. Prof. Dr. Sebastian van Strien and Prof. Dr. Jeroen Lamb
Dec 2019 - Mar 2020	Imperial College London, London, UK. Prof. Dr. Sebastian van Strien and Prof. Dr. Jeroen Lamb

Imperial College London, London, UK.
Jan - May, 2019 Prof. Dr. Sebastian van Strien and Prof. Dr. Jeroen Lamb

Imperial College London, London, UK.
Jan - Feb, 2018 Prof. Dr. Jeroen Lamb

Potsdam Institute for Climate Impact Research - PIK, Potsdam, Germany
Jul - Aug, 2015 Prof. Dr. Jurgen Kurths

Organizing

NERCCS 2024
Mar 20 - 22, 2024 Co-organization with Prof. Dr. Chunlei Liang, Prof. Dr. Erik Bollt, Dr. Golshan Madraki, and Dr. Jeremie Fish

Dynamical systems research seminars at ICMC-USP
2022 - 2023 Co-organization with Dr. Zheng Bian

Dynamical systems research seminars
Jun - Jul, 2022 Organization of seminars at Imperial College London

NetDynamics Seminars between ICMC-USP and Nodds Lab – Dr. Deniz Eroglu's group from Kadir Has University (KHAS)
Apr - Dec, 2021 Co-organization with Dr. Elif Yunt.

São Paulo Dynamical Systems days
Oct 24 - 26, 2018 Co-organization with Prof. Dr. Tiago Pereira and Prof. Dr. Ali Tahzibi

SIFSC 4 - Semana Integrada de Física de São Carlos
2014 Co-organization with undergraduate and graduate students from IFSC-USP

SIFSC 3 - Semana Integrada de Física de São Carlos
2013 Co-organization with undergraduate and graduate students from IFSC-USP

Peer review

Physical Review Letters; Physical Review E; Physica A: Statistical Mechanics and its Applications; and Physica D: Nonlinear Phenomena

Programming languages

Advanced *Python*
Basic *C++, Fortran, Matlab, Julia, Mathematica*

Teaching

TA for Linear Algebra and Ordinary Differential Equations
2019 University of São Paulo
Undergraduate Course

TA for Advanced Laboratory of Physics
2017 University of São Paulo
Undergraduate Course

TA for Mathematical Physics
2017 University of São Paulo
Undergraduate Course

Extra Activities

2020 - 2022 Modcovid19.
Participation in a large collaboration group formed by different Brazilian institutions to model COVID-19 in Brazil, in particular, model validation of COMORBUSS software, which can be accessed in the following link:

https://comorbuss.org/Home.

Judge during the finals in Brazil.

2014 International Young Physicists Tournament (IYPT)