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, 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

Ph.D. in Mathematics, *cum laude*, Università degli Studi di Trento.   November 2017 – January 2021
Thesis: "A Geometric Singular Perturbation approach to epidemic compartmental models"
Supervisor: Prof. Andrea Pugliese

M.Sc. in Mathematics, Universiteit van Amsterdam.   September 2015 – June 2017
Thesis: "Homoclinic vegetation stripes in a Klausmeier-Gray-Scott model"
Supervisor: Prof. Dr. Arjen Doelman

B.Sc. in Mathematics, Università degli Studi di Padova.   September 2011 – September 2014
Thesis: "Portfolio optimization for quadratic utility function with partial information"
Supervisor: Prof. Wolfgang J. Runggaldier

RESEARCH EXPERIENCE

Postdoctoral researcher in Mathematics, Università degli Studi di Trento.   March 2025 – present
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).

Postdoctoral researcher in Mathematics, Politecnico di Torino.   March 2023 – February 2025
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).

Postdoctoral researcher in Mathematics, Inria at Université Côte d'Azur.   December 2021 – February 2023
Postdoctoral researcher in the group MathNeuro, led by Prof. Mathieu Desroches.

Postdoctoral researcher in Mathematics, TU Delft.   March – November 2021
Postdoctoral researcher in the group NAS, led by Prof. Piet Van Mieghem.

PUBLICATIONS

23. **M. A. Achterberg, M. S. and S. Sottile**. *A minimal model for multigroup adaptive SIS epidemics*. Accepted, to appear in Chaos. Preprint on arXiv

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, Volume 595, 7 December 2024, 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, Volume 185, August 2024, 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, Vol. 84, Iss. 2 (April 2024)

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*. Phys. Rev. E 109, 034308

18. **M. Adimy, A. Chekroun, L. Pujo-Menjouet and M. S.**. *A multigroup approach to delayed prion production*. Discrete and Continuous Dynamical Systems-B 29.7 (2024): 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, Volume 455, December 2023, 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, Volume 75, February 2024, 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 17.2 (2024): 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 (2023)

13. **N. Cangiotti, M. Capolli and M. S.**. *A generalization of unaimed fire Lanchester's model in multi-battle warfare*. Operational Research volume 23, Article number: 38 (2023)

12. **M. A. Achterberg and M. S.**. *A minimal model for adaptive SIS epidemics*. Nonlinear Dynamics 111.13 (2023): 12657-12670

11. **S. Ottaviano, M. S. and S. Sottile**. *Global stability of multi-group SAIRS epidemic models*. Mathematical Methods in the Applied Sciences, 46.13 (2023): 14045-14071

10. **N. Cangiotti and M. S.**. *Exact solutions for a Solow-Swan model with non-constant returns to scale*. IJPAM, Volume 54, pages 1278–1285 (2023)

9. **S. Ottaviano, M. S. and S. Sottile**. *Global stability of SAIRS epidemic models*. Nonlinear Analysis: Real World Applications, Volume 65, June 2022, 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 18.2 (2024): 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, vol 1015, p. 607-618, Springer (2022)

6. **N. Cangiotti and M. S.**. *Benford's Law: a Number-Theoretical Perspective*. PJM, Volume 11, No 3, 379-385 (2022)

5. **N. Cangiotti and M. S.**. *A geometric characterization of VES and Kadiyala-type production functions*. Filomat, Volume 35, No 5, 1661-1670 (2021)

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., Series A, Vol. 83, Iss. 2, 2021

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 83, 72 (2021)

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 83, 37 (2021)

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, Volume 58, April 2021, 103220

Preprints

2. **A. Chizhov, L. Pujo-Menjouet, T. Schwalger and M. S.**. *A refractory density approach to a multi-scale SEIRS epidemic model*. Preprint on arXiv

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

- 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)

- 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

At Università degli Studi di Trento:

- 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

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

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

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"*

Invited speaker, University of Trento.   7 December 2022
Mathematics Seminar, title: *"Delayed loss of stability in multiple time scale models of natural phenomena"*

Invited speaker, Rijksuniversiteit Groningen.   23 November 2022
Floris Takens Seminar, title: *"Entry-exit functions in fast-slow systems with intersecting eigenvalues"*

Invited speaker, Vrije Universiteit Amsterdam.   21 November 2022
Extra Dynamics Seminar, title: *"A Geometric Singular Perturbation approach to epidemic compartmental models"*

Invited speaker, University of Edinburgh.   14 October 2022
Applied and Computational Mathematics, title: *"Delayed loss of stability in multiple time scale models of natural phenomena"*

Minisymposium organizer and contributed speaker, ECMTB 2022, Heidelberg.   19 – 23 September 2022
Title: *"A generalization of the full SNARE-SM model"*.
Minisymposium: "Recent advances in mathematical modelling in neuroscience"

Contributed speaker, 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"

Contributed speaker, 100 UMI - 800 UniPD, Padova.   23 – 27 May 2022
Title: *"A Geometric Singular Perturbation approach to epidemic compartmental models"*

Seminar organizer, Inria – Université Côte d'Azur.   April – September 2022
MathNeuro seminars, cycle of seminars on mathematical models in neuroscience

Invited speaker, University of Edinburgh.   11 March 2022
Edinburgh Dynamical Systems Study Group, title: *"Entry-exit functions: beyond eigenvalue separation"*

Invited speaker, University of Edinburgh.   18 June 2021
Edinburgh Dynamical Systems Study Group, title: *"A Geometric Singular Perturbation approach to epidemic compartmental models"*

Organizer, scientific committee and contributed speaker, DSABNS 2020, Trento.   4 – 7 February 2020
Title: *"A GSPT approach to epidemics on homogeneous graphs"*

Invited speaker, University of Trento.   12 September 2019
Doc in Progress, title: *"An introduction to Geometric Singular Perturbation Theory"*

Contributed speaker, Edinburgh Slow-Fast-Ival, Edinburgh.   4 – 5 July 2019
Title: *"A GSPT approach to perturbed SIR and SIRWS models"*

Contributed speaker, DSABNS 2019, Naples.   3 – 6 February 2019
Title: *"A GSPT approach to perturbed SIR and SIRWS models"*
Invited speaker, Technische Universität München (TUM).   21 January 2019
Oberseminar Dynamics, title: *"A GSPT approach to perturbed SIR and SIRWS models"*

Reviewing

Journals:

- Advances in Difference Equations
- Applied Mathematical Modelling
- Contemporary Mathematics
- Epidemiologia
- International Journal of Biomathematics
- Journal of Biological Systems
- Journal of Complex Networks
- Journal of Mathematical Biology

- Mathematical Biosciences and Engineering
- Mathematical Methods in the Applied Sciences
- Mathematics
- Mathematics and Computers in Simulation
- Nonlinear Dynamics
- Physica D: Nonlinear Phenomena
- Results in Applied Mathematics
- SIADS

Attended conferences, schools and workshops

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

Membership and collaborations

GNFM – INdAM   2025 – present
Member of the group *Gruppo Nazionale di Fisica Matematica*, of the *Istituto Nazionale di Alta Matematica*

EMS - TAG - MLS   2024 – present
Member of the *EMS Topical Activity Group Mathematical Modelling in Life Sciences* (EMS - TAG - MLS) of the *European Mathematical Society*

ESMTB   2024 – present
Member of the *European Society for Mathematical and Theoretical Biology* (ESMTB)

Collaborazioni Matematiche con il Sud Globale - UMI   2024 – present
Member of the group *Collaborazioni Matematiche con il Sud Globale* (Mathematical Collaborations with the Global South) of the *Unione Matematica Italiana*

MSE - UMI   2023 – present
Member of the group *Modellistica Socio-Epidemiologica* (Social-Epidemiological Modelling) of the *Unione Matematica Italiana*

CSSF   2023 – present
Member of the *Complex Systems Society France*

Mathematical Epidemiology group, University of Trento   2021 – present
Collaborator of the *Mathematical Epidemiology group*, University of Trento

GNAMPA – INdAM   2017 – 2021
Member of the group *Gruppo Nazionale per l'Analisi Matematica, la Probabilità e le loro Applicazioni*, of the *Istituto Nazionale di Alta Matematica*

Software

LaTeX, Matlab, Wolfram Mathematica, Python, Microsoft Office tools.

Languages

Italian (mother tongue), English (C1).