Giulio Colombini

27 November 1996
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REFERENCES

Prof. Armando Bazzani
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Prof. Nicola Guglielmi
Gran Sasso Science Institute
nicola.guglielmi@gssi.it

Prof. Rudolf Hanel
Complexity Science Hub
Medizinische Universität Wien
rudolf.hanel@meduniwien.ac.at

LANGUAGES

Italian	mother tongue
English	proficient (IELTS 7.5)
German	intermediate

IT SKILLS

- C/C++ (STL, ROOT)
- Python:
  - scientific computing
  - code parallelisation
  - C++/FORTRAN binding
- git collaboration and version control
- Matlab and Octave
- LaTeX
- Linux shell (bash)

WORK EXPERIENCE

University of Bologna — Feb 2025–Ongoing

Research fellowship

Dynamical models on graphs for epidemics spreading and human mobility.
The objective of this grant is the realization of models for the short and medium-term forecasting at a local scale of seasonal influenza during the winter months, and prediction of heatwave-related hospital admissions in fragile individuals during the summer. The approach is based on the integration of dynamical models and clinical data provided by the local health authority. The work is carried out in collaboration with the DigitAl lifelong pRevEntion (DARE) project from the italian National Recovery and Resilience Plan (PNRR).

EDUCATION

University of Bologna — Nov 2021–Mar 2025

Ph.D. in Physics

Thesis: *Applications of Delay Differential Equations to the Physics of Complex Systems.*
Supervisor: Prof. A. Bazzani
Research topics:

- Dynamical network models for the neurosciences
- Effective Delay Differential Equation models for dynamical stationary states on directed graph structures
- Epidemiological models
- Linear response and predictivity studies in distributed delay epidemiological models
- Simplified modelling of noisy neural dynamics

University of Bologna — Oct 2018–Sept 2021

M.Sc. in Physics

110/110 cum laude
Thesis: *Synchronisation Phenomena in Complex Neuronal Networks.*
Supervisor: Prof. A. Bazzani
Curriculum: Theoretical Physics

University of Bologna — Oct 2015–Dec 2018

B.Sc. in Physics

110/110
Thesis: *Entropic Measures in Human Mobility: the BellaMossa database in Bologna.*
Supervisor: Prof. A. Bazzani

AFFILIATION TO SCIENTIFIC INSTITUTIONS

Istituto Nazionale di Fisica Nucleare
Bologna Section — Nov 2021–Ongoing

INFN Theoretical Group affiliation

I am affiliated to the Italian National Institute of Nuclear Physics, within the Theoretical Group in the LearnINg COmpLex Networks (LINCOLN) specific initiative, concerned with the study of Complex Systems.

PUBLICATIONS

2022 C. Mizzi, A. Fabbri, G. C., F. Bertini, A. Bazzani
A survival model to explain the statistical properties of multimodal mobility.
Journal of Statistical Mechanics: Theory and Experiment, 2022(2), 023404. DOI: 10.1088/1742-5468/ac4c40

PREPRINTS

2025 G. C., N. Guglielmi, A. Bazzani
Equivalence of stationary solutions in a directed chain and a Delay Differential Equation of neuroscientific relevance
arXiv:2506.11654. DOI: 10.48550/arXiv.2506.11654

2025 F. Durazzi, E. Lunedei, G. C., G. Gatti, V. Sambri, A. de Cesare, C. Crippa, F. Pasquali, Bologna MODELS4COVID Study Group, G. Castellani, D. Remondini, A. Bazzani
Human mobility and sewage data correlate with COVID-19 epidemic evolution in a 3-year surveillance of the metropolitan area of Bologna
Accepted for publication on BMC Infectious Diseases
medRxiv 2025.03.27.25324700. DOI: 10.1101/2025.03.27.25324700

WORKSHOPS, CONFERENCES, TALKS, POSTERS

2025 StatPhys29 satellite: Collective Dynamics and Information Processing in Neural Systems
Venice, Italy

Poster: "*An interspike statistics-preserving simplified model for noisy FitzHugh-Nagumo neurons on a network*"

2024 INFN Iniziativa Specifica BioPhys Workshop
Sesto Fiorentino, Italy

Contributed talk: "*A simple model for delay stabilisation in nonlinear dissipative systems*"

2024 CSH Talk
Complexity Science Hub, Vienna, Austria

Title: "*Can mobility data be a proxy for sociality measures in an epidemiological context? What we learned in 3 years of monitoring COVID-19 in the Bologna metropolitan area.*"

2024 PhD and Early Researchers Workshop
Complexity Science Hub, Vienna, Austria

Contributed talk: "*Neurons, networks, loops and delay differential equations: what we have done so far and what are our goals*"

2023 INFN Iniziativa Specifica BioPhys Workshop
Rimini, Italia

Contributed talk: "*Stationary dynamical states in a directed neural network*"

2023 International Conference on Statistical Physics: SigmaPhi 2023
Chania, Greece

Contributed talk: "*Equivalence of solitonic solutions in a neuron chain and single neuron delay differential equations*"

2022 Conference on Complex Systems 2022
Palma de Mallorca, Spain

Contributed talk: "*Synchronisation Phenomena in Complex Neuronal Networks*"

2022 INFN Iniziativa Specifica BioPhys Workshop
Scuola Normale Superiore, Florence, Italy

Contributed talk: "*The Synchronisation Phase Transition in Networks of Model Neurons*"

PHD SCHOOLS

2022 Stochastic Forecasting in Complex Systems 2022
Ettore Majorana Foundation and Centre for Scientific Culture, Erice, Italy

2022 Mediterranean School of Complex Networks 2022
Catania, Italy

Contributed talk: "*Synchronisation Phenomena in Complex Neuronal Networks*"

2022 Statistical Physics of Deep Learning
Lake Como School of Advanced Studies, Como, Italy

VISITING PERIODS

Complexity Science Hub, Vienna
Medizinische Universität Wien, Vienna — Jan–May, Nov–Dec 2024

Visiting period working with Prof. Rudolf Hanel on topics of Dynamical Systems on Graphs with application to neural dynamics.

GRANTS

2023 Winner of a University of Bologna *Marco Polo* mobility funding grant for a research visit abroad.

CO-SUPERVISION OF M.SC. DISSERTATIONS

2025 M. Shqemza
Network theory and out of equilibrium statistical mechanics: a quantum density matrix approach

CO-SUPERVISION OF B.SC. DISSERTATIONS

2023 G. Sguera
Il modello di FitzHugh-Nagumo su network e sue applicazioni alla rivalità binoculare
English: *The FitzHugh-Nagumo model on a network and its applications to binocular rivalry*

2023 M. Bonacini
Applicazione della teoria del controllo: il pendolo invertito su rotaia
English: *Application of control theory: the inverted pendulum on a rail*

2022 M. Shqemza
Proprietà statistiche dell'apprendimento nella rete di Hopfield diluita
English: *Statistical properties of learning in the dilute Hopfield network*

2022 C. Zelco
Dynamical Models in Neuroscience: The Delay FitzHugh-Nagumo Equation

TEACHING EXPERIENCE

University of Bologna — Mar 2022–May 2024

Laboratory assistant

I have been a laboratory assistant in the Computer Programming laboratory of the programming course for the B.Sc. in Physics at the Department of Physics and Astronomy. My activities have been carried out mainly in the periods from March to April of 2022, April to May and September to December 2023 and May 2024.

OUTREACH EXPERIENCE

Università di Bologna, Campus di Rimini — Sep 2023

European Researchers Night

I have organized, with the rest of the research group and a B.Sc. thesis student, some outreach demonstrations on control theory and the synchronization of metronomes, with interactive experiments for the public of the event. I have also participated in a brief piece of video content showcasing one of the experiments, available on some of the University of Bologna outreach social media.

PERSONAL INTERESTS

Collegium Musicum Almae Matris — Nov 2017–Ongoing

Since 2017 I have actively participated in the music association of the University of Bologna, the Collegium Musicum Almae Matris. Within the association I have taken part in the activities of both a larger and a chamber choir as a singer, and I have played in the symphonic orchestra.
In collaboration with two other members of the association, I founded a wind band within the Collegium Musicum in October 2022 and coordinated its activities ever since. Amonth these activities I organized two international exchanges with university wind bands from Belgium and Austria, during 2025.
I have also been a member of the association Directive Council for a year, from June 2023 to June 2024, and currently am with the role of Vice-president since June 2025.