

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

Jan - May, 2019	Imperial College London, London, UK. PROF. DR. SEBASTIAN VAN STRIEN AND PROF. DR. JEROEN LAMB
Jan - Feb, 2018	Imperial College London, London, UK. PROF. DR. JEROEN LAMB
Jul - Aug, 2015	Potsdam Institute for Climate Impact Research - PIK, Potsdam, Germany PROF. DR. JURGEN KURTHS

ORGANIZING

Jun 28 - Jul 3, 2026	Half a Century of the Kuramoto Model: Explaining Emergent Order in Time and Space CO-ORGANIZATION WITH DR. SIMONA OLMI, PROF. DR. MICHAEL ROSENBLUM, AND PROF. DR. MARC TIMME
Oct, 2025 - ongoing	Nonlinear time series analysis seminars at MPI-PKS CO-ORGANIZATION WITH PROF. DR. HOLGER KANTZ
Mar 20 - 22, 2024	NERCCS 2024 CO-ORGANIZATION WITH PROF. DR. CHUNLEI LIANG, PROF. DR. ERIK BOLLT, DR. GOLSHAN MADRAKI, AND DR. JEREMIE FISH
2022 - 2023	Dynamical systems research seminars at ICMC-USP CO-ORGANIZATION WITH DR. ZHENG BIAN
Jun - Jul, 2022	Dynamical systems research seminars ORGANIZATION OF SEMINARS AT IMPERIAL COLLEGE LONDON
Apr - Dec, 2021	NetDynamics Seminars between ICMC-USP and Nodds Lab – Dr. Deniz Eroglu’s group from Kadir Has University (KHAS) CO-ORGANIZATION WITH DR. ELIF YUNT.
Oct 24 - 26, 2018	São Paulo Dynamical Systems days CO-ORGANIZATION WITH PROF. DR. TIAGO PEREIRA AND PROF. DR. ALI TAHZIBI
2014	SIFSC 4 - Semana Integrada de Física de São Carlos CO-ORGANIZATION WITH UNDERGRADUATE AND GRADUATE STUDENTS FROM IFSC-USP
2013	SIFSC 3 - Semana Integrada de Física de São Carlos 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

2019	TA for Linear Algebra and Ordinary Differential Equations UNIVERSITY OF SÃO PAULO Undergraduate Course
2017	TA for Advanced Laboratory of Physics UNIVERSITY OF SÃO PAULO Undergraduate Course

2017 TA for Mathematical Physics
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>.

2014 Judge during the finals in Brazil.
INTERNATIONAL YOUNG PHYSICISTS TOURNAMENT (IYPT)