

# Mattia Sensi

Caritro postdoctoral fellow at Università degli Studi di Trento

Università degli Studi di Trento  
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## RESEARCH INTERESTS

Mathematical modelling, mathematical biology, mathematical epidemiology, dynamical systems, billiards, multiple time scales dynamics, Geometric Singular Perturbation Theory (GSPT), qualitative theory of ordinary differential equations, partial differential equations, integro-differential equations, delay differential equations.

## EDUCATION

<b>Ph.D. in Mathematics</b> , <i>cum laude</i> , Università degli Studi di Trento. Thesis: "A Geometric Singular Perturbation approach to epidemic compartmental models" Supervisor: Prof. Andrea Pugliese	November 2017 – January 2021
<b>M.Sc. in Mathematics</b> , Universiteit van Amsterdam. Thesis: "Homoclinic vegetation stripes in a Klausmeier-Gray-Scott model" Supervisor: Prof. Dr. Arjen Doelman	September 2015 – June 2017
<b>B.Sc. in Mathematics</b> , Università degli Studi di Padova. Thesis: "Portfolio optimization for quadratic utility function with partial information" Supervisor: Prof. Wolfgang J. Runggaldier	September 2011 – September 2014

## RESEARCH EXPERIENCE

<b>Postdoctoral researcher in Mathematics</b> , Università degli Studi di Trento. Caritro postdoctoral fellow in the group of Prof. Andrea Pugliese, researching the project "Modelli matematici di malattie infettive più ospiti e popolazioni eterogenee: applicazioni all'influenza aviaria" (Mathematical models of infectious disease spreading in multi-host and heterogeneous populations: applications avian flu).	March 2025 – present
<b>Postdoctoral researcher in Mathematics</b> , Politecnico di Torino. Postdoctoral researcher in the group of Prof. Andrea Tosin, as part of PRIN 2020 project "Integrated Mathematical Approaches to Socio-Epidemiological Dynamics" (No. 2020JLWP23, CUP: E15F21005420006).	March 2023 – February 2025
<b>Postdoctoral researcher in Mathematics</b> , Inria at Université Côte d'Azur. Postdoctoral researcher in the group MathNeuro, led by Prof. Mathieu Desroches.	December 2021 – February 2023
<b>Postdoctoral researcher in Mathematics</b> , TU Delft. Postdoctoral researcher in the group NAS, led by Prof. Piet Van Mieghem.	March – November 2021

## PUBLICATIONS

27. **L. Eigentler and M. S.**. *Wavelength selection for periodic travelling waves: an unsolved problem*. Bulletin of Mathematical Biology, Volume 88, article number 22, (2026)
26. **J. Borsotti and M. S.**. *A geometric analysis of the Bazykin-Berezovskaya predator-prey model with Allee effect in an economic framework*. Nonlinear Analysis: Real World Applications, Volume 89, June 2026, 104534
25. **E. Bernardi, T. Lorenzi, M. S. and A. Tosin**. *Heterogeneously structured compartmental models of epidemiological systems: from individual-level processes to population-scale dynamics*. Studies in Applied Mathematics 155, no. 2 (2025): 155, e70091
24. **A. Chizhov, L. Pujo-Menjouet, T. Schwalger and M. S.**. *A refractory density approach to a multi-scale SEIRS epidemic model*. Infectious Disease Modelling, 2025, 10(3), pp. 787–801
23. **M. A. Achterberg, M. S. and S. Sottile**. *A minimal model for multigroup adaptive SIS epidemics*. Chaos, 2025, 35(3), 033127
22. **L. Eigentler and M. S.**. *Delayed loss of stability of periodic travelling waves: insights from the analysis of essential spectra*. Journal of Theoretical Biology, 2024, 595, 111945
21. **I. M. Bulai, M. S. and S. Sottile**. *A geometric analysis of the SIRS compartmental model with fast information and misinformation spreading*. Chaos, Solitons and Fractals, 2024, 185, 115104
20. **P. Kaklamanos, A. Pugliese, M. S. and S. Sottile**. *A geometric analysis of the SIRS model with secondary infections*. SIAM Journal on Applied Mathematics, 2024, 84(2), pp. 661–686
19. **R. Persoons, M. S., B. Prasse and P. Van Mieghem**. *Transition from time-variant to static networks: Timescale separation in N-intertwined mean-field approximation of susceptible-infectious-susceptible epidemics*. Physical Review E, 2024, 109(3), 034308
18. **M. Adimy, A. Chekroun, L. Pujo-Menjouet and M. S.**. *A multigroup approach to delayed prion production*. Discrete and Continuous Dynamical Systems - Series B, 2024, 29(7), pp. 2972–2998
17. **M. S., M. Desroches and S. Rodrigues**. *Slow-fast dynamics in a neurotransmitter release model: delayed response to a time-dependent input signal*. Physica D: Nonlinear Phenomena, 2023, 455, 133887
16. **R. Della Marca, A. d'Onofrio, M. S. and S. Sottile**. *A geometric analysis of the impact of large but finite switching rates on vaccination evolutionary games*. Nonlinear Analysis: Real World Applications, 2024, 75, 103986
15. **N. Cangiotti, M. Capolli, M. S. and S. Sottile**. *A survey on Lyapunov functions for epidemic compartmental models*. Bollettino dell'Unione Matematica Italiana, 2024, 17(2), pp. 241–257
14. **P. Kaklamanos, C. Kuehn, N. Popovic and M. S.**. *Entry-exit functions in fast-slow systems with intersecting eigenvalues*. Journal of Dynamics and Differential Equations, 2025, 37(1), pp. 559–576, 103220
13. **N. Cangiotti, M. Capolli and M. S.**. *A generalization of unaimed fire Lanchester's model in multi-battle warfare*. Operational Research, 2023, 23(2), 38
12. **M. A. Achterberg and M. S.**. *A minimal model for adaptive SIS epidemics*. Nonlinear Dynamics, 2023, 111(13), pp. 12657–12670

11. S. Ottaviano, M. S. and S. Sottile. *Global stability of multi-group SAIRS epidemic models*. Mathematical Methods in the Applied Sciences, 2023, 46(13), pp. 14045–14071
10. N. Cangiotti and M. S.. *Exact solutions for a Solow-Swan model with non-constant returns to scale*. IJPAM, 2023, 54(4), pp. 1278–1285
9. S. Ottaviano, M. S. and S. Sottile. *Global stability of SAIRS epidemic models*. Nonlinear Analysis: Real World Applications, 2022, 65, 103501
8. S. Sottile, O. Kahramanogullari and M. S.. *How network properties and epidemic parameters influence stochastic SIR dynamics on scale-free random networks*. Journal of Simulation, 2024, 18(2), pp. 206–219
7. B. Chang, L. Yang, M. S., M. A. Achterberg, F. Wang, M. Rinaldi and P. Van Mieghem. *Markov Modulated Process to model human mobility*. Complex Networks & Their Applications X. Studies in Computational Intelligence, 2022, 1015, pp. 607–618
6. N. Cangiotti and M. S.. *Benford's Law: a Number-Theoretical Perspective*. PJM, 2022, 11(3), pp. 379–385
5. N. Cangiotti and M. S.. *A geometric characterization of VES and Kadiyala-type production functions*. Filomat, 2021, 35(5), pp. 1661–1670
4. N. Cangiotti and M. S.. *Notes on a conformal characterization of 2-dimensional Lorentzian manifolds with constant Ricci scalar curvature*. U.P.B. Sci. Bull., 2021, 83(2), pp. 129–136
3. T. Lorenzi, A. Pugliese, M. S. and A. Zardini. *Evolutionary dynamics in an SI epidemic model with phenotype-structured susceptible compartment*. Journal of Mathematical Biology, 2021, 83(6-7), 72
2. H. Jardón-Kojakhmetov, C. Kuehn, A. Pugliese and M. S.. *A geometric analysis of the SIRS epidemiological model on a homogeneous network*. Journal of Mathematical Biology, 2021, 83(4), 37
1. H. Jardón-Kojakhmetov, C. Kuehn, A. Pugliese and M. S.. *A geometric analysis of the SIR, SIRS and SIRWS epidemiological models*. Nonlinear Analysis: Real World Applications, 2021, 58, 103220

## PREPRINTS

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4. S. De Reggi, A. Pugliese, M. S., C. Soresina. *A model for mosquito-borne epidemic outbreaks with information-dependent protective behaviour*. Preprint on arXiv
3. A. Andò, N. Cangiotti and M. S.. *Exploring Exponential Runge-Kutta Methods: A Survey*. Preprint on arXiv
2. C. Oelen, B. Rink and M. S.. *Non-Birkhoff periodic orbits in symmetric billiards*. Preprint on arXiv, GitHub repository BilliardOrbitFinder
1. M. Aguiar, B. Kooi, A. Pugliese, M. S. and N. Stollenwerk. *Time scale separation in the vector borne disease model SIRUV via center manifold analysis*. Preprint on medRxiv

## GRANTS & AWARDS

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- **Progetti Giovani GNFM 2025** with the project “Analisi geometrica della diffusione spaziale di epidemie su più scale temporali” (Geometric analysis of the spatial diffusion of epidemics on multiple time scales), coordinated by Rossella Della Marca, from August 2025 to July 2026. Participant, 2000€
- **Caritro postdoctoral fellowship 2024** with the project “Modelli matematici di malattie infettive più ospiti e popolazioni eterogenee: applicazioni all'influenza aviaria” (Mathematical models of infectious disease spreading in multi-host and heterogeneous populations: applications to avian flu), from March 2025 to February 2027. Principal investigator, 85000€

## ASN (ITALIAN NATIONAL SCIENTIFIC QUALIFICATION)

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- ASN 2023/2025, Abilitazione Scientifica Nazionale alle funzioni di professore universitario di Seconda Fascia nel Settore Concorsuale 01/A3: Analisi Matematica, Probabilità e Statistica Matematica (Scientific Area 01/A3: Mathematical Analysis, Probability and Mathematical Statistics; qualification to become Associate Professor). From 28/02/2025 to 28/02/2037
- ASN 2023/2025, Abilitazione Scientifica Nazionale alle funzioni di professore universitario di Seconda Fascia nel Settore Concorsuale 01/A4: Fisica Matematica (Scientific Area 01/A4: Mathematical Physics; qualification to become Associate Professor). From 07/03/2025 to 07/03/2037

## TEACHING EXPERIENCE

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### At Università degli Studi di Trento:

- Teacher for the course *Analisi matematica 1*, for first year students of Bachelor's Degree in Industrial Engineering, September 2025 – February 2026
- Teacher for Ph.D. course “Advances in Mathematical Applications to Biology and Medicine: Stability analysis of dynamical systems in mathematical biology”, for first year Ph.D. students in Mathematics, June 2024
- Assistant teacher for Prof. Alberto Valli’s course *Analisi 1*, for first year students of Bachelor's Degree in Civil, Environmental and Mechanical Engineering, September 2018 – February 2019; September 2020 – February 2021; September – December 2022
- Tutor for Prof. Andrea Pugliese’s course *Probabilità e Statistica 2*, for second year students of Bachelor's Degree in Biotechnologies, February – May 2018

### At Politecnico di Torino:

- Assistant teacher for Prof. Luisa Mazzi’s course *Analisi 1*, for first year students of Bachelor's Degree in Aerospace Engineering, October 2023 – February 2024; September 2024 – February 2025

### At Inria – Université Côte d'Azur:

- Teacher of Mathematics for *Linear Algebra Bootcamp*, for first year students of Master's Degree in Computational Neuroscience, September – October 2022

## At Università Popolare Trentina (CFP-UPT):

- Teacher of Mathematics, October 2019 – June 2020

## At Universiteit van Amsterdam:

- Assistant teacher for Prof. Dr. Rob Stevenson's course *Numerieke Analyse*, for third year students of Bachelor's Degree in Mathematics, February – June 2017
- Assistant teacher for Dr. Han Peters' course *Wiskunde 3*, for third year students of Bachelor's Degree in Physics, November – December 2015

## Other:

- Private tutor for Camplus, Torino, May – June 2023
- Private tutor for WisMon / Bèta onderwijsinstituut, Amsterdam and Utrecht, April 2016 – June 2017
- Freelance private teacher of Mathematics and Physics, for high-school and university students, 2008 – present

## MENTORING

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### Master thesis:

- Brian Chang, February – June 2021. *Modeling the Spread of Epidemics*
- Liufei Yang, February – June 2021. *Developing a Markov-Modulated Process Model for Mobility Processes*

## VISITING PERIODS

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### Visiting postdoc:

- Lyon, France, 4 – 8 June 2023. At Inria Lyon, working with Laurent Pujo-Menjouet and Mostafa Adimy
- Trento, Italy, 5 – 8 December 2022; 27 – 31 March 2023. At University of Trento, working with Andrea Pugliese and Sara Sottile
- Amsterdam and Groningen, the Netherlands, 21 – 25 November 2022. At Vrije Universiteit Amsterdam and Rijksuniversiteit Groningen, working with Bob Rink and Hildeberto Jardón-Kojakhmetov

### Visiting Ph.D. student:

- München, Germany, 15 April – 15 June 2019. At Technische Universität München (TUM), working with Christian Kuehn and Hildeberto Jardón-Kojakhmetov

## COMMUNICATIONS

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**Invited speaker**, Biomath 2025, Sofia, Bulgaria.

15 – 20 June 2025

Title: "A general kinetic model for the spread of infectious diseases in continuously structured compartments"

**Invited speaker**, BIMSA Computational Math Seminar, Beijing.

22 May 2025

Title: "Geometric Singular Perturbation Theory in epidemic modelling: motivation and examples"

**Invited speaker**, CDLab, Udine.

1 April 2025

Title: "A general kinetic model for the spread of infectious diseases in continuously structured compartments"

**Invited speaker**, EPIMAT seminar, Trento.

11 March 2025

Title: "A general kinetic model for the spread of infectious diseases in continuously structured compartments"

**Invited speaker**, Numerical Aspects of Hyperbolic Balance Laws and Related Problems, Ferrara.

17 – 19 December 2024

Title: "A general kinetic model for the spread of infectious diseases in continuously structured compartments"

**Scientific committee**, Complex Networks 2024, Istanbul, Turkey.

10 – 12 December 2024

Member of the scientific committee which evaluates abstract and article submissions.

**Invited speaker**, MACBES team, Inria d'Université Côte d'Azur.

18 November 2024

Title: "Various approaches to the mathematical modelling of epidemics"

**Minisymposium organizer**, ECMTB 2024, Toledo.

22 – 26 July 2024

Minisymposium: "Travelling wave phenomena in biology"

**Invited speaker**, GIMC SIMAI YOUNG 2024, Napoli.

10 – 12 July 2024

Title: "A general kinetic model for the spread of infectious diseases in continuously structured compartments"

Part of the minisymposium "MS01 – Mathematical Models for Socio-Epidemiological Dynamics"

**Invited speaker**, Laboratoire de Mathématiques Appliquées du Havre.

2 May 2024

Title: "Various approaches to the mathematical modelling of epidemics"

**Invited speaker**, Integrated Mathematical approaches to Socio-Epidemiological Dynamics, Trento.

29 – 31 January 2024

Title: "A general kinetic model for the spread of infectious diseases in continuously structured compartments"

**Scientific committee**, Complex Networks 2023, Menton Riviera, France.

28 – 30 November 2023

Member of the scientific committee which evaluates abstract and article submissions.

**Poster presentation**, Special Semester on Mathematical Methods in Medicine, Linz, Austria.

30 October – 3 November 2023

Title: "A general kinetic model for the spread of infectious diseases in continuously structured compartments".

Part of workshop 1 "Epidemics modeling"

**Invited speaker**, SIMAI 2023, Matera.

28 August – 1 September 2023

Title: "A general kinetic model for the spread of infectious diseases in continuously structured compartments".

Part of the minisymposium "MS03: Recent Advances on the mathematical and numerical modeling of epidemics"

**Invited speaker**, Inria Lyon.

7 June 2023

Title: "Various approaches to the mathematical modelling of epidemics"

**Scientific committee**, FRCCS 2023, Le Havre.

31 May – 02 June 2023

Member of the scientific committee which evaluates abstract and article submissions.

**Contributed speaker**, Workshop MSE, Napoli.

18 – 19 May 2023

Title: "A geometric analysis of the SIRS model with secondary infections"

<b>Invited speaker</b> , University of Trento.	7 December 2022
<b>Mathematics Seminar</b> , title: "Delayed loss of stability in multiple time scale models of natural phenomena"	
<b>Invited speaker</b> , Rijksuniversiteit Groningen.	23 November 2022
<b>Floris Takens Seminar</b> , title: "Entry-exit functions in fast-slow systems with intersecting eigenvalues"	
<b>Invited speaker</b> , Vrije Universiteit Amsterdam.	21 November 2022
<b>Extra Dynamics Seminar</b> , title: "A Geometric Singular Perturbation approach to epidemic compartmental models"	
<b>Invited speaker</b> , University of Edinburgh.	14 October 2022
<b>Applied and Computational Mathematics</b> , title: "Delayed loss of stability in multiple time scale models of natural phenomena"	
<b>Minisymposium organizer and contributed speaker</b> , ECMTB 2022, Heidelberg.	19 – 23 September 2022
Title: "A generalization of the full SNARE-SM model".	
Minisymposium: "Recent advances in mathematical modelling in neuroscience"	
<b>Contributed speaker</b> , ENOC 2022, Lyon.	17 – 22 July 2022
Title: "Delayed loss of stability in multiple time scale models of natural phenomena".	
Part of the minisymposium "MS-05 Slow-Fast Systems and Phenomena"	
<b>Contributed speaker</b> , 100 UMI - 800 UniPD, Padova.	23 – 27 May 2022
Title: "A Geometric Singular Perturbation approach to epidemic compartmental models"	
<b>Seminar organizer</b> , Inria – Université Côte d'Azur.	April – September 2022
<b>MathNeuro seminars</b> , cycle of seminars on mathematical models in neuroscience	
<b>Invited speaker</b> , University of Edinburgh.	11 March 2022
<b>Edinburgh Dynamical Systems Study Group</b> , title: "Entry-exit functions: beyond eigenvalue separation"	
<b>Invited speaker</b> , University of Edinburgh.	18 June 2021
<b>Edinburgh Dynamical Systems Study Group</b> , title: "A Geometric Singular Perturbation approach to epidemic compartmental models"	
<b>Organizer, scientific committee and contributed speaker</b> , DSABNS 2020, Trento.	4 – 7 February 2020
Title: "A GSPT approach to epidemics on homogeneous graphs"	
<b>Invited speaker</b> , University of Trento.	12 September 2019
<b>Doc in Progress</b> , title: "An introduction to Geometric Singular Perturbation Theory"	
<b>Contributed speaker</b> , Edinburgh Slow-Fast-Ival, Edinburgh.	4 – 5 July 2019
Title: "A GSPT approach to perturbed SIR and SIRWS models"	
<b>Contributed speaker</b> , DSABNS 2019, Naples.	3 – 6 February 2019
Title: "A GSPT approach to perturbed SIR and SIRWS models"	
<b>Invited speaker</b> , Technische Universität München (TUM).	21 January 2019
<b>Oberseminar Dynamics</b> , title: "A GSPT approach to perturbed SIR and SIRWS models"	

## REVIEWING

### Journals:

- Advances in Difference Equations
- Applied Mathematical Modelling
- Bollettino dell'Unione Matematica Italiana
- Contemporary Mathematics
- Discrete and Continuous Dynamical Systems - Series B
- Epidemiologia
- International Journal of Biomathematics
- Journal of Biological Dynamics
- Journal of Biological Systems
- Journal of Complex Networks
- Journal of Mathematical Biology
- Mathematical Biosciences and Engineering
- Mathematical Methods in the Applied Sciences
- Mathematical Reviews
- Mathematics
- Mathematics and Computers in Simulation
- Nonlinear Analysis: Hybrid Systems
- Nonlinear Analysis: Real World Applications
- Nonlinear Dynamics
- Physica D: Nonlinear Phenomena
- Proceedings of the Royal Society A
- Qualitative Theory of Dynamical Systems
- Results in Applied Mathematics
- SIAM Journal on Applied Dynamical Systems (SIADS)

## ATTENDED CONFERENCES, SCHOOLS AND WORKSHOPS

<b>Selected participant</b> , Modeling, analysis, and control of multi-agent systems across scales, Pisa.	22 – 26 January 2024
<b>Selected participant</b> , NeuroMod Meeting 2022, Antibes.	30 June – 1 July 2022
<b>Selected participant</b> , MoDiS – Modelling Diffusive Systems: Theory & Biological Applications, Edinburgh.	6 – 9 September 2021
<b>Selected participant</b> , online Hausdorff School: Diffusive Systems, Bonn.	12 – 15 April 2021
<b>Selected participant</b> , Mathematical Biology on the Mediterranean Conference, Samos.	1 – 8 September 2019
<b>Selected participant</b> , Multiscale Phenomena in Geometry and Dynamics, München.	22 – 26 July 2019
<b>Selected participant</b> , Mathematics for BioMedicine, Rome.	8 – 11 October 2018
<b>Selected participant</b> , The Helsinki Summer School on Mathematical Ecology and Evolution 2018, Turku.	19 – 26 August 2018

## MEMBERSHIP AND COLLABORATIONS

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<b>GNFM – INdAM</b>	2025 – present
Member of the group <i>Gruppo Nazionale di Fisica Matematica</i> , of the <i>Istituto Nazionale di Alta Matematica</i>	
<b>EMS - TAG - MLS</b>	2024 – present
Member of the <i>EMS Topical Activity Group Mathematical Modelling in Life Sciences</i> (EMS - TAG - MLS) of the <i>European Mathematical Society</i>	
<b>ESMTB</b>	2024 – present
Member of the <i>European Society for Mathematical and Theoretical Biology</i> (ESMTB)	
<b>Collaborazioni Matematiche con il Sud Globale - UMI</b>	2024 – present
Member of the group <i>Collaborazioni Matematiche con il Sud Globale</i> (Mathematical Collaborations with the Global South) of the <i>Unione Matematica Italiana</i>	
<b>MSE - UMI</b>	2023 – present
Member of the group <i>Modellistica Socio-Epidemiologica</i> (Social-Epidemiological Modelling) of the <i>Unione Matematica Italiana</i>	
<b>CSSF</b>	2023 – present
Member of the <i>Complex Systems Society France</i>	
<b>Mathematical Epidemiology group, University of Trento</b>	2021 – present
Collaborator of the <i>Mathematical Epidemiology group</i> , University of Trento	
<b>GNAMPA – INdAM</b>	2017 – 2021
Member of the group <i>Gruppo Nazionale per l'Analisi Matematica, la Probabilità e le loro Applicazioni</i> , of the <i>Istituto Nazionale di Alta Matematica</i>	

## SOFTWARE

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L<sup>A</sup>T<sub>E</sub>X, Matlab, Wolfram Mathematica, Python, Microsoft Office tools.

## LANGUAGES

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Italian (mother tongue), English (C1), French (basic).