

# Giacomo Albi

## Curriculum Vitae

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### Personal Data

Born 22/02/1985  
Palce of Birth Zevio (VR), Italy  
Citizenship Italian

### Actual employment

March 2017-now Ricercatore di Tipo A in MAT/08 at Department of Computer Science, University of Verona

### Previous employments

May 2014- March 2017 Postdoc at Technische Universität München, Fakultät für Mathematik

### 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.  
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.
- 2004 **Scientific high-school diploma**, June 2004, Liceo Scientifico A. Messedaglia, Verona.

### Prizes and awards

- 2015 Award for the *Best PhD thesis for the XXVI cycle* University of Ferrara.
- 2014 *Nicolò Copernico recognition* for innovative PhD thesis in science and technology.

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## Research interests

My main research interest is focused on the development of numerical methods for optimal control of kinetic equations, and hyperbolic-type system. Applications of these methods range from the description of high-dimensional multi-agent systems, to optimal treatment planning in radiotherapy.

Additionally, I am also interested in the development energy preserving schemes for the modelling of biological network formation, and their relation to optimal transport theory.

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

**Affiliations** American Mathematical Society (AMS); Gruppo Nazionale Calcolo Scientifico, (GNCS-INdAM); Complex System group, (SisCo-SIMAI).

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## Publications

### Articles in referred journals

- [Opinion dynamics over complex networks: kinetic modeling and numerical methods](#), G. Albi, L. Pareschi, M. Zanella, accepted in *Kin. Rel. Med.*, pp. 31, 2016.
- [Biological transportation network: modeling and simulation](#), G. Albi, M. Artina, M. Fornasier, P. A. Markovich, *Analysis and Applications*, 14(01), pp. 185-206, 2016.
- [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.
- [Uncertainty quantification in control problems for flocking models](#), G. Albi, L. Pareschi, M. Zanella, *Mathematical Problems in Engineer*, 2015.
- [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.
- [Boltzmann type control of opinion consensus through leaders](#), G. Albi, L. Pareschi, M. Zanella, *Proc. of the Roy. Soc. A.*, 372(2028), 2014.
- [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.
- [Asymptotic Preserving time-discretization of optimal control problems for the Goldstein–Taylor model](#), G. Albi, M. Herty, C. Jörres, L. Pareschi, *Num. Meth. for PDE*, 30(6), 1770-1784, 2014.
- [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.
- [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.

### Articles in books

- [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.
- [Discrete and 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.

### Conference proceedings

- [On the optimal control of opinion dynamics on evolving networks](#), G. Albi, L. Pareschi, M. Zanella, in IFIP TC7 2015 proceedings.
- [A Boltzmann approach to mean-field sparse feedback control](#), G. Albi, M. Fornasier, D. Kalise, accepted in proceedings of IFAC WC 2017.

### Preprints

- [Mean field control hierarchy](#), G. Albi, Y-P. Choi, M. Fornasier, D. Kalise, preprint arXiv:1608.01728 (accepted), 2016.
- [Selective model-predictive control for flocking systems](#), G. Albi, L. Pareschi, preprint arXiv:1603.05012v2 (accepted), 2016.

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## Computer skills

Standard C, C++, PYTHON, FORTRAN, R, MAPLE, HTML, EXCEL, OFFICE.  
Advanced MATLAB, MATHEMATICA, FREEFEM++, L<sup>A</sup>T<sub>E</sub>X.

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## Languages

Italian **Mothertounge**  
English **Advanced**  
German **Intermediate**

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## Communications

### Invited Talks

- 2017 [Boltzmann-type control for consensus dynamics](#), Inha University, 18/10/2017, Incheon, Seoul, South Korea. (Invited speaker).  
[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 speaker).
- 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 speaker).
- 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 speaker).
- 2013 *Modeling self-organized systems numerical methods and interaction with few individuals*, 10/09, 2013, RTWH, Aachen, Germany. (Invited speaker)
- 2012 *Modeling self-organized systems interacting with few individuals: from microscopic to macroscopic dynamics*, 12/12, 2012, CASA colloquium TU Eindhoven, Eindhoven, NL. (Invited speaker)
- Contributed Talks and Posters
- 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, Jyväskylä, 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<sup>nd</sup> 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.

## Conferences, Workshops and Schools

- 2017 IperPV 2017, 06-09/09, Pavia, Italia.
- AMMCS 2017, 20-25/08, Waterloo, Ontario, Canada.
- Mean-field games and related topics, 21-23/06, Roma, Italy.
- School on uncertainty quantification for kinetic equations, GSSI, 10-12/04, L'Aquila, Italy.
- 54th British Applied Mathematical Conference, University of Surrey, 10-12/04, Guildford, UK.
- Mean-Field Days, LSIS, 12-15/03, Marseilles, France.
- SIAM Conference on Computational Science and Engineering, 27/02-03/03, Atlanta, GA, US.
- 2016 Transport phenomena in collective dynamics: from micro to social hydrodynamics, 01-04/09, ETH Zurich, Swiss.
- SIMAI Conference 2016, 07-09/09, Milano, Italy.
- Computational Methods in Applied Mathematics (CMAM-7), 01-05/08, Jyväskylä, Finland.
- HIM program: Mathematics of Signal Processing, 05/02-20/03, Hausdorff Research Institute, Bonn, Germany.
- KTMP 2016, Kinetic Theory and Multiscale Phenomena: Modelling, Analysis, Computation and New Applications, 22 - 25/01, Stellenbosch, Cape Town, South Africa.

- WONAPDE 2016 Fifth Chilean Workshop on Numerical Analysis of Partial Differential Equations, 11 - 15/01 Universidad de Concepción, Concepción, Chile. ([Minisymposium organizer](#): *Recent developments in numerical methods for HJB and Multi-agent systems.*)
- 2015 Numerical aspects of hyperbolic balance laws and related problems, 17-19/12, Ferrara, Italy.
- IperGSSI, 16th Italian Meeting on Hyperbolic Equations, 22-25/10, L'Aquila, Italy.
- 27th IFIP Conference on System Modelling and Optimization, 29/06-03/07, Sophia Antipolis, France.
- 26th Biennial Numerical Analysis Conference, 23-26/06, University of Strathclyde, Glasgow, UK.
- Complex networks: theory, methods and applications, 18-22/05, Lake Como School of Advanced Studies, Como, Italy.
- 13th Viennese Workshop on Optimal Control and Games, 13-16/05, Vienna, Austria. ([Minisymposium organizer](#): *Mean-field modeling and control of multi-agents systems.*)
- Numerics for Nonlinear PDEs, 29-30/01, Roma 3, Roma, Italy.
- 2014 NETGCOOP2014, International conference on Network Games, Control and Optimization, 29-31/10, Trento, Italy.
- Multiscale kinetic and fluid problems: asymptotic analysis, modelling and numerical simulation, 28/09-4/10, Cargèse (IESC), Corsica, France.
- SIMAI Conference 2014, 07-12/07, Taormina, Italia.
- Collective Behavior: Macroscopic versus Kinetic Descriptions, 19-23/05, Imperial College London, UK.
- Monte Carlo & Quasi Monte Carlo methods, 2014, 07-11, KU Leuven, Belgium.
- 2013 XXXVII Summer School on Mathematical Physics, 14-28/09, Ravello, SA, Italy.
- IperMiB, 15th Italian Meeting on Hyperbolic Equations, 10-13/09, Milano, Italy.
- HyperBALLs, Indam GNCS Workshop, 09-10/09, Milano, Italy.
- 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, 2012, Dagli individui alla collettività: folle e sciame, 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.
- Analysis, Modeling and Simulation of Collective Dynamics from Bacteria to Crowds, CISM, 9-13/07, Udine, Italy.
- 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.

Workshop on Numerical aspects of hyperbolic balance laws and related problems, 3-4/04, Ferrara, Italy. [Local organizer](#).

Spring School on Mathematical Fluid Dynamics, TU Darmstadt, 28/02 - 3/03, Germany.

## Participation in research projects

- 2014-2017 ERC-Starting Grant: *High-Dimensional Sparse Optimal Control*.  
Responsible: Prof. Massimo Fornasier.
- 2013 GNCS project: *Hyperbolic dominated multi-scale problems: numerical methods and applications*.  
Responsible: Dr. Matteo Semplice.
- 2012 5x1000 Young Researchers Grant, University of Ferrara: *Differential equations and collective behavior with applications to social, economics and natural sciences*.  
Responsible: Dr. Giacomo Albi
- 2010-2012 Bilateral project Italy–Germany Vigoni: *Adjoint IMEX methods for the numerical solution to optimization problems*.  
Responsible: Prof. Lorenzo Pareschi and Prof. Michael Herty.
- 2011-2013 PRIN: *High-order numerical methods for systems of balance laws with sources in fluid-dynamics*.  
Responsible: Prof. Lorenzo Pareschi.
- 2011 FAR: *Metodi numerici e statistici avanzati per le applicazioni*. Responsible: Prof. Lorenzo Pareschi.

## Students supervision

- 2016 Master thesis at TU München: Optimal planning for a traffic model on networks, student: Markus Stachl.
- 2015-2017 PhD Mentor at the International Research Training Group IGDK, student: Juliane Sigl. Web: <http://igdk.eu/IGDK1754/Mentors>

## Teaching activities

- 2017 Responsible for: "Calcolo Numerico I con Laboratorio", University of Verona.  
Total: 56 hours.
- 2016 Mentor and TA\* for: Traffic flow on networks, Haupt-Seminar for master students, TU München, web: [www-m15.ma.tum.de/Allgemeines/TrafficFlow](http://www-m15.ma.tum.de/Allgemeines/TrafficFlow).  
Total: 20 hours.
- 2013 TA\* for: "Geometria", Engineer bachelor degree course, University of Ferrara. Responsible: Prof. Paltin Ionescu. web: [www.giacomoalbi.com/teaching/geometria/](http://www.giacomoalbi.com/teaching/geometria/).  
Total: 20 hours.
- 2011-2013 TA\* for: "Matematica Applicata", Architecture bachelor degree course, University of Ferrara. Teacher: Prof. Lorenzo Pareschi.  
Total: 60 hours.

2011-2013 TA\* for: "Analisi II", Engineer bachelor degree course, University of Ferrara. Responsible: Prof. Michele Miranda. [www.giacomoalbi.com/teaching/analisi-ii/](http://www.giacomoalbi.com/teaching/analisi-ii/). Total: 60 hours.

2011-2012 TA\*, laboratory and exercises of: "Metodi e Modelli Numerici", Mathematics master degree course, University of Ferrara. Responsible: Prof. Lorenzo Pareschi. web: [www.giacomoalbi.com/teaching/metodi-e-modelli-numeric/](http://www.giacomoalbi.com/teaching/metodi-e-modelli-numeric/). Total: 30 hours.

2011-2013 Teacher for: "Laboratorio sulle dinamiche socio-economiche", pre-university course, PLS project (progetto lauree scientifiche) . web: <https://laboratoriopls.wordpress.com/>. Total: 80 hours.

\* TA=Teaching Assistant