

# Paolo Frasca - Curriculum vitae et studiorum

## Current Address (Work)

Dipartimento di Matematica  
Politecnico di Torino  
corso Duca degli Abruzzi, 24  
10129 Torino - Italy

## Permanent Address (Home)

via San Sebastiano, 15  
10081 Castellamonte (TO) - Italy

Born July 29, 1981  
Italian

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## Research interests

My interests include mathematical control theory, discrete mathematics, and applications of graph theory and probability. I am specially interested in problems involving an interplay of control and communication, multi-agent and networked systems, opinion dynamics and social networks, algorithms for robotic and sensor networks, modeling and control of natural and artificial swarms.

## Current position

Post-doc researcher (“Assegnista di Ricerca”) February 15, 2010 – present  
at the *Dipartimento di Matematica, Politecnico di Torino*  
Involved in the department project “Information dynamics in large-scale networks”  
Working with Fabio Fagnani

## Previous positions

Post-doc researcher (“Titolare di contratto di ricerca”) November 3, 2008 – October 4, 2010  
at the *Dipartimento di Ingegneria dell’Informazione e Matematica Applicata, Università di Salerno*  
and at the *Istituto per le Applicazioni del Calcolo, C.N.R., Rome, Italy*  
Involved in the MIUR-FIRB project “INtegrated SYstems for EMERgency”  
Working with Benedetto Piccoli

Visiting researcher (“Junior Specialist”) February 15 – July 15, 2008  
at the *Department of Mechanical Engineering, University of California at Santa Barbara,*  
*Santa Barbara (CA), U.S.A.*  
Working with Francesco Bullo

Ph.D. student January 2006 – December 2008  
*Dipartimento di Matematica, Politecnico di Torino, Torino, Italy*  
supported by a studentship from the grant “Coordinated control and identification of dynamical systems with communication constraints”, sponsored by “Fondazione CRT - Istituto Lagrange”

## Education

- Ph.D.*, Matematica per le Scienze dell'Ingegneria  
 Politecnico di Torino, Torino, Italy  
 Thesis: *Distributed optimization with communication constraints*  
 Advisors: Fabio Fagnani, Sandro Zampieri  
 March 26, 2009
- (M.S.) *Laurea Specialistica*, Ingegneria Matematica, *cum laude*  
 Politecnico di Torino  
 Thesis: *Modelli cinetici alle velocità discrete per il traffico veicolare* (in italian)  
 Advisor: Nicola Bellomo  
 October 13, 2005
- (B.S.) *Laurea*, Matematica per le Scienze dell'Ingegneria, *cum laude*  
 Politecnico di Torino  
 Thesis: *Il problema di Stokes. Spazi funzionali e formulazioni variazionali* (in italian)  
 Advisor: Claudio Canuto  
 October 10, 2003
- High school degree Maturità Classica (score 100/100),  
 Liceo "C. Botta", Ivrea (TO), Italy  
 July 2000

## Visiting periods

- Center for Control, Dynamical Systems, and Computation*,  
 University of California at Santa Barbara, Santa Barbara (CA), U.S.A.  
 Host: Francesco Bullo  
 June 2011
- Université Catholique de Louvain*, Louvain-la-Neuve, Belgium,  
 Host: Jean-Charles Delvenne  
 April 2011
- Rutgers University of New Jersey (Camden)*, Camden (NJ), U.S.A.  
 Host: Benedetto Piccoli  
 May 2010
- Lunds Tekniska Högskola*, Lund, Sweden  
 during the thematic program "Distributed Decision-Making and Control"  
 Host: Anders Rantzer  
 February – April 2010
- Università di Padova*, Padova, Italy  
 Host: Sandro Zampieri  
 September 2006

## Teaching and mentoring experience

- Teacher (with F. Fagnani)  
 graduate course "Control of/over networks" of the "Master Universitario di II livello" in "Automatica and Control Technologies" (MACT), III Facoltà di Ingegneria, Politecnico di Torino.  
 January-March 2012
- Master thesis advisor (with F. Fagnani and F. Colaneri):  
 Wilbert S. Rossi, "Localizzazione relativa su grandi reti" (Relative localization on large networks), *cum laude*  
 July 9, 2011
- Teacher (with F. Fagnani)  
 graduate course "Control of/over networks" of the "Master Universitario di II livello" in "Automatica and Control Technologies" (MACT), III Facoltà di Ingegneria, Politecnico di Torino (27 h).  
 January-March 2011
- Teacher  
 January 2008

General mathematics at the Istituto di Istruzione Superiore “F. Faccio”, Castellamonte, Italy.

Teaching Assistant 2005-2008 Undergraduate calculus courses at the Politecnico di Torino, including: in Fall 2005 (20 h) “Istituzioni di Matematiche II” with prof. J. Pejsachowicz; in Spring 2007 (45 h) “Analisi Matematica II” with prof. L. Caire; in Fall 2007 (24 h) “Matematica Generale” with prof. F. Pellerey; in Fall 2008 (48 h) “Analisi Matematica I” with prof. R. Camerlo.

Student Tutor

2003-2005

Mentoring undergraduate students, under the supervision of prof.s J. Pejsachowicz and L. Rondoni.

## Further scientific activities

### Reviewer activities

Since 2007, I have been serving as a peer reviewer for the proceedings of international technical conferences and for scholarly journals. Journals include

Automatica (7 papers), European Journal of Control, IEEE Journal of Selected Topics in Signal Processing (2), IEEE Transactions on Automatic Control (7), IEEE Transactions on Circuits and Systems (2), IEEE Transactions on Signal Processing (2), IET Control Theory & Applications (2), International Journal of Control, International Journal of Robust and NonLinear Control, Linear Algebra and its Applications, Networks and Heterogeneous Media (2), Systems and Control Letters (5).

Conferences include

American Control Conference, IEEE Conference on Decision and Control, IFAC Workshop on Estimation and Control of Networked Systems, International Symposium on Distributed Autonomous Robotics Systems, International Symposium on Mathematical Theory of Networks and Systems, and other workshops and symposia sponsored by IEEE or IFAC (more than 30 papers).

### Project activities

Collaborator

Institute for Collaborative Biotechnologies (ICB), Santa Barbara, USA. “Opinion Dynamics in Social Networks: Peer-to-Peer Interactions, Information Assimilation, and Strategic Manipulation”.

Project leader: F. Bullo. (Nov. 2011 - Dec 2012)

Team member

MIUR-PRIN 2008 project “Sistemi distribuiti su larga scala: stima, ottimizzazione e controllo, con applicazioni”.

Project leader: G. Calafiore. (March 2010 - Sep. 2012)

### Completed (as a team member)

- MIUR-FIRB project “INSYEME–INtegrated SYstems for EMERgency” (2008-2011)
- MIUR-FIRB project “CASHMA–Context Aware Security by Hierarchical Multilevel Architectures” (2008-2011)
- With the industrial partner “SELEX Sistemi Integrati”, “Studio di algoritmi stocastici finalizzati alla simulazione di ambiente radar per n-res” (simulation and detection of stochastic signals by radars) (2009-2010)
- MIUR-PRIN project coordinated by A. Agrachev (2007-2009)

## Organization activities

- International workshop on “Algorithms and dynamics over networks”, Dipartimento di Scienze Matematiche, Politecnico di Torino, February 8-9, 2012 (with G. Calafiore, F. Fagnani, and S. Zampieri)
- International workshop on “Algorithms and dynamics over networks”, Dipartimento di Matematica, Politecnico di Torino, July 14-15, 2010 (with G. Calafiore, F. Ceragioli, and F. Fagnani)
- Invited session on “Crowd and swarm dynamics: interactions, self-organization, mathematics, applications”, 10th biannual meeting of SIMAI (Società Italiana di Matematica Applicata ed Industriale), Cagliari, Italy, June 21-25, 2010 (with A. Tosin)

## Talks and seminars

### Invited seminars

- “Coverage control via gossip communication”, Rijksuniversiteit Groningen, The Netherlands, August 24, 2011
- “Discontinuous feedback in consensus-seeking systems: Bounded confidence, quantization, hysteresis”, University of California, Santa Barbara, USA, June 17, 2011
- “Gossip coverage control on graphs”, Université Catholique de Louvain, Louvain-la-Neuve, Belgium, April 5, 2011
- “Broadcast gossip averaging algorithms: interference and asymptotical error”, Kungliga Tekniska Högskola, Stockholm, Sweden, April 16, 2010
- “Distributed averaging on digital noisy networks”, Lunds Tekniska Högskola, Lund, Sweden, April 9, 2010
- “Broadcast gossip averaging algorithms: interference and asymptotical error”, Lunds Tekniska Högskola, Lund, Sweden, March 2, 2010
- “The role of communication constraints in optimization problems over networks”. IAC-CNR, Roma, Italy, March 2009
- “Gossip coverage control”. Dipartimento di Ingegneria dell’Informazione, Università di Padova, Padova, Italy, Sep. 2008
- “Quantized Gossip Consensus”. Mathematics and Cognition Seminar, Arizona State University, Tempe (AZ), USA, April 15, 2008

### Conference talks and posters

- “Continuous-time discontinuous equations in bounded confidence opinion dynamics”. IFAC World Congress, Milan, Italy, Aug. 2011
- “The asymptotical error of broadcast gossip averaging algorithms”. IFAC World Congress, Milan, Italy, Aug. 2011

- “Discontinuous feedback in consensus-seeking systems: Bounded confidence, quantization, hysteresis”, 2011 Santa Barbara Control Workshop, Santa Barbara, USA, June 24, 2011 (poster)
- “Mathematical issues of distributed complex systems”. M. Anile SIMAI workshop, Roma, Italy, Oct. 9, 2009
- “Average consensus on networks with transmission noise or quantization”. European Control Conference, Kos, Greece, July 2007
- “Agreement on networks”. V Séminaire Transalpin de Physique, Torino, Italy, Feb. 2007

### Talks at project meetings

- “Estimation of Gaussian signals via hexagonal sensor networks: Wildfire and pollutant detection”. CASHMA FIRB review meeting, Università di Salerno, Salerno, Italy, March 1, 2011
- “Average consensus with communication constraints”. Meeting on mathematical control theory: controllability, optimization, stability (PRIN 2006 review meeting). Dipartimento di Matematica, Politecnico di Torino, Torino, Italy, April 20-21, 2009

### Further education (attended workshops and schools, internships)

June 24, 2011: Santa Barbara Control Workshop: Decision, Dynamics and Control in Multi-Agent Systems, University of California, Santa Barbara, USA

April 21 - 23, 2010: LCCC Workshop on “Adaptation and Learning in Autonomous Systems”, Lund Institute of Technology, Lund, Sweden

March 10 - 12, 2010: LCCC Workshop on “Distributed Decisions via Games and Price Mechanisms”, Lund Institute of Technology, Lund, Sweden

June 22 - 26, 2009: CIME/NEWCOMM summer school “Mathematical Foundations of Complex Networked Information Systems”, Politecnico di Torino, Verres (AO), Italy

October 10 - 12, 2008: Workshop “Frontiers in Game Theory and Networked Control Systems”, Massachusetts Institute of Technology, Cambridge, MA, USA

December 3 - 7, 2007: Workshop “Cooperative multi agent systems: distributed computation, estimation and control”, Centro “De Giorgi”, Pisa, Italy

July 29 - August 17, 2007: SMI summer school in Probability (lectures by Paolo Baldi and Pierre Brémaud), Cortona, Italy

July 2004 : Internship at the Laboratoire de Génie Mécanique de Toulouse, Institut National des Sciences Appliquées, Toulouse, France. Supervisor: Alain Daidié

January 2004 - July 2004: “Erasmus” Student Exchange Programme. *Institut National des Sciences Appliquées*, Toulouse, France

### Certificates

“Qualification aux fonctions de Maître de Conférences” certificate (# 10226210365) February 5, 2010  
Section 26 – Mathématiques appliquées et applications des mathématiques.  
(Required to become a faculty in France)

## PUBLICATIONS

## Submitted

- [S1] Paolo Frasca and Julien M. Hendrickx. On the mean square error of randomized averaging algorithms. *Automatica*, Nov. 2011, submitted

## Journal Papers

- [J13] Joseph W. Durham, Ruggero Carli, Paolo Frasca, and Francesco Bullo. Discrete partitioning and coverage control for gossiping robots. *IEEE Transactions on Robotics*, Oct. 2011, to appear (first submission Nov. 2010). doi:10.1109/TRO.2011.2170753
- [J12] Francesco Bullo, Ruggero Carli, and Paolo Frasca. Gossip coverage control for robotic networks: dynamical systems on the space of partitions. *SIAM Journal on Control and Optimization*, Sep. 2011, to appear (first submission Aug. 2010)
- [J11] Francesca Ceragioli and Paolo Frasca. Continuous and discontinuous opinion dynamics with bounded confidence. *Nonlinear Analysis: Real World Applications*, 13 (3), pp. 1239-1251, 2012
- [J10] Paolo Frasca. Continuous-time quantized consensus: Convergence of Krasovskii solutions. *Systems and Control Letters*, 61(2), pp. 273-278, 2012
- [J9] Andrea Tosin and Paolo Frasca. Existence and approximation of probability measure solutions to models of collective behaviors. *Networks and Heterogeneous Media*, 6 (3), pp. 561-596, 2011
- [J8] Francesca Ceragioli, Claudio De Persis, and Paolo Frasca. Discontinuities and hysteresis in quantized average consensus. *Automatica*, 47(9), pp. 1916-1928, 2011
- [J7] Fabio Fagnani and Paolo Frasca. Broadcast gossip averaging: interference and unbiasedness in large Abelian Cayley networks. *IEEE Journal of Selected Topics in Signal Processing*, 5 (4), pp. 866-875, 2011
- [J6] Emiliano Cristiani, Paolo Frasca, and Benedetto Piccoli. Effects of anisotropic interactions on the structure of animal groups. *Journal of Mathematical Biology*, 62 (4), pp. 569-588, 2011
- [J5] Ruggero Carli, Giacomo Como, Paolo Frasca, and Federica Garin. Distributed averaging on digital erasure networks. *Automatica*, 47 (3), pp. 115-121, 2011
- [J4] Ruggero Carli, Fabio Fagnani, Paolo Frasca, and Sandro Zampieri. Gossip consensus algorithms via quantized communication. *Automatica*, 46 (1), pp. 70-80, 2010
- [J3] Paolo Frasca, Paolo Mason, and Benedetto Piccoli. Detection of Gaussian signals via hexagonal sensor networks. *International Journal of Mathematical Modelling and Numerical Optimisation*, 1 (1-2), pp. 39-55, 2009
- [J2] Paolo Frasca, Ruggero Carli, Fabio Fagnani, and Sandro Zampieri. Average consensus on networks with quantized communication. *International Journal of Robust and NonLinear Control*, 19 (16), pp. 1787-1816, 2009
- [J1] Vincenzo Coscia, Marcello Delitala, and Paolo Frasca. On the mathematical theory of vehicular traffic flow II: Discrete velocity kinetic models. *International Journal of Non-Linear Mechanics*, 42 (3), pp. 411-421, 2007

## Proceedings of International Conferences

- [C13] Joseph W. Durham, Ruggero Carli, Paolo Frasca, and Francesco Bullo. Dynamic coverage control with asynchronous one-to-base-station communication. (Invited paper) *IEEE Conference on Decision and Control*, Dec. 2011
- [C12] Francesca Ceragioli and Paolo Frasca. Continuous-time discontinuous equations in bounded confidence opinion dynamics. *IFAC World Congress*, pp. 1986-1990, Milan, Italy, Aug. 2011
- [C11] Fabio Fagnani and Paolo Frasca. The asymptotical error of broadcast gossip averaging algorithms. *IFAC World Congress*, pp. 10027-10031, Milan, Italy, Aug. 2011
- [C10] Ruggero Carli, Giacomo Como, Paolo Frasca, and Federica Garin. Distributed averaging on digital noisy networks. (Invited paper) *Information Theory and Applications Workshop*, San Diego, CA, USA, Feb. 2011
- [C9] Francesca Ceragioli, Claudio De Persis, and Paolo Frasca. Quantized average consensus: Discontinuities and hysteresis. (Invited paper) *IFAC Symposium on Nonlinear Control Systems*, pp. 78-83, Bologna, Italy, Sep. 2010
- [C8] Joseph W. Durham, Ruggero Carli, Paolo Frasca, and Francesco Bullo. Discrete partitioning and coverage control with gossip communication. *ASME Dynamic Systems and Control Conference*, Hollywood, CA, Oct. 2009
- [C7] Ruggero Carli, Giacomo Como, Paolo Frasca, and Federica Garin. Average consensus on digital noisy networks. *IFAC Workshop on Estimation and Control of Networked Systems*, pp. 36-41, Venice, Italy, Sep. 2009
- [C6] Paolo Frasca, Ruggero Carli, Francesco Bullo. Multiagent coverage algorithms with gossip communication: Control systems on the space of partitions. *American Control Conference*, pp. 2228-2235, St. Louis, MO, USA, June 2009
- [C5] Paolo Frasca, Ruggero Carli, Fabio Fagnani, and Sandro Zampieri. Average consensus by gossip algorithms with quantized communication. (Invited paper) *IEEE Conference on Decision and Control*, pp. 4831-4836, Cancun, Mexico, Dec. 2008
- [C4] Ruggero Carli, Fabio Fagnani, Paolo Frasca, and Sandro Zampieri. The quantization error in the average consensus problem. *Mediterranean Conference on Control and Automation*, Ajaccio, France, June 2008
- [C3] Ruggero Carli, Fabio Fagnani, Paolo Frasca, and Sandro Zampieri. A probabilistic analysis of the average consensus algorithm with quantized communication. *IFAC World Congress*, pp. 8062-8067, Seoul, Korea, Aug. 2008
- [C2] Ruggero Carli, Fabio Fagnani, Paolo Frasca, Thomas Taylor, and Sandro Zampieri. Average consensus on networks with transmission noise or quantization. *European Control Conference*, pp. 1852-1857, Kos, Greece, July 2007
- [C1] Ruggero Carli, Fabio Fagnani, Paolo Frasca, and Sandro Zampieri. Efficient quantized techniques for consensus algorithms. *Workshop on Networked Control System: Tolerant to Faults*, Nancy, France, June 2007

## Other publications

- [O1] Paolo Frasca. Ottimizzazione distribuita con vincoli di comunicazione. *La matematica nella Società e nella Cultura: rivista della Unione Matematica Italiana. Serie I*, 3 (1), pp. 35-37, 2010

Torino, January 28, 2012