Giacomo Albi

Curriculum Vitae

Office: Strada Le Grazie 15, Ca Vignal 2
Verona, Italy 37134
✉ *giacomo.albi@univr.it*

Personal Data

Born	22/02/1985
Citizenship	Italian

Employments

Current

11/2022–now	Associate Professor (G.S.D. 01/MATH-05/A - Numerical Analysis) at Department of Computer Science, University of Verona

Previous

11/2019 – 11/2022	Assistant Professor (RTDb S.C. 01/A5 - S.S.D. MAT/08, Numerical Analysis) at Department of Computer Science, University of Verona
05/2017– 11/2019	Assistant Professor (RTDa S.C. 01/A5 - S.S.D. MAT/08, Numerical Analysis) at Department of Computer Science, University of Verona
05/2014– 03/2017	Postdoc at Technische Universität München (TUM), Fakultät für Mathematik, within "ERC project: High-Dimensional Sparse Optimal Control" (Responsible, M. Fornasier).

Education

2014 **Ph.D. in Mathematics and Computer Science**, *03/03/2014, with honors*, University of Ferrara,
Thesis: Kinetic approximation, stability and control of collective behavior in self-organized systems (Prize INdAM-SIMAI-UMI 2017).
Advisor: Prof. Lorenzo Pareschi.

2010 **Master in Mathematics**, *18/02/2010*, University of Padova,
Thesis: Law of large numbers and fluctuations for the random Curie-Weiss model.
Tutor: Prof. Paolo Dai Pra.

2007 **Bachelor in Mathematics**, *19/09/2007*, University of Trento,
Thesis: Finite-Difference method for pay-off options with discontinuous barrier.
Tutor: Prof. Aldo Tagliani.

Prizes & Recognitions

2023 *ASN*: National qualification to the role of Full Professor in Numerical Analysis S.C. 01/A5 - S.S.D. MAT/08: 30/01/2023-30/01/2034.

2018 *ASN*: National qualification to the role of Associate Professor in Numerical Analysis S.C. 01/A5 - S.S.D. MAT/08: 31/08/2018-31/08/2024.

2017 Prize INdAM-SIMAI-UMI 2017 for the *Best PhD thesis in Applied Mathematics*.

2015 Award for the *Best PhD thesis for the XXVI cicle* University of Ferrara.

2014 *Nicolò Copernico recognition* for innovative PhD thesis in science and technology.

Research interests

My main research interests are focused on the development of numerical methods for evolutionary equations in the field of kinetic theory, hyperbolic-balance laws, and optimal control problems. In particular, I am interested in: high-order time integrator techniques, and structure preserving schemes for hyperbolic system with relaxation terms, development of efficient algorithms, such as stochastic and iterative methods for high-dimensional problems like Boltzmann-type, and mean-field equations.

Applications of these methods range from the equations of statistical physics, to biological processes, up to the description of multi-agent systems in socio-economic modelling and optimization.

Keywords Numerical analysis, Boltzmann equation, multi-agent systems, optimal control, Monte-Carlo methods, uncertainty quantification, mathematical modeling, hyperbolic systems, Asymptotic Preserving schemes, IMEX schemes.

Scientific Groups Gruppo Nazionale Calcolo Scientifico, (GNCS-INdAM); Società Italian Matematica Applicata e Industriale (SIMAI), Unione Matematica Italiana (UMI).

Computer skills

Standard C, C++, Python, Fortran, R, Maple, Html, Excel, Office.

Advanced MATLAB, Mathematica, Freefem++, LaTeX.

Known languages

Italian	Mothertounge
English	Advanced
German	Intermediate

Research publications, projects and seminars

Publications

Articles accepted in referred journals

32 *Impact of opinion formation phenomena in epidemic dynamics: kinetic modeling on networks* , G. Albi, E. Calzola, G. Dimarco, M. Zanella, SIAM Journal of Applied Mathematics, accepted, 2025

31 *Instantaneous control strategies for magnetically confined fusion plasma* , G. Albi, G. Dimarco, F. Ferrarese, L. Pareschi, Journal of Computational Physics, accepted, 2025.

30 *Exponential integrators for mean-field selective optimal control problems* , G. Albi, M. Caliari, E. Calzola, F. Cassini, Journal of Approximation Software, 1 (2), 1-21, 2024. WEB: ojs.unito.it/index.php/JAS/article/view/10973

29 *Kinetic Description of Swarming Dynamics with Topological Interaction and Transient Leaders*, G. Albi, F. Ferrarese, Multiscale Modeling & Simulation, 22(3), 1169-1195, 2024. DOI: 10.1137/23M1588615

28 *A data-driven kinetic model for opinion dynamics with social network contacts*, G. Albi, E. Calzola, G. Dimarco, European Journal of Applied Mathematics, 1-27, 2024. DOI: 10.1017/S0956792524000068

27 *Robust feedback stabilization of interacting multi-agent systems under uncertainty*, G. Albi, M. Herty, C. Segala. Applied Mathematics & Optimization, 89(1), 16, 2024. DOI:10.1007/s00245-023-10078-2

26 *Kinetic based optimization enhanced by genetic dynamics*, G. Albi, F. Ferrarese, C. Totzeck, Math. Models Methods Appl. Sci., 33(14), 2905–2933, 2023. DOI: 10.1142/S0218202523500641

25 *Efficient stochastic algorithms for agent-based models with predator-prey dynamics*, G. Albi, R. Chignola, F. Ferrarese, Mathematics and Computers in Simulation, 199, 317–340 DOI: 10.1016/j.matcom.2022.03.019

24 *Moment-driven predictive control of mean-field collective dynamics*, G. Albi, M. Herty, D. Kalise, C. Segala, SIAM journal on Control and Optimization, 60(2), 814–841, 2022. DOI: 10.1137/21M1391559

23 *Mean-field selective optimal control via transient leadership*, G. Albi, S. Almi, M. Morandotti, F. Solombrino, Applied Mathematics & Optimization, 85 (9), 1-44, 2022. DOI: 10.1007/s00245-022-09837-4.

22 *Gradient-augmented Supervised Learning of Optimal Feedback Laws Using State-dependent Riccati Equations*, G. Albi, S. Bicego, D. Kalise, IEEE Control Systems Letters, 6 pp. 836–841, 2022. DOI: 10.1109/LCSYS.2021.3086697.

21 *Modelling lockdown measures in epidemic outbreaks using selective socio-economic containment with uncertainty*, G. Albi, L. Pareschi, M. Zanella. Mathematical Biosciences and Engineering, Volume 18, Issue 6, Pages 7161 - 7190. 2021.

20 *Control with uncertain data of socially structured compartmental epidemic models*, G. Albi, L. Pareschi, M. Zanella, Journal of Mathematical Biology 82.7 1-41. 2021. DOI: 10.1007/s00285-021-01617-y

19 *High order semi-implicit multistep methods for time dependent partial differential equations*, G. Albi, L. Pareschi, Communications on Applied Mathematics and Computation 1-18, 2021. DOI: 10.1007/s42967-020-00110-5

18 *Implicit-Explicit multistep methods for hyperbolic systems with multiscale relaxation*, G. Albi, G. Dimarco, L. Pareschi, SIAM Journal on Scientific Computing 42.4, A2402-A243, 2020. DOI: 10.1137/19M1303290.

17 Linear multistep methods for optimal control problems and applications to hyperbolic relaxation systems G. Albi, M. Herty, L. Pareschi, App. Math. & Comp. 354, pp. 460-477, 2019. DOI: 10.1016/j.amc.2019.02.021.

16 Boltzmann Games in Heterogeneous Consensus Dynamics G. Albi, L. Pareschi, M. Zanella, J. of Stat. Phys. 175(1), pp. 97-125, 2019. DOI: 10.1007/s10955-019-02246-y.

15 *Vehicular traffic, crowds, and swarms. From kinetic theory and multiscale methods to applications and research perspectives.*, G. Albi, N. Bellomo, L. Fermo, S.-Y. Ha, J. Kim, L. Pareschi, D. Poyato and J. Soler, Math. Models Methods Appl. Sci., Vol. 29, No. 10, pp. 1901-2005, 2019. DOI: 10.1142/S0218202519500374.

14 *Leader formation with mean-field birth and death models*, G. Albi, F. Rossi, F. Solombrino, Math. Models Methods Appl. Sci., 29(4), pp. 633-679, 2019. DOI: 10.1142/S0218202519400025.

13 *Selective model-predictive control for flocking systems*, G. Albi, L. Pareschi, Comm. in App. and Ind. Math. 9(2), pp. 4-21, 2018. DOI: 10.2478/caim-2018-0009.

12 *Pressureless Euler alignment with control*, G. Albi, Y-P. Choi., A-S. Häck, Math. Models Methods Appl. Sci., 28 (09), pp. 1635-1664, 2018. DOI: 10.1142/S0218202518400018.

11 *Mean field control hierarchy*, G. Albi, Y-P. Choi, M. Fornasier, D. Kalise, App. Math. Optim.,76(1):93-135, 2017. DOI: 10.1007/s00245-017-9429-x

10 *Opinion dynamics over complex networks: kinetic modeling and numerical methods*, G. Albi, L. Pareschi, M. Zanella, Kin. Rel. Med., 10(1): 1-32, 2017. DOI: 10.3934/krm.2017001.

9 *Biological transportation network: modeling and simulation*, G. Albi, M. Artina, M. Fornasier, P. A. Markovich, Analysis and Applications, 14(01), pp. 185-206, 2016. DOI: 10.1142/S0219530515400059.

8 *Invisible control of self-organizing agents leaving unknown environments*, G. Albi, M. Bongini, E. Cristiani, D. Kalise, SIAM J. Appl. Math., 76(4), 1683 - 1710, 2016. DOI: 10.1137/15M1017016.

7 *Uncertainty quantification in control problems for flocking models*, G. Albi, L. Pareschi, M. Zanella, Mathematical Problems in Engineer, 2015. DOI: 10.1155/2015/850124.

6 *Kinetic description of optimal control problems and applications to opinion consensus*, G. Albi, M. Herty, L. Pareschi, Comm. Math. Scien.,13(6), pp. 1407-1429, 2015. DOI: 10.4310/CMS.2015.v13.n6.a3

5 *Boltzmann type control of opinion consensus through leaders*, G. Albi, L. Pareschi, M. Zanella, Proc. of the Roy. Soc. A., 372(2028), 2014. DOI: 10.1098/rsta.2014.0138.

4 *Stability analysis of flock and mill rings for 2nd order models in swarming*, G. Albi, D. Balagué, J. A. Carrillo, J. von Brecht, SIAM J. Appl. Math., 74(3), pp. 794-818, 2014. DOI: 10.1137/13091779X.

3 *Asymptotic Preserving time-discretization of optimal control problems for the Goldstein–Taylor model*, G. Albi, M. Herty, C. Jörres, L. Pareschi, Numer. Meth. Partial Diff. Equations, 30(6), 1770-1784, 2014. DOI: 10.1002/num.21877.

2 *Binary interaction algorithms for the simulation of flocking and swarming dynamics*. G. Albi, L. Pareschi. SIAM Multiscale Model. Simul., 11(1), pp. 1-29, 2013. DOI: 10.1137/120868748.

1 *Modeling self-organized systems interacting with few individuals: from microscopic to macroscopic dynamics*. G. Albi, L. Pareschi, App. Math. Lett., 26, pp. 397-401, 2013. DOI: 10.1016/j.aml.2012.10.011.

Articles in books

5 *Kinetic modelling of epidemic dynamics: social contacts, control with uncertain data, and multiscale spatial dynamics.*, G. Albi, G. Bertaglia, W. Boscheri, G. Dimarco, L. Pareschi, G. Toscani, M. Zanella, In: Predicting Pandemics in a Globally Connected World, Volume 1: Toward a Multiscale, Multidisciplinary Framework through Modeling and Simulation. Cham: Springer International Publishing, p. 43-108, 2022. DOI: 10.1007/978-3-030-96562-4_3

4 *Optimized leaders strategies for crowd evacuation in unknown environments with multiple exits.*, G. Albi, F. Ferrarese, C. Segala, in L. Gibelli, editor, Crowd Dynamics Volume 3 - Theory, Models, and Applications. Birkhauser-Springer, pp. 97–13,1 2022, DOI: https://doi.org/10.1007/978-3-030-91646-6_5

3 *Mathematical models and methods for crowd dynamics control.*, G. Albi, E. Cristiani, L. Pareschi, D. Peri, in L. Gibelli, editor, Crowd Dynamics Volume 2 - Theory, Models, and Applications. Birkhauser-Springer, 2020. DOI: https://doi.org/10.1007/978-3-030-50450-2_8

2 *Recent advances in opinion modeling: control and social influence.*, G. Albi, L. Pareschi, G. Toscani, M. Zanella, in N. Bellomo, P. Degond, and E. Tadmor, editors, Active Particles Volume 1, Theory, Methods, and Applications. Birkhauser-Springer, 2016. DOI: 10.1007/978-3-319-49996-3_2.

1 *Continuum Modeling of Biological Network Formation.*, G. Albi, M. Burger, J. Haskovec, P. A. Markowich, M. Schlottbom, in N. Bellomo, P. Degond, and E. Tadmor, editors, Active Particles Volume 1, Theory, Methods, and Applications. Birkhauser-Springer, 2016. DOI: 10.1007/978-3-319-49996-3_1.

Conference proceedings

5 *Supervised learning for kinetic consensus control*, G. Albi, S. Bicego, D. Kalise, IFAC-PapersOnLine 55(30), pp. 103-108, 2022. DOI: 10.1016/j.ifacol.2022.11.036.

4 *Relaxation approximation of optimal control problems and applications to traffic flow models*, G. Albi, M. Herty, L. Pareschi, AIP Conference Proceedings 1975, 020001, 2018. DOI: 10.1063/1.5042169.

3 *(Sub)Optimal feedback control of mean-field multi-population dynamics: a Boltzmann-Bellman approach*, G. Albi, D. Kalise, IFAC-PapersOnLine 51(3), pp. 86-91, 2018. DOI: 10.1016/j.ifacol.2018.06.020.

2 *A Boltzmann approach to mean-field sparse feedback control*, G. Albi, M. Fornasier, D. Kalise, IFAC-PapersOnLine 50(1), pp. 2898-2903, 2017. DOI: 10.1016/j.ifacol.2017.08.646.

1 *On the optimal control of opinion dynamics on evolving networks*, G. Albi, L. Pareschi, M. Zanella, in IFIP TC7 2015 proceedings. DOI:10.1007/978-3-319-55795-3_4.

Books

2 *Advances in Numerical Methods for Hyperbolic Balance Laws and Related Problems* , G. Albi, W. Boscheri and M. Zanella editors, SEMA-SEMAI, 2023. DOI: 10.1007/978-3-031-29875-2

1 *Trails in Kinetic Theory Foundational Aspects and Numerical Methods* , G. Albi, S. Merino, A. Nota and M. Zanella editors, SEMA-SEMAI, 2021. DOI: 10.1007/978-3-030-67104-4

Preprints

2 *Control of high-dimensional collective dynamics by deep neural feedback laws and kinetic modelling* , G. Albi,S. Bicego, D. Kalise, 2024, preprint arXiv:2404.02825

1 *Data/moment-driven approaches for fast predictive control of collective dynamics* , G. Albi,S. Bicego,M. Herty, Y. Huang, D. Kalise, C. Segala, 2024, preprint arXiv:2402.15611.

Total: 46 Documents (2 Preprints, 32 Articles, 5 Chapters, 5 Proceedings, 2 Books).

Bibliometric indexes (01/02/2025)

	Publications	h-index	Citations
Mathschinet	30	15	667
Scopus	41	17	1166
GScholar	44	23	1768

Dissemination & outreach

4 *Manuale per un leader: Strategie matematiche di controllo dell'opinione pubblica*. Gli Stati Generali, May 2015.

3 *L'effetto gregge esisite*. Le Scienze. May 2015.

2 *Effetto gregge e controllo di folle*. MaddMaths, June 2015.

1 *Laboratorio di dinamiche socio-economiche* , activities for high-school students within "Progetto Lauree Scientifiche" (PLS) [web], since 2012.

Research projects

Coordination of research projects

2023 - Project PRIN PNRR 2022: *Data-driven discovery and control of multi-scale interacting artificial agent systems*, (total: 224775 €, Verona unit: 97125 €) (role: PI).

- Project PRIN 2022: *Efficient numerical schemes and optimal control methods for time-dependent partial differential equations*. (total: 214683 €, Verona unit: total: 66923 €) (role: local coordinator, co-PI), Responsable: Prof. Walter Boscheri.

2019 - Project PRIN 2017: *Innovative numerical methods for evolutionary partial differential equations and applications*. (total: 533540 €, Verona Unit: 76500 €) (role: local coordinator), Responsable: Prof. Giovanni Russo.

2018 - Project GNCS-INDAM 2018: *Metodi Numerici per problemi di controllo multiscala*. (total: 5000 €) (role: PI)

2012 - Young Researchers Grant University of Ferrara: *Differential equations and collective behavior with applications to social, economics and natural sciences*. (total: 3500 €) .

Participation in research projects

2020 RIBA University of Verona: *Geometric evolution of multi-agent system*. Responsable: Prof. Marco Caliari.

2019 Project GNCS-INDAM 2019: *Approssimazione numerica di problemi di natura iperbolica e applicazioni*.
Responsable: Prof. Elisabetta Carlini.

2014-2017 ERC-Starting Grant: *High-Dimensional Sparse Optimal Control*.
Responsable: Prof. Massimo Fornasier.

2013 Project GNCS-INDAM:*Hyperbolic dominated multi-scale problems: numerical methods and applications*.
Responsable: Dr. Matteo Semplice.

2010-2012 Bilateral project Italy–Germany Vigoni: *Adjoint IMEX methods for the numerical solution to optimization problems*.
Responsables: Prof. Lorenzo Pareschi and Prof. Michael Herty.

2011-2013 PRIN: *High-order numerical methods for systems of balance laws with sources in fluid-dynamics*.
Responsable: Prof. Lorenzo Pareschi.

Organization of scientific meetings

2024 - Conference: "Numerical aspects of hyperbolic balance laws and related problems" - Young Researcher Conference, 17-19/12, Ferrara, Italy, (Organizer).

- Kick-off meeting: "Data-driven discovery and control of multi-scale interacting artificial agent systems", 4-5 April, Verona, Italy, (Organizer).
- Workshop: "Modeling, analysis, and control of multi-agent systems across scales"- 21-26/01, Centro De Giorgi, Pisa, Italy, (Organizer).

2023 - Workshop "Geometric Evolution of Multi Agent Systems" 20/12, Verona, Italy, (Organizer).

2022 - 35th ECMI Modelling Week - 03-09/07, Verona, Italy, (Organizer).

- One day– Young Researchers Seminars, Maths Applications & Models" 8/07, Verona, Italy.(Organizer).

2021 - Conference: "Numerical aspects of hyperbolic balance laws and related problems" - Young Researcher Conference, 15-17/12, Verona, Italy, (Organizer).

2020 - Electronic Workshop:"Collective Models, Control and Uncertainty Quantification for Infectious Diseases and Related Problems", 04/04 - Online (Organizer).

2019 - Minisymposium: "Novel Concepts in Model-driven Optimization and Control of Agent-based Systems", 15-19/07 ICIAM 2019 Valencia, Spain, (MS Organizer).

- Summer School: "Trails in Kinetic Theory: theoretical aspects and numerical methods", 20-25/05, HIM Bonn, Germany, (Organizer).

2018 - Winter School: "From Interacting Particle Systems to Kinetic equations", 26-30/11, Verona, Italy, (Organizer).

- Conference: "Numerical aspects of hyperbolic balance laws and related problems", 26-30/04, Ferrara, Italy, (Organizer).

2016 - Minisymposium: "Recent developments in numerical methods for HJB and Multi-agent systems", WONAPDE 2016, Fifth Chilean Workshop on Numerical Analysis of Partial Differential Equations, 11 - 15/01 Universidad de Concepcion, Concepcion, Chile. (MS Organizer).

2015 - Minisymposium: "Mean-field modeling and control of multi-agents systems", 13th Viennese Workshop on Optimal Control and Games, 13-16/05,Vienna, Austria. (MS Organizer)

2012 - Conference: "Numerical aspects of hyperbolic balance laws and related problems", 3-4/04, Ferrara, Italy. (Organizer).

Invited communications

2025 - *Robust control strategies in magnetic confined fusion plasma*, "3C Conference: Challenges in Computational methods for Complex environmental applications", 21-23 /05, Chambery, France (Invited speaker).

- *Multiscale linear multistep methods for transport and control problem*, "Efficient high-order time discretization methods for PDEs", 12-17 /05, Capri, Italy (Invited speaker).
- *Controlling high-dimensional particle systems with supervised machine learning*, "Mathematics for Machine Learning: Applications to PDEs and Related Fields", 23-26 /03, Ferrara, Italy (Invited speaker).

2024 - *Controlling high-dimensional particle systems in magnetically confined fusion plasma*, "Mini-Workshop: High-Dimensional Control Problems and Mean-Field Equations with Applications in Machine Learning", 9-13 /12, Oberwolfach, Germany (Invited speaker).

- *Impact of opinion formation phenomena in epidemic dynamics: kinetic modeling on networks* , "Novel perspectives on continuous opinion formation models & related topics, 11-12/11, Pavia, Italy (Invited speaker).
- *High order multi-step methods for time dependent partial differential equations*, "Innovations in the Numerical Treatment of Stiff Differential Equations", 19-22/02, Roma, Italy. (Invited speaker).
- *Instantaneous control of Vlasov-Poisson system via magnetic confinement*, "New Trends in Optimal Control", 15-17 /05, Venice, Italy. (Invited speaker).
- *High order multi-step methods for time dependent partial differential equations*, "Innovations in the Numerical Treatment of Stiff Differential Equations", 19-22/02, Roma, Italy. (Invited speaker).

2023 - *Supervised learning for high-dimensional mean-field optimal control problems*, "Control Methods in Hyperbolic Partial Differential Equations", 5-10/09, Oberwolfwach,Germany. (Invited speaker).

- *Supervised learning for high-dimensional mean-field optimal control problems*, "Numerical aspects of hyperbolic balance laws and related problems, 19-23/06, Cortona, Italy. (Invited speaker).
- *Data-driven kinetic model for opinion dynamics and contacts*, "Mathematical Challenges in Social Systems and Applications to Public Health", 9-12/05, Buenos Aires, Argentina. (Invited speaker).
- *Machine learning for mean-field optimal control problems*, "Innovative Numerical Methods for Evolutionary Partial Differential Equations and Application", 18–22/02, Catania, Italy. (Invited speaker).

2022 - *Control and optimization of interacting multi-agent systems across scales*, " Mathematical Models in Social Innovation Blended Intensive Program", September 5 - 10, 2022 L'Aquila, Italy. (Invited speaker).

- *Kinetic approximation for mean-field control problems*, "Theoretical and Numerical Trends in Inverse Problems and Control for PDEs, and Hamilton-Jacobi Equation: a French-Italian-Japanese Conference", CIRM, Luminy - Marseille, France June 13-17, 2022. (Invited speaker).
- *Multistep methods for hyperbolic systems with relaxation and optimal control problems* "Frontiers in numerical analysis of kinetic equations", May 22-27, 2022, INI Institute, Cambdrige University, UK (Invited speaker).

2021 - *Kinetic approximation for optimal control of collective behavior*, Workshop and Summer School on Kinetic Theory and Related Applications, Computational Science Research Center, Beijing, China, June 28-July 10, 2021. (Invited speaker).

- *Kinetic approximation for optimal control of collective behavior*, Control Methods in Hyperbolic Differential Equations 19-23/08. (Invited speaker).

2019 - *Kinetic control of emergent behavior*, Recent Advances in Nonlocal Kinetic, Fluid and Diffusive PDEs, Jeju, South Korea 19-23/08. (Invited speaker).

- *Boltzmann-type control in multi-agent systems*, Workshop in Control Theory and applications, GSSI L'Aquila, Italy 28-29/03. (Invited speaker).
- *Boltzmann-type optimal control problems*, Sussex University, 24-26/03 (Invited seminar).

2018 - *Boltzmann game in heterogeneous consensus dynamics*, Recent Trends in Kinetic Modelling and Related Fields, 25-26/10, Torino, Italy. (Invited speaker).

- *Multistep methods in hyperbolic systems with relaxation*, Interactive workshop on hyperbolic equations (WIDEI), Ferrara, 10-12/09, 2018. (Invited speaker).
- *Boltzmann-type optimal control problems*, Workshop on Kinetic Theory for Control, Games and Uncertainty, Aachen, 15-16/05, 2018. (Invited speaker).
- *Numerical methods for optimal control in multiscale differential problems*, Conference on Frontiers in Industry and Applied Mathematics 2018, 26-27/04 Hamirpur, Himchal-Pradesh, India. (Plenary speaker).

2017 - *Boltzmann-type control for consensus dynamics*, Inha University, 18/10, Incheon-Seoul, South Korea. (Invited seminar).

Mean-field control hierarchy, LSIS, 12-15/03, Marseilles, France. (Invited speaker).

2016 - *Kinetic approximation and control of multi-agent systems*, 01/02, WWM Münster, Germany. (Invited seminar).

2015 - *Kinetic approximation and control of multi-agent systems*, Numerical aspects of hyperbolic balance laws and related problems, 17-19/12, Ferrara, Italy. (Invited speaker).

- *Kinetic modeling and control of self-organizing systems*, 02/12, KAUST, Thuwal, KSA. (Invited seminar).
- *Multi-scale modeling and control of self-organizing systems*, IperGSSI, 16th Italian Meeting on Hyperbolic Equations, 22-25/10, L'Aquila, Italy. (Invited speaker).
- *AP and IMEX RK schemes for optimal control hyperbolic problems with relaxation*, Numerics for Nonlinear PDEs, in Roma 3, 29-30/01, Roma, Italy. (Invited speaker).

2014 - *Kinetic description of optimal control problems in consensus modeling*, Multiscale kinetic and fluid problems: asymptotic analysis, modelling and numerical simulation, in Cargèse (IESC), 28/09-4/10, Corsica, France. (Invited speaker).

- *Modeling self-organized systems numerical methods and control dynamics*, 29/01, KU Leuven, Belgium. (Invited seminar).

2013 - *Modeling self-organized systems numerical methods and interaction with few individuals*, 10/09, 2013, RTWH, Aachen, Germany. (Invited seminar)

2012 - *Modeling self-organized systems interacting with few individuals: from microscopic to macroscopic dynamics*, 12/12, 2012, CASA colloquium TU Eindhoven, Eindhoven, NL. (Invited seminar)

Contributed Talks

2024 - A Data-Driven Kinetic Model for Opinion Dynamics with Social Network Contacts, Minisimposia: "Dynamics of Socially- and Behaviorally-structured Multi-population and Multiagent Systems", SIAM Conference on the Life Sciences,5-9/06, Portland,Oregon, US.

2023 - *Kinetic description of swarming dynamics with topological interaction and emergent leaders*, Minisimposia: " Matematica per le scienze della vita" , XXII Congresso Nazionale UMI, 6-7/09, Pisa, Italy.

- *Kinetic description of swarming dynamics with topological interaction and emergent leaders*, Minisimposia: "Many-agent systems and mean-field models for socio-economic and life sciences dynamics" , ICIAM 2023, 18-26/08, Tokyo, Japan.

2022 - *Kinetic approximation of mean-field optimal control*, Minisimposia: "Inverse Problems, PDE-Constrained Optimization, and Applications " , SCICADE 2022, 24-29/07, Rekyvik, Iceland.

2021 - *Mean-field selective optimal control with transient leadership*, Minisimposia: "Recent Results in Kinetic Theory and Applications" , SIMAI 2020, Parma.

- *Moment-driven predictive control of collective dynamics*, Minisimposia: "Innovative numerical methods for evolutionary PDEs" , SIMAI 2020, Parma, Italy.

- *IMEX Linear Multistep Methods for hyperbolic problems with relaxation*, NumHyp Trento, 21-29/07, Trento, Italy.

2019 - *IMEX Linear Multistep Methods for hyperbolic problems with relaxation*, Invited Minisymposium " Asymptotic preserving methods for kinetic equations", sciCADE 2019, 20-25/07, Innsbruck, Austria.

- *Boltzmann control strategies for multi-agent systems*, Minisymposium: "Novel Concepts in Model-driven Optimization and Control of Agent-based Systems", ICIAM 2019, 15-19/07, Valencia, Spain.

- *Linear multistep methods for optimal control problems and applications to hyperbolic relaxation systems*, "Efficient high-order time discretization methods for PDEs", 8-10/05, Villa Orlandi, Anacapri, Italy.

- *Boltzmann-type optimal control problems*, Minisymposium: "Recent advances in PDE models describing emergent behaviour and collective dynamics", BAMC 2019, 24-26/04, Bath, UK.

2018 - *Boltzmann-type optimal control problems*, "Advances in Kinetic Theory", UMI-SIMAI-PTM, 17-20/09, Wrocław, Poland.

- *Boltzmann game in heterogeneous consensus dynamics*, Special Session: "Advances in kinetic theory", AIMS Conference, Taipei, Taiwan, 05-09/07.
- *Boltzmann-type optimal control problems*, Special Session: "Kinetic and related equations: collisions, mean field, and organized motion", AIMS Conference, Taipei, Taiwan, 05-09/07.

2017 - *Boltzmann-type optimal control*, IperPV 2017, 06-09/09, Pavia, Italy.

- *Mean-field control hierarchy for opinion dynamics*, AMMCS 2017, 20-25/08, Waterloo, Ontario, Canada.
- *Mean-field control hierarchy*, BAMC 2017, 10-12/04, Guildford, UK.
- *Mean-field control hierarchy in consensus models*, SIAM CSE, 27/02-03/03, Atlanta, GA, US.

2016 - *Binary interaction approximation for mean-field optimal control problems*, SIMAI 2016, 13-16/09, Milano, Italy.

- *Binary interaction approximation for mean-field optimal control problems*, CMAM-7 2016, 01-05/08, Jyväskyla, Finland.
- *Kinetic modeling and control of self-organizing systems*, KTMP 2016, 22-25/01, Stellenbosch, South Afrika.
- *Kinetic modeling and control of self-organizing systems*, WONAPDE 2016, 11-15/01, Concepcion, Chile.

2015 - *Invisible control of self-organizing agents leaving unknown environments*, 27th IFIP Conference on System Modelling and Optimization, 29/06-3/07, Sophia Antipolis, France.

- *Uncertainty quantification in control problems for flocking models*, 26th Biennial Numerical Analysis Conference, 23-26/06, University of Strathclyde, Glasgow, UK.

2014 - *Boltzmann type control for consensus dynamic with leaders*, 13/09, 2014, CNR, Roma,Italy.

- *Binary algorithm for the simulation of self-organized systems*, 07/07, 2014, SIMAI Conference, Taormina, Italy.
- *Kinetic description of optimal control problems in consensus modeling*, 08/07, 2014, SIMAI Conference, Taormina, Italy.
- *Asymptotic Preserving schemes for optimal control problem for hyperbolic relaxation system*, 08/07, 2014, SIMAI Conference, Taormina, Italy.
- *Binary algorithm for the simulation of self-organized systems*, 07/04, MCQMC14, KU Leuven, Belgium

2013 - *Modeling self-organized systems numerical methods and interaction with few individuals*, 10/09, 2013, School on Mathematical Physics, INdAM, Ravello, SA, Italy

- *AP schemes for optimal control problem for hyperbolic relaxation system*, 10/09, 2013, HyperBAlls, Indam GNCS Workshop, Milano, Italy

2012 - *Modeling self-organized systems interacting with few individuals: from microscopic to macroscopic dynamics*, poster session, 4/09, 2012, CRM, UAB, Barcelona, Spain

- *Binary interaction algorithm for the simulations of swarming and flocking dynamics*, 2^{nd} Young researcher meeting, BIOMAT 2012 Granada, Spain.

2011 - *Monte Carlo algorithms for the Boltzmann equation*, 26/10, 2011 Young Researcher Seminars, ICERM, Brown University, Providence RI, US.

Visiting and participation in research institutes

Long stays and affiliations at research institutes and universities

2022 Semester on " Frontiers in kinetic theory: connecting microscopic to macroscopic scales - KineCon 2022", INI for Mathematical Sciences - Cambridge, UK, (1 month)

2019 HIM Junior Trimester program: Kinetic Theory, 20/05-27/06, Hausdorff Research Institute Bonn, Germany. (1,25 months)

2018 Trimester on "Mathematical Biology" at Institut Mittag-Leffler, 10-28/10, Djursholm, Sweden. (15 days)

2016 HIM Trimester program: Mathematics of Signal Processing, 05/02-20/03, Hausdorff Research Institute, Bonn, Germany. (1 month)

2015 KAUST, 15/11-01/12, Jeddah, Saudi Arabia, contact person: Prof. P. A. Markowich, (17 days)

2014 Visiting researcher at IAC-CNR Roma, 01-15/09, Roma, Italy, person: Dr. E. Cristiani (15 days)

2011-2013 Visiting PhD student at RTWH Aachen, tutor: Prof. M. Herty (total: 3 months)

2012-2013 Visiting PhD student at Universitat Autonoma de Barcelona, tutor: Prof. J. A. Carrillo (total: 3 months)

2011 - Trimester on "Kinetic Theory and Computation", ICERM, Brown University, Providence, Rhode Island, US, Sep 7 - Dec 9, 2011 (1,25 months)

Supported participation in scientific events

2017 - School on Uncertainty Quantification for kinetic equations, GSSI, 10-12/04, L'Aquila, Italy.

2016 - Conference: Transport phenomena in collective dynamics: from micro to social hydrodynamics, 01-04/09, ETH Zurich, Swiss.

- Summer school: Complex networks: theory, methods and applications, 18-22/05, Lake Como School of Advanced Studies, Como, Italy.

2014 - Conference: NETGCOOP2014, International conference on Network Games, Control and Optimization, 29-31/10, Trento, Italy.

- Conference: “Collective Behavior: Macroscopic versus Kinetic Descriptions", 19-23/05, Imperial College London, UK.

2013 - XXXVII Summer School on Mathematical Physics, 14-28/09, Ravello, SA, Italy. (14 days)

- 12th Summer School on Scientific Visualization,10-14/06, CINECA, Milano, Italy.
- Mathematics for Planet Earth, Workshop INdAM, 27-29/05, Roma, Italy.

2012 - 15-16/11, “Dagli individui alla collettività: folle e sciami", CNR Roma, Italy.

- Applied Differential Equations in Physics, Biology and Social Sciences: Classical and Modern Perspectives, ESF Conference, CRM, UAB, 3 - 7/09, Barcelona, Spain.
- School: Analysis, Modeling and Simulation of Collective Dynamics from Bacteria to Crowds, CISM, 9-13/07, Udine, Italy.
- School: BIOMAT 2012, 2-6/07, Granada, Spain.

2011 - Workshop on Boltzmann Models in Kinetic Theory, ICERM, Brown University, 7 - 11/11, Providence RI, US.

- Workshop on Novel Applications of Kinetic Theory and Computations, ICERM, Brown University, Providence RI, US.
- Spring School on Mathematical Fluid Dynamics, TU Darmstadt, 28/02 - 3/03, Germany.

Student supervisions, teaching activities, administrative roles

Students supervision

Doctoral students

11/2020-11/2023 Federica Ferrarese, University of Trento, PhD Thesis: *‘Particles methods for kinetic equations in plasma physics, collective behaviors and optimization*.’ 07/03/2024.

11/2018-11/2021 Chiara Segala, University of Trento. PhD Thesis: *‘Robust numerical control methods for mean-field collective dynamics.’* 30/06/2022.

Postdoc supervision

from 8/2024 Matteo Piu, University of Verona. Project: *"Efficient numerical schemes and optimal control methods for time-dependent partial differential equations". PRIN 2022*

from 3/2024 Elisa Calzola, University of Verona. Project: *"Data-driven discovery and control of multi-scale interacting artificial agent systems". PRIN PNRR 2022*

11/2021-4/2023 Elisa Calzola, University of Verona. Project: *"Innovative numerical methods for evolutionary partial differential equations and applications". PRIN2017*

06/2020-06/2021 Franco Zivcovich, University of Verona. Project: *"Innovative numerical methods for evolutionary partial differential equations and applications". PRIN2017*

Supervision of Master and Bachelor thesis (L-35)

2024 - Master thesis (LM-40), University of Verona: Kinetic modelling of opinion dynamics over social-network, student: A. Ambrosi.

- Master thesis (LM-40), University of Verona: Data-driven age-structure kinetic model for breast tumor, student: A. Bontempi.

2023 - Master thesis (LM-40), University of Verona: Kinetic Description of Neural Differential Equations, student: V. Flora.

- Master thesis (LM-40): Data-driven mean-field modeling for opinion dynamics in Twitter sentiment analysis, student: D. Prezioso.
- Bachelor thesis (L-35), University of Verona: Dinamiche collettive in modelli preda-predatore, student: F. Poma.
- Bachelor thesis (L-35), University of Verona: Modelli epidemiologici con struttura di età per pandemia covid-19, student: V. Piccoli.

2022 - Master thesis (LM-40), University of Verona: Numerical schemes for time-delay models and applications to self-organizing systems, student: M. A. Savu.

- Bachelor thesis (L-35), University of Verona: Controllo e calibrazione di modelli epidemiologici per la trasmissione del virus SARA-Cov-2, student: S. Arcari.
- Bachelor thesis (L-35), University of Verona: Modelli matematici per epidemie da bostrico in ecosistemi forestali, student: F. Marini.

2021 - Master thesis (LM-40), University of Verona: Supervised learning feedback laws for nonlinear large-scale dynamics, student: S. Bicego, Co-supervision: D. Kalise (Imperial College London).

- Master thesis (LM-40), University of Verona: Regularization Methods in Deep Learning: an Optimal Control Perspective, student: G. Tabarelli.
- Master thesis (LM-40), University of Verona: Tracking the evolution of cancer cell populations through the mathematical lens of phenotype-structured equations, student: A. Sfilio. Co-supervision: T. Lorenzi (Politecnico di Torino).
- Master thesis (LM-40), University of Verona: Optimization methods in Machine Learning and applications to facial detection problems, student: R. Vencato.
- Master thesis (LM-40), University of Verona: Random Batch Methods for interacting particle systems and modern applications, student: M. Ambrosi
- Bachelor thesis (L-35), University of Verona: Modelli matematici per dinamiche socio-epidemiologiche, student: A. Marcazzan.

2020 - Master thesis (LM-40), University of Verona: Optimized leaders strategies in crowd dynamics, student: F. Corsini.

- Master thesis (LM-40), University of Verona: Stochastic algorithms for populations biology, student: F. Ferrarese.
- Bachelor thesis (L-35), University of Verona: Strategie di controllo e stima dei parameteri per modelli epidemiologici applicati al COVID19, student: A. Mortaro.
- Bachelor thesis (L-35), University of Verona: Dinamiche di sincronizzazione in modelli Kuramoto: soglie critiche e metodi Runge-Kutta stocastici, student: P. Brunetto.

2019 - Master thesis (LM-40), University of Verona: Kinetic approximation of particle swarming optimization, student: F. Rubes.

- Master thesis (LM-40), University of Verona: On a system of nonlocal parabolic equations modelling evolutionary dynamics of healthy and cancer cell populations, student: C. Langella, Co-supervision: T. Lorenzi (Politecnico di Torino)
- Bachelor thesis (L-35), University of Verona: Schemi Chang-Cooper per equazioni Fokker-Planck non locali e applicazoni, student: G. Campagnari.
- Bachelor thesis (L-35), University of Verona: Modelli cinetici e problemi di controllo ottimo per le disuguaglianze economiche, student: M. Framba.
- Bachelor thesis (L-35), University of Verona: Metodi IMEX per problemi stiff e applicazioni, student: M. Ambrosi.
- Bachelor thesis (L-35), University of Verona: Dinamiche a due popolazioni per sistemi multi-agente e applicazioni alle scienze sociali e biologiche, student: S. Baltieri.

2018 - Master thesis (LM-40), University of Verona: Control and learning of interaction kernel in multi-agent systems, student: E. Frison.

- Bachelor thesis (L-35), University of Verona: Modelli matematici per lo studio delle mutazioni di Luria - Delbrück, student: A. Sfilio.
- Bachelor thesis (L-35), University of Verona: Metodi di shooting e applicazioni alla fisica, student: F. Ferrarese

2017 - Master thesis at TU München: Optimal planning for a traffic model on networks, student: M. Stachl.

Total: 14 Master thesis, 13 Bachelor thesis.

Teaching activities

a.a. 24/25 - "Logistic Optimization" (SSD MATH-06/A) 12 hours/year in LM-77R (Supply Chain Management).

- "Calcolo Numerico I con laboratorio" (SSD MATH-05/A) 32 hours/year in L-35 (Matematica Applicata). (coordinator)
- "Foundation of Data Analysis", (SSD MATH-05/A) 52 hours/year in LM-40 (Mathematics), in LM-91 (Data Science), in LM-18 (Artificial Intelligence). (coordinator)
- "Metodi Matematici e Statistici in la Biologia", (SSD BIO/13) 24 hours/year in L-M35 (Matematica Applicata). (coordinator)
- "Advances in Numerical Analysis and Mathematical Modelling: Multi-agent interaction models, from control to learning across scales." (SSD MATH-05/A) 10 hours/year *PhD course at University of Trento*.

Total : 5 modules, 130 hours/year

a.a. 23/24 - "Numerical methods for partial differential equations" (SSD MAT/08) 16 hours/year in LM-40 (Mathematics).

- "Calcolo Numerico I con laboratorio" (SSD MAT/08) 32 hours/year in L-35 (Matematica Applicata). (coordinator)
- "Numerical Modelling and Optimization", (SSD MAT/07) 28 hours/year in LM-40 (Mathematics). (coordinator)
- "Foundation of Data Analysis", (SSD MAT/08) 52 hours/year in LM-40 (Mathematics), in LM-91 (Data Science), in LM-18 (Artificial Intelligence). (coordinator)
- "Metodi Matematici e Statistici in la Biologia", (SSD BIO/13) 24 hours/year in L-M35 (Matematica Applicata). (coordinator)
- "Advances in Numerical Analysis and Mathematical Modelling: Multi-agent interaction models, from control to learning across scales." (SSD MAT/08) 15 hours/year *PhD course at University of Trento*.

Total : 6 modules, 167 hours/year

a.a. 22/23 -
- "Numerical methods for partial differential equations" (SSD MAT/08) 12 hours/year in LM-40 (Mathematics).
- "Numerical Modelling and Optimization", (SSD MAT/07) 44 hours/year in in LM-40 (Mathematics). (coordinator)
- "Foundation of Data Analysis", (SSD MAT/08) 52 hours/year in LM-40 (Mathematics), in LM-91 (Data Science), in LM-18 (Artificial Intelligence). (coordinator)
- "Metodi Matematici e Statistici in la Biologia", (SSD BIO/13) 24 hours/year in L-M35 (Matematica Applicata). (coordinator)
- "Advances in Numerical Analysis and Mathematical Modelling: Multi-agent interaction models, from control to learning across scales." (SSD MAT/08) 15 hours/year *PhD course at University of Trento*.

Total : 5 modules, 147 hours/year

a.a. 21/22 -
- "Numerical methods for partial differential equations" (SSD MAT/08) 12 hours/year in LM-40 (Mathematics).
- "Numerical Modelling and Optimization", (SSD MAT/07) 28 hours/year in in LM-40 (Mathematics). (coordinator)
- "Foundation of Data Analysis", (SSD MAT/08) 52 hours/year in LM-40 (Mathematics), in LM-91 (Data Science). (coordinator)
- "Metodi Matematici e Statistici in la Biologia", (SSD BIO/13) 24 hours/year in L-M35 (Matematica Applicata). (coordinator)

Total : 4 modules, 116 hours/year

a.a. 20/21 -
- "Foundation of Data Analysis", (SSD MAT/08) 56 hours/year in LM-40 (Mathematics), in LM-91 (Data Science). (coordinator)
- "Numerical Modelling and Optimization", (SSD MAT/07) 28 hours/year in in LM-40 (Mathematics). (coordinator)
- "Metodi Matematici e Statistici in la Biologia", (SSD BIO/13) 24 hours/year in L-M35 (Matematica Applicata). (coordinator)

Total : 3 modules, 108 hours/year

a.a. 19/20 - "Foundation of Data Analysis", (SSD MAT/08) 56 hours/year in LM-40 (Mathematics), in LM-91 (Data Science). (coordinator)

- "Numerical Modelling and Optimization", (SSD MAT/07) 28 hours/year in in LM-40 (Mathematics). (coordinator)
- "Metodi Matematici e Statistici in la Biologia", (SSD BIO/13) 24 hours/year in L-M35 (Matematica Applicata). (coordinator)

Total : 3 modules, 108 hours/year

a.a. 18/19 - "Advanced Numerical Analysis II", (SSD MAT/08) 28 hours/year in LM-40 (Mathematics).

- "Metodi Matematici e Statistici in la Biologia", (SSD BIO/13) 24 hours/year in L-M35 (Matematica Applicata). (coordinator)
- Responsible for: "Research Modelling Seminar", (SSD MAT/07) 8 hours/year in LM-40 (Mathematics). (coordinator)

Total : 3 modules, 60 hours/year

a.a. 17/18 - "Advanced Numerical Analysis II", (SSD MAT/08) 28 hours/year in LM-40 (Mathematics).

- "Calcolo Numerico I con laboratorio", (SSD MAT/08) 24 hours/year in L-M35 (Matematica Applicata). (coordinator)
- Responsible for: "Research Modelling Seminar", (SSD MAT/07) 8 hours/year in LM-40 (Mathematics). (coordinator)

Total : 3 modules, 60 hours/year

a.a. 16/17 - "Calcolo Numerico I con laboratorio", (SSD MAT/08) 56 hours/year in L-M35 (Matematica Applicata). (coordinator)

Total : 1 module, 56 hours/year

Other teaching experiences

2015/16 Mentor and Assistant for: Traffic flow on networks, Haupt-Seminar for master students, TU München, web: `www-m15.ma.tum.de/Allgemeines/TrafficFlow`. Total: 20 hours.

2012/13 Assistant for: "Geometria", Engineer bachelor degree course, University of Ferrara. Responsable: Prof. Paltin Ionescu. Total: 20 hours.

2012/13 Assistant for: "Matematica Applicata", Architecture bachelor degree course, University of Ferrara. Teacher: Prof. Lorenzo Pareschi.
Total: 60 hours.

2012/13 Assistant for: "Analisi II", Engineer bachelor degree course, University of Ferrara.
Total: 30 hours.

2011/12 Assistant for: "Analisi II", Engineer bachelor degree course, University of Ferrara.
Total: 30 hours.

2011/12 Assistant for: "Metodi e Modelli Numerici", Mathematics master degree course, University of Ferrara. Responsable: Prof. Lorenzo Pareschi.
Total: 30 hours.

2011/13 Responsible for PLS project "Laboratorio sulle dinamiche socio-economiche", web: `https://laboratoriopls.wordpress.com/`.
Total: 80 hours.

Institutional roles at University of Verona

since 11/2021 "Delegato all'internazionalizzazione" for the Computer Science department.

since 10/2021 Deputy Coordinator of the International Mobilty for the Area of Science and Engineering, and member of the Erasmus+ selection committee.