

Fabio DELLA ROSSA

PERSONAL DATA

PLACE OF BIRTH: Sondrio (SO), Italy
DATE OF BIRTH: March 30th, 1984
ADDRESS: Via Tirundel 6, 23100, Sondrio (SO), Italy
CITIZENSHIP: Italian
OFFICE: (+39) 02 2399 3579
MOBILE: (+39) 347 3818265
EMAIL: fabio.dellarossa@polimi.it



POSITIONS

today | **Postdoctoral Research Assistant**
2019 | *Università degli studi Federico II, Dipartimento di Ingegneria Elettrica e delle Tecnologie dell'Informazione, Napoli, Italy*

2019 | **Postdoctoral Research Assistant**
2018 | *University of New Mexico, Mechanical Department, Albuquerque, New Mexico 87131, USA*

2018 | **Assistant Professor**
2014 | *Politecnico di Milano, Dipartimento di Elettronica, Informazione e Bioingegneria, Milano, Italy*

2014 | **Postdoctoral Research Assistant**
2012 | *Politecnico di Milano, Dipartimento di Elettronica, Informazione e Bioingegneria, Milano, Italy*

2011 | **PhD student**
2009 | *Politecnico di Milano, Dipartimento di Elettronica, Informazione, Milano, Italy*
Supervisors: Prof. Sergio Rinaldi, Prof. Yuri A. Kuznetsov

EDUCATION

2011 | **Ph.D. in Information Technology – Systems and Control** (cum laude)
2009 | *Politecnico di Milano, Milano, Italy*
Thesis title: Two-parameter bifurcations in smooth and piecewise-smooth dynamical systems: New theoretical results and applications

2010 | **Mathematical Research Institute Master**
2009 | *Utrecht Universiteit, Utrecht, The Netherlands*
Thesis title: Numerical periodic normalization for codim-2 bifurcations of limit cycles

2008 | **Master of science in Mathematical Engineering**
2006 | *Politecnico di Milano, Milano, Italy*
Thesis title: Vehicular Traffic Analysis (developed within the Gran Paris contest)

2004 | **Bachelor of science in Mathematical Engineering**
2003 | *Politecnico di Milano, Milano, Italy*
Thesis title: Periodic orbit in the restricted three-body problem: From the circular to the elliptic case

AWARDS

2012 | Best PhD Student in Information Technology – XXIV Cycle - Dipartimento di Elettronica e Informazione, Politecnico di Milano

2011 | European Doctorate certificate

2009 | Master Degree prize Centro Interdipartimentale di Ricerche sulla Interazione Tecnologia-Ambiente

LANGUAGES

ITALIAN: Mother tongue
ENGLISH: Fluent – TOEFL iBT 223/300 – C1 (CEFR) (October 2004)

COMPUTER SKILLS

OSs	Microsoft operating systems, Linux.
Languages	C, Fortran, Python, Flash, Java, Visual Basic, Bash scripting, XML, (X)HTML, CSS, PHP, \LaTeX , SQL, MySQL, MySQLi.
Scientific Languages & Tools	Matlab, Auto, R, Maple, Mathematica, SageMath.
Technologies	Illustrator, Arduino, Lego Mindstorm, NumPy, SciPy, Microsoft Office.

SCIENTIFIC ACTIVITIES

Bifurcation analysis and its applications

Nonlinear (continuous or discontinuous) dynamical systems described by ODEs depending on parameters are ubiquitous in all fields of science. The discussion of the impact of the parameters on the asymptotic behavior of the dynamical system is one of the most important topics. The discussion typically requires the determination of the so-called bifurcations, namely the parameters' combinations at which the system dynamics undergo a structural change, namely a change that involves some qualitative, other than quantitative, difference. Examples of bifurcations are the appearance or disappearance of equilibria or limit cycles, or changes in their stability. In my scientific activities I studied both the theoretical aspects of bifurcation analysis [J22, J29, J33, C2, C10, C11, C16, C19, C20], and the applications of bifurcation theory to problems in engineering (vehicle dynamics [B4, J20, J31, C3, C4, C9], attitude control of spacecrafts [C12, C14, C15]), biology (evolutionary dynamics [J17, J18]), pattern formation [J24, J30], fishery sustainability [J14, C18], drug delivery [J4]), and social sciences (interpersonal relationships [B3, J19, J21, J26, J27, J35], dynamics of conflicts [C7], behavioral models [J12, J25, J32, C6, J2]).

Automotive

Automation is revolutionizing vehicle dynamics. By substituting the direct links between driver and actuators with digital systems that can modulate driver commands, even the most clumsy driver can be turned into a fairly good chauffeur, or race pilot, depending on parameters setup. In my studies I focused both on the understanding of vehicle dynamics, fundamental to identify the cases—rare but very dangerous—that can lead to tragedy [B4, J31], and on the interaction between the driver and the vehicle [J20, C3, C4, C8, C9, J10]. The natural evolution of this trend is to use automatic control to improve cars behaviour not only in terms of dynamics, but in relation to the surrounding environment. New car models employ arrays of sensors to detect nearby objects, either to implement emergency braking or safety-distance-keeping systems or, in some cases, to allow for driverless functioning in sufficiently simple scenarios (such as on a highway). A step forward in this new trend of automotive technology will take place once vehicle-to-vehicle and vehicle-to-infrastructure communications will become widespread. In this direction, I studied efficient methods to understand traffic evolution on large-scale street networks [J34], and I developed minimal intrusive techniques to design achievable controllers able to prevent collisions at cities' intersections [J5, J7, J11, C8].

Complex networks

Most social, biological, and technological applications can be interpreted, and formally modeled, through a complex network. Thus, disclosing the main features of the structure of a network is crucial to understand a number of static and dynamic properties, such as robustness to failures, spreading dynamics, or collective behaviours. In my research I studied geometrically defined network properties (like the core-periphery characterization of a network [J23]), dynamical effects on stationary [J25] and time-dependent [C6] social networks, and network decomposition and mean-field approximations for the analysis of traffic problems [J11, J34]. Looking for collective behaviors, I re-discovered the qualitative resonance of chaotic oscillators [J8]—through which one can obtain complexity reduction via a designed control signal, I defined the new concept of targeted synchronization [J6]—find a signal able to synchronize only part of the system, or generating group of elements independently synchronized, and I theoretically and experimentally characterized complete and group synchronization in networks composed by different kind of interactions [J1].

Active noise control

Active noise control is a methodology for the cancellation or attenuation of disturbing acoustic noise. While passive noise control operates by sound absorption or reflection using passive elements, such as barriers, silencers, absorptive material, active noise control employs additional secondary sound sources to cancel the (primary) noise based on the destructive interference principle. The principal technique employed to generate the cancellation (secondary) signal is filtering, that must be adapted to take into account the (generically not Gaussian) nature of acoustic noise [J28, C13, C17].

TEACHING AND SERVICES TO THE RESEARCH COMMUNITY

today 2017	Lecturer <i>Fondamenti di Automatica</i> – 10 ECTS Politecnico di Milano, Laurea on-line (30 students, 80h)
today 2014	Teaching Assistant <i>Systems Theory (nonlinear dynamics)</i> – 5 ECTS Prof. Fabio Dercole, Politecnico di Milano (30 students, 20h)
today 2017	SICC Secreteriat <i>Italian Society for Chaos and Complexity</i> – www.sicc-it.org
2018 2010	Teaching Assistant <i>Teoria dei sistemi (Dinamica non lineare)</i> – 5 ECTS Prof. Sergio Rinaldi, Politecnico di Milano (200 students, 20h)
2018 2009	Teaching Assistant <i>Fondamenti di automatica (per ingegneria matematica)</i> – 10 ECTS Prof. Carlo Piccardi, Politecnico di Milano (200 students, 44h)
2016	Member of the organizing committee <i>Complex Networks 2016</i> , the 5th International Workshop on Complex Networks and their Applications
2016	Member of the organizing committee <i>Paradigmatic Models in Social Sciences</i> , the 11th SICC International Tutorial Workshop “Topics in nonlinear dynamics”
2015	Lecturer <i>Biology of Ecological System</i> – 5 ECTS Graduate Program in Ecology and Evolution, Ecole Normale Supérieure, Paris, France (30 students, 12h)
2014	Member of the organizing committee <i>Modeling and Analysis of Innovation and Competition Processes</i> , the 9th SICC International Tutorial Workshop “Topics in nonlinear dynamics”
2011 2009	Lecturer <i>The art of modelling</i> Alta Scuola Politecnica, Bardonecchia (50 students, 2h)

PUBLICATIONS

Citations overview

- Citation profile: <https://scholar.google.it/citations?user=1SjnbPcAAAAJ&hl=en>
- Total citations: 499 (google scholar), 306 (Scopus), 300 (ISI Web of Science)
- *h*-index: 14 (google scholar), 10 (Scopus), 9 (ISI Web of Science)
- *i10*-index: 18 (google scholar), 10 (Scopus), 9 (ISI Web of Science)

Books and book chapters

- [B1] S. Rinaldi and F. Della Rossa. “Mathematical Models of Romantic Relationships”. In: *Romantic Relationships. Perceptions, Social Influences and Gender Differences*. Ed. by K. M. Hughes. Nova Science Publishers, 2017, pp. 97–126.
- [B2] S. Rinaldi and F. Della Rossa. “Modelli matematici di storie d’amore”. In: *Quaderni di matematica - Overlapping of Mathematics and Humanities*. Ed. by C. Bruno and R. Alessio. Dipartimento di Matematica e Fisica, Università degli Studi della Campania Luigi Vanvitelli, 2017, pp. 97–126.
- [B3] S. Rinaldi, F. Della Rossa, F. Dercole, A. Gagnani, and P. Landi. *Modeling Love Dynamics*. Vol. 89. (reviewed in Nature). World Scientific, 2015.
- [B4] G. Mastinu, F. Della Rossa, and C. Piccardi. “Nonlinear dynamics of a road vehicle running into a curve”. In: *Applications of Chaos and Nonlinear Dynamics in Science and Engineering-Vol. 2*. Springer Berlin Heidelberg, 2012, pp. 125–153.

International Journals

- [J1] K. A. Blaha, K. Huang, F. Della Rossa, L. Pecora, M. Hossein-Zadeh, and F. Sorrentino. “Cluster Synchronization in Multilayer Networks: A Fully Analog Experiment with L C Oscillators with Physically Dissimilar Coupling”. In: *Physical Review Letters* 122.1 (2019), p. 014101.
- [J2] F. Dercole, F. Della Rossa, and C. Piccardi. “Direct reciprocity and model-predictive rationality explain network reciprocity over social ties”. In: *Scientific Reports* 9 (2019), p. 5367.
- [J3] G. Orlando and F. D. Rossa. “An Empirical Test on Harrod’s Open Economy Dynamics”. In: *Mathematics* 7.6 (2019), p. 524.
- [J4] A. Shirin, F. Della Rossa, I. Klickstein, J. Russell, and F. Sorrentino. “Optimal Regulation of Blood Glucose Level in Type I Diabetes using Insulin and Glucagon”. In: *PLOS ONE* 14 (2019), e0213665.
- [J5] G. de Campos, F. Della Rossa, and A. Colombo. “Safety verification methods for human-driven vehicles at traffic intersections: optimal driver-adaptive supervisory control”. In: *IEEE Transactions on Human-Machine Systems* 48.1 (2018), pp. 72–84.
- [J6] S. Chhabria, K. A. Blaha, F. Della Rossa, and F. Sorrentino. “Targeted synchronization in an externally driven population of mechanical oscillators”. In: *Chaos: An Interdisciplinary Journal of Nonlinear Science* 28.11 (2018), p. 111102.
- [J7] A. Colombo and F. Della Rossa. “Composition of least restrictive controllers, with application to collision avoidance in multiagent systems”. In: *IEEE Transactions on Automatic Control* 63.11 (2018), pp. 3972–3978.
- [J8] F. Della Rossa and F. Dercole. “Qualitative resonance of feedback-controlled chaotic oscillators”. In: *IFAC-PapersOnLine* 51.33 (2018), pp. 1–6.
- [J9] F. Della Rossa and F. Dercole. “Tree-based algorithms for the stability of discrete-time switched linear systems under arbitrary and constrained switching”. In: *IEEE Transactions on Automatic Control* (2018), accepted.
- [J10] F. Della Rossa and G. Mastinu. “Straight ahead running of a nonlinear car and driver model—new nonlinear behaviours highlighted”. In: *Vehicle system dynamics* 56.5 (2018), pp. 753–768.
- [J11] A. Colombo, G. R. De Campos, and F. Della Rossa. “Control of a city road network: distributed exact verification of traffic safety”. In: *IEEE Transactions on Automatic Control* (2017).
- [J12] F. Della Rossa, F. Dercole, and C. Vicini. “Extreme Selection Unifies Evolutionary Game Dynamics in Finite and Infinite Populations”. In: *Bulletin of mathematical biology* 5.79 (2017), pp. 1070–1099.
- [J13] F. Della Rossa and G. Mastinu. “Analysis of the lateral dynamics of a vehicle and driver model running straight ahead”. In: *Nonlinear Dynamics* (2017), pp. 1–10.
- [J14] F. Dercole and F. Della Rossa. “A deterministic eco-genetic model for the short-term evolution of exploited fish stocks”. In: *Ecological Modelling* 343 (2017), pp. 80–100.
- [J15] G. Mastinu, F. Della Rossa, M. Gobbi, and G. Previati. “Bifurcation Analysis of a Car Model Running on an Even Surface-A Fundamental Study for Addressing Autonomous Vehicle Dynamics”. In: *SAE International Journal of Vehicle Dynamics, Stability, and NVH* 1.2017-01-1589 (2017).
- [J16] S. Rinaldi and F. Della Rossa. “Conflicts among N armed groups: Scenarios from a new descriptive model”. In: *Nonlinear Dynamics* (2017), pp. 1–10.
- [J17] F. Dercole, F. Della Rossa, and P. Landi. “The transition from evolutionary stability to branching: A catastrophic evolutionary shift”. In: *Scientific reports* 6 (2016).

- [J18] F. Della Rossa, F. Dercole, and P. Landi. “The branching bifurcation of adaptive dynamics”. In: *International Journal of Bifurcation and Chaos* 25.07 (2015), p. 1540001.
- [J19] S. Rinaldi, P. Landi, and F. Della Rossa. “Temporary bluffing can be rewarding in social systems: The case of romantic relationships”. In: *The Journal of Mathematical Sociology* 39.3 (2015), pp. 203–220.
- [J20] F. Della Rossa, M. Gobbi, G. Mastinu, C. Piccardi, and G. Previati. “Bifurcation analysis of a car and driver model”. In: *Vehicle System Dynamics* 52.1 (2014), pp. 142–156.
- [J21] S. Rinaldi, F. Della Rossa, and P. Landi. “A mathematical model of “Pride and Prejudice””. In: *Nonlinear Dynamics in Psychology and Life Sciences* 18 (2014), pp. 199–211.
- [J22] V. De Witte, F. Della Rossa, W. Govaerts, and Y. A. Kuznetsov. “Numerical periodic normalization for codim 2 bifurcations of limit cycles: computational formulas, numerical implementation, and examples”. In: *SIAM Journal on Applied Dynamical Systems* 12.2 (2013), pp. 722–788.
- [J23] F. Della Rossa, F. Dercole, and C. Piccardi. “Profiling core-periphery network structure by random walkers”. In: *Scientific reports* 3 (2013).
- [J24] F. Della Rossa, S. Fasani, and S. Rinaldi. “Conditions for patchiness in plankton models”. In: *Theoretical Population Biology* 83 (2013), pp. 95–100.
- [J25] F. Dercole, M. De Carli, F. Della Rossa, and A. V. Papadopoulos. “Overpunishing is not necessary to fix cooperation in voluntary public goods games”. In: *Journal of Theoretical Biology* 326 (2013), pp. 70–81.
- [J26] S. Rinaldi, F. Della Rossa, and P. Landi. “A mathematical model of “Gone with the Wind””. In: *Physica A: Statistical Mechanics and its Applications* 392.15 (2013), pp. 3231–3239.
- [J27] S. Rinaldi, P. Landi, and F. Della Rossa. “Small discoveries can have great consequences in love affairs: The case of Beauty and The Beast”. In: *International Journal of Bifurcation and Chaos* 23.11 (2013), p. 1330038.
- [J28] M. Bergamasco, F. Della Rossa, and L. Piroddi. “Active noise control with on-line estimation of non-Gaussian noise characteristics”. In: *Journal of Sound and Vibration* 331.1 (2012), pp. 27–40.
- [J29] F. Della Rossa and F. Dercole. “Generalized boundary equilibria in n-dimensional Filippov systems: The transition between persistence and nonsmooth-fold scenarios”. In: *Physica D: Nonlinear Phenomena* 241.22 (2012), pp. 1903–1910.
- [J30] F. Della Rossa, S. Fasani, and S. Rinaldi. “Potential Turing instability and application to plant–insect models”. In: *Mathematical and Computer Modelling* 55.3 (2012), pp. 1562–1569.
- [J31] F. Della Rossa, G. Mastinu, and C. Piccardi. “Bifurcation analysis of an automobile model negotiating a curve”. In: *Vehicle System Dynamics* 50.10 (2012), pp. 1539–1562.
- [J32] S. Rinaldi, F. Della Rossa, and S. Fasani. “A conceptual model for the prediction of sexual intercourse in permanent couples”. In: *Archives of sexual behavior* 41.6 (2012), pp. 1337–1343.
- [J33] F. Dercole, F. Della Rossa, A. Colombo, and Y. A. Kuznetsov. “Two degenerate boundary equilibrium bifurcations in planar Filippov systems”. In: *SIAM Journal on Applied Dynamical Systems* 10.4 (2011), pp. 1525–1553.
- [J34] F. Della Rossa, C. D’Angelo, and A. Quarteroni. “A distributed model of traffic flows on extended regions.” In: *Networks and Heterogeneous Media* 5.3 (2010), pp. 525–544.
- [J35] S. Rinaldi, F. Della Rossa, and F. Dercole. “Love and appeal in standard couples”. In: *International Journal of Bifurcation and Chaos* 20.08 (2010), pp. 2443–2451.

International Conferences

- [C1] F. Della Rossa and F. Dercole. “A simple tree-based algorithm for deciding the stability of discrete-time switched linear systems”. In: *2017 IEEE 56th Annual Conference on Decision and Control (CDC)*. IEEE. 2017, pp. 5298–5303.
- [C2] A. Colombo, F. Della Rossa, F. Dercole, and C. Piccardi. “Measuring Robustness of Nonlinear Models via Randomized Continuation”. In: *Proceedings of the 2016 Workshop on Complexity in Engineering*. IEEE. 2016.
- [C3] F. Della Rossa, M. Gobbi, G. Mastinu, and G. Previati. “Countersteering to recover straight ahead running after a disturbance”. In: *ASME 2016 International Design Engineering Technical Conferences and Computers and Information in Engineering Conference*. American Society of Mechanical Engineers. 2016.
- [C4] F. Della Rossa and G. Mastinu. “Multiple attractors in a vehicle and driver model”. In: *Proceedings of the 2016 Workshop on Complexity in Engineering*. IEEE. 2016.

- [C5] F. Della Rossa, O. Sukharev, and G. Mastinu. “Straight ahead running of a non linear car and driver model”. In: *Advanced Vehicle Control: Proceedings of the 13th International Symposium on Advanced Vehicle Control (AVEC’16), September 13-16, 2016, Munich, Germany*. CRC Press. 2016, p. 243.
- [C6] F. Dercole, F. Della Rossa, and C. Piccardi. “Reciprocity supports selfish cooperation in heterogeneous social networks”. In: *Proceedings of the 2016 Workshop on Complexity in Engineering*. IEEE. 2016.
- [C7] S. Rinaldi and F. Della Rossa. “The fate of conflicts among N armed groups”. In: *Proceedings of the 2016 Workshop on Complexity in Engineering*. IEEE. 2016.
- [C8] G. R. de Campos, F. Della Rossa, and A. Colombo. “Optimal and least restrictive supervisory control: safety verification methods for human-driven vehicles at traffic intersections”. In: *54th IEEE Conference on Decision and Control*. IEEE. 2015, pp. 1707–1712.
- [C9] F. Della Rossa, M. Gobbi, G. Mastinu, C. Piccardi, and G. Previati. “Stability of Controlled Road Vehicles: A Preliminary Fundamental Study”. In: *ASME 2015 International Design Engineering Technical Conferences and Computers and Information in Engineering Conference*. American Society of Mechanical Engineers. 2015, V003T01A024–V003T01A024.
- [C10] F. Della Rossa and A. Colombo. “Bifurcation analysis of a power converter highlights open problems in piecewise smooth system theory”. In: *2014 European Nonlinear Conference*. 2014.
- [C11] F. Della Rossa and F. Dercole. “Automatic system perturbation for the continuation of codim-1 transcritical bifurcations in MatCont”. In: *2014 European Nonlinear Conference*. 2014.
- [C12] F. Della Rossa, F. Dercole, and M. Lovera. “Chaotic dynamics in an Earth pointing, magnetically controlled spacecraft”. In: *2014 European Nonlinear Conference*. 2014.
- [C13] M. Bergamasco, F. Della Rossa, and L. Piroddi. “Active noise control of impulsive noise with selective outlier elimination”. In: *2013 American Control Conference*. IEEE. 2013, pp. 4165–4170.
- [C14] F. Della Rossa, F. Dercole, and M. Lovera. “Attitude Stability Analysis for an Earth Pointing, Magnetically Controlled Spacecraft”. In: *Automatic Control in Aerospace*. Vol. 19. 1. 2013, pp. 518–523.
- [C15] F. Della Rossa, M. Bergamasco, and M. Lovera. “Bifurcation analysis of the attitude dynamics for a magnetically controlled spacecraft”. In: *51st IEEE Conference on Decision and Control*. 2012.
- [C16] F. Della Rossa and F. Dercole. “Generic and generalized boundary operating points in piecewise-linear (discontinuous) control systems”. In: *51st IEEE Conference on Decision and Control*. IEEE. 2012, pp. 7714–7719.
- [C17] M. Bergamasco, F. Della Rossa, and L. Piroddi. “Active control of impulsive noise with on-line outlier detection”. In: *IFAC Proceedings Volumes*. Vol. 44. 1. Elsevier, 2011, pp. 7909–7914.
- [C18] C. Bruschi, F. Della Rossa, and F. Dercole. “The ecology of exploited fish stocks: Consequences of technological innovation on stock quality and persistence”. In: *2011 European Nonlinear Conference*. 2011.
- [C19] F. Della Rossa and F. Dercole. “The transition from persistence to nonsmooth-fold scenarios in relay control system”. In: *IFAC Proceedings Volumes*. Vol. 44. 1. Elsevier, 2011, pp. 13287–13292.
- [C20] F. Dercole, F. Della Rossa, A. Colombo, and Y. A. Kuznetsov. “Codimension-two singularities on the stability boundary in 2D Filippov systems”. In: *IFAC Proceedings Volumes*. Vol. 44. 1. Elsevier, 2011, pp. 13281–13286.

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