

Mattia Sensi

Postdoctoral researcher at Politecnico di Torino

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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**, Politecnico di Torino. March 2023 – present
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**, TUDelft. March – November 2021
Postdoctoral researcher in the group [NAS](#), led by [Prof. Piet Van Mieghem](#).

PUBLICATIONS

19. **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
18. **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)
17. **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
16. **M. Adimy, A. Chekroun, L. Pujo-Menjouet and M. S.**. *A multigroup approach to delayed prion production*. Discrete and Continuous Dynamical Systems - B (2023)
15. **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
14. **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
13. **N. Cangiotti, M. Capolli, M. S. and S. Sottile**. *A survey on Lyapunov functions for epidemic compartmental models*. Bollettino dell’Unione Matematica Italiana (2023)
12. **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)
11. **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)
10. **M. A. Achterberg and M. S.**. *A minimal model for adaptive SIS epidemics*. Nonlinear Dynamics (2023)
9. **S. Ottaviano, M. S. and S. Sottile**. *Global stability of multi-group SAIRS epidemic models*. Mathematical Methods in the Applied Sciences (2023), 1–27
8. **S. Ottaviano, M. S. and S. Sottile**. *Global stability of SAIRS epidemic models*. Nonlinear Analysis: Real World Applications, Volume 65, June 2022, 103501
7. **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, Volume 16, Issue 4 (2022)
6. **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, Springer (2022)
5. **N. Cangiotti and M. S.**. *A geometric characterization of VES and Kadiyala-type production functions*. Filomat, Volume 35, No 5 (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

3. **A. Chizhov, L. Pujo-Menjouet, T. Schwalger and M. S.**. *A refractory density approach to a multi-scale SEIRS epidemic model*. [Preprint on arXiv](#)
2. **L. Eigentler and M. S.**. *Delayed loss of stability of periodic travelling waves: insights from the analysis of essential spectra*. [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](#)

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

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, [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. 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”	28 August – 1 September 2023
Invited speaker , Inria Lyon. Title: “Various approaches to the mathematical modelling of epidemics”	7 June 2023
Scientific committee , FRCCS 2023 , Le Havre. Member of the scientific committee which evaluates abstract and article submissions.	31 May – 02 June 2023
Contributed speaker , Workshop MSE , Napoli. Title: “A geometric analysis of the SIRS model with secondary infections”	18 – 19 May 2023
Invited speaker , University of Trento. Mathematics Seminar , title: “Delayed loss of stability in multiple time scale models of natural phenomena”	7 December 2022
Invited speaker , Rijksuniversiteit Groningen. Floris Takens Seminar , title: “Entry-exit functions in fast-slow systems with intersecting eigenvalues”	23 November 2022
Invited speaker , Vrije Universiteit Amsterdam. Extra Dynamics Seminar , title: “A Geometric Singular Perturbation approach to epidemic compartmental models”	21 November 2022
Invited speaker , University of Edinburgh. Applied and Computational Mathematics , title: “Delayed loss of stability in multiple time scale models of natural phenomena”	14 October 2022
Minisymposium organizer and contributed speaker , ECMTB 2022 , Heidelberg. Title: “A generalization of the full SNARE-SM model”. Minisymposium: “Recent advances in mathematical modelling in neuroscience”	19 – 23 September 2022
Contributed speaker , ENOC 2022 , Lyon. Title: “Delayed loss of stability in multiple time scale models of natural phenomena”. Part of the minisymposium “MS-05 Slow-Fast Systems and Phenomena”	17 – 22 July 2022
Contributed speaker , 100 UMI - 800 UniPD , Padova. Title: “A Geometric Singular Perturbation approach to epidemic compartmental models”	23 – 27 May 2022
Seminar organizer , Inria – Université Côte d’Azur. MathNeuro seminars , cycle of seminars on mathematical models in neuroscience	April – September 2022
Invited speaker , University of Edinburgh. Edinburgh Dynamical Systems Study Group , title: “Entry-exit functions: beyond eigenvalue separation”	11 March 2022
Invited speaker , University of Edinburgh. Edinburgh Dynamical Systems Study Group , title: “A Geometric Singular Perturbation approach to epidemic compartmental models”	18 June 2021
Organizer, scientific committee and contributed speaker , DSABNS 2020 , Trento. Title: “A GSPT approach to epidemics on homogeneous graphs”	4 – 7 February 2020
Invited speaker , University of Trento. Doc in Progress , title: “An introduction to Geometric Singular Perturbation Theory”	12 September 2019
Contributed speaker , Edinburgh Slow-Fast-Ival , Edinburgh. Title: “A GSPT approach to perturbed SIR and SIRWS models”	4 – 5 July 2019
Contributed speaker , DSABNS 2019 , Naples. Title: “A GSPT approach to perturbed SIR and SIRWS models”	3 – 6 February 2019
Invited speaker , Technische Universität München (TUM). Oberseminar Dynamics , title: “A GSPT approach to perturbed SIR and SIRWS models”	21 January 2019

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](#)
- [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

ESMTB

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

2024 – present

Collaborazioni Matematiche con il Sud Globale - UMI

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

2024 – present

MSE - UMI

Member of the group *Modellistica Socio-Epidemiologica* (Social-Epidemiological Modelling) of the *Unione Matematica Italiana*

2023 – present

CSSF

Member of the *Complex Systems Society France*

2023 – present

Mathematical Epidemiology group, University of Trento

External collaborator of the *Mathematical Epidemiology group*, University of Trento

2021 – present

GNAMPA – INdAM

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

2017 – 2021

SOFTWARE

L^AT_EX, Matlab, Wolfram Mathematica, Python, Microsoft Office tools.

LANGUAGES

Italian (mother tongue), English (C1).