

## Edmilson Roque dos Santos

Current position: Research Associate at the DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING  
CLARKSON CENTER FOR COMPLEX SYSTEMS SCIENCE

CLARKSON UNIVERSITY

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

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🌐 <https://github.com/edmilson-roque-santos>

### PROFESSIONAL APPOINTMENTS

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#### Research Associate

CLARKSON CENTER FOR COMPLEX SYSTEMS SCIENCE

Feb 2023 – present CLARKSON UNIVERSITY.

NSF-NIH CRCNS: *Functional Brain Networks with Tensioned Stability for Optimal Processing*

### EDUCATION

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#### 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

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#### PREPRINTS AND IN PREPARATION

1. Edmilson Roque dos Santos and Erik Bollt. “On the emergence of numerical instabilities in Next Generation Reservoir Computing”. <https://arxiv.org/abs/2505.00846>. Under review in Chaos (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://arxiv.org/abs/2407.08641>. Under review in Chaos (2025).
3. Edmilson Roque dos Santos. *Reconstruction of bursting network dynamics from data*. (2024). Under review in Physica D.
4. Tiago Pereira, Edmilson Roque dos Santos, Sebastian van Strien. “Robust reconstruction of sparse network dynamics”. <https://arxiv.org/abs/2308.06433> Accepted in Nonlinearity (2025).
5. Edmilson Roque dos Santos, Sebastian van Strien, and Tiago Pereira. “Ergodic Basis Pursuit induces Divide-and-Conquer Network Reconstruction”. In preparation.

## JOURNAL PUBLICATIONS

1. Anil Kumar, Edmilson Roque dos Santos, Paul J. Laurienti, and Erik Boltt. “Symmetry breaker governs synchrony patterns in neuronal inspired networks”. *Chaos* 34, 113115 (2024). <https://doi.org/10.1063/5.0209865>
2. Erik Boltt, 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>.
3. 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>
4. 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>
5. 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

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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	Garfields Medal: Best Oral Presentation in Symposium of Mathematics to 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

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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. <i>Ergodic Basis Pursuit induces robust network reconstruction</i> . (contributed talk)
Jan, 9 - 11. 2023	Dynamics Days US 23. <i>Ergodic basis pursuit induces robust reconstruction of weakly coupled sparse networks</i> . (contributed talk - online format)
Dec, 17-18. 2022	Mathematical Physics Days 2022. <i>Reconstruction of Weakly Coupled Sparse Networks from Data</i> . (invited talk - online format)

Sep, 12 - 21. 2022	Inverse Network Dynamics - NETDAT22. MPI for the Physics of Complex Systems, Dresden - Germany. <i>Ergodic basis pursuit induces robust reconstruction of sparse networks.</i> (contributed talk)
Jun, 20 - 23. 2022	Rényi 100. Hungarian Academy of Sciences, Budapest - Hungary. <i>Ergodic basis pursuit induces robust reconstruction of sparse networks.</i> (poster presentation)
May, 6. 2022	Free University of Berlin (FUB). Berlin - Germany. <i>Ergodic basis pursuit induces robust reconstruction of sparse networks.</i> (presentation)
May, 5. 2022	Potsdam Institute for Climate Impact Research (PIK). Potsdam - Germany. <i>Ergodic basis pursuit induces robust reconstruction of sparse networks.</i> (presentation)
May, 5. 2022	Weierstrass Institute for Applied Analysis and Stochastic (WIAS). Berlin - Germany. <i>Ergodic basis pursuit induces robust reconstruction of sparse networks.</i> (presentation)
May, 4. 2022	University of Potsdam. Potsdam - Germany. <i>Ergodic basis pursuit induces robust reconstruction of sparse networks.</i> (presentation)
May, 23 - 27. 2021	SIAM Conference on Applications of Dynamical Systems (DS21). <i>Ergodicity implies stable reconstruction of sparse network dynamics.</i> (invited talk - online format)
April, 29. 2021	Dynamical Systems and Networks Seminars. Courant Institute of Mathematical Sciences, New York - USA. <i>Chimera states through invariant manifold theory.</i> (invited talk - online format)
Oct, 07 - 11. 2019	V Escola Brasileira de Sistemas Dinâmicos. UFMG - Belo Horizonte, MG - Brazil. <i>Chimera states through invariant manifold theory.</i> (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. <i>Discontinuous transitions to collective dynamics in star motifs of coupled oscillators.</i> (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: <i>Influence of frequency distribution on the discontinuous phase transition in networks of Kuramoto oscillators.</i> (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: <i>Influence of frequency distribution on the discontinuous phase transition in networks of Kuramoto oscillators.</i> (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: <i>Influence of frequency distribution on the discontinuous phase transition in networks of Kuramoto oscillators.</i> (contributed talk)

## VISITING

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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

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## ORGANIZING

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### 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

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## PEER REVIEW

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

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## PROGRAMMING LANGUAGES

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Advanced *Python*

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

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## TEACHING

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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

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## EXTRA ACTIVITIES

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### Modcovid19.

2020 - 2022  
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)