

Alessandro Colombo

Curriculum Vitæ

Politecnico di Milano
Dept. of Electronics, Information, and
Bioengineering
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Research Interests

Nonlinear Dynamics and Control Theory, modelling and analysis of complex systems, mathematical modelling of human behaviour.

Academic Background

- 2018– **Associate Professor**, *Politecnico di Milano*, Italy.
- 2012 – 2018 **Assistant Professor**, *Politecnico di Milano*, Italy.
- 2010 – 2012 **Postdoctoral Associate**, *Massachusetts Institute of Technology*, Cambridge, MA, USA.
- 2010 **Visiting Fellow**, *Univeristy of Bristol*, UK.
- 2009 – 2010 **Postdoc**, *Politecnico di Milano*, Italy.
- 2006 – 2009 **PhD (cum laude)**, *Politecnico di Milano*, Italy.
PhD by research on “Bifurcation Analysis of Discontinuous Systems” funded by the Italian Ministry of Research and Education. The dissertation won the 2009 Chorafas Foundation Award.
- 2003 – 2005 **Diplôme d’Ingénieur (Master’s degree in Engineering)**, *ENSTA*, Paris, France.
Master’s degree in Engineering at the École Nationale Supérieure de Techniques Avancées. Final project on “Analysis of Complex Dynamics in Nonsmooth Dynamical Systems”, supervised by Prof. S. J. Hogan (University of Bristol, UK) graded 17.5/20, ECTS grading A, best 10%
- 2000 – 2003 **Laurea (Bachelor’s degree) in Electronics Engineering**, *Politecnico di Milano*, Italy.
Bachelor’s degree in Electronics Engineering, 110/110 cum laude

Editorial Activities

- 2018 – **Nonlinear Analysis: Hybrid Systems**, IFAC Journal, Associate Editor.
- 2023 – **IEEE International Conference on Intelligent Transportation Systems (ITSC)**, Associate Editor.
- 2019 – 2022 **IEEE International Conference on Human-Machine Systems**, Technical Program Committee Member.
- 2016 – 2021 **IEEE International Symposium on Circuits and Systems (ISCAS)**, Review committee member.
- 2017 – 2019 **IEEE Conference on Automation Science and Engineering (CASE)**, Associate Editor.
- 2014 – 2017 **International Workshop on Wireless Networking and Control for Unmanned Autonomous Vehicles (WI-UAV)**, Program Committee member.

Other Professional Activities

- 2021 – **Head of the Modelling, Analysis, and Dynamics of Human Action Lab at Politecnico di Milano.**
- 2018 – **Inventor of 3 patents.**
- 2020 – 2022 **Member of the IEEE ITSS Italy Chapter Best PhD Thesis Award Organising Committee.**

- 2014 – **Member of the IEEE CSS Technical Committee on Hybrid Systems.**
- 2014 – **Member of the IEEE CASS Nonlinear Circuits and Systems Technical Committee.**
- 2018 – **Senior member of the IEEE.**

Languages

Italian	Mother Tongue
English	Proficient
French	Proficient
Spanish	Basic

Publications

Journal Papers

- P. Bolzern, A. Colombo, and C. Piccardi., Manipulating Opinions in Social Networks with Community Structure, *IEEE Transactions on Network Science and Engineering*, accepted, **2023**
- N. Dozio, L. Rozza, M. S. Lukasiewicz, A. Colombo, and F. Ferrise., Localization and prediction of visual targets' position in immersive Virtual Reality, *PRESENCE: Virtual and Augmented Reality*, accepted, **2023**
- A. Colombo, R. Maj, M. Canina., F. Fedeli, N. Dozio, and F. Ferrise, Design of a sensor network for the quantitative analysis of sport climbing, *Frontiers in Sports and Active Living*, 5, **2023**
- M. Bahraini, M. Zanon, P. Falcone., and A. Colombo, Scheduling and Robust Invariance in Networked Control Systems, *IEEE Transactions on Automatic Control*, 6, 3075–3082, **2022**
- M. Bahraini, M. Zanon, A. Colombo, and P. Falcone. Optimal scheduling and control for constrained multi-agent networked control systems, *Optimal Control Applications and Methods*, 43, 23–43, **2022**
- A. Colombo. The Basic Reproduction Number as a Loop Gain Matrix, *IEEE Control Systems Letters*, 6, 199–204, **2021**
- M. Bahraini, M. Zanon, A. Colombo, and P. Falcone. Optimal Control Design for Perturbed Constrained Networked Control Systems, *IEEE Control Systems Letters*, 5, 553–558, **2021**
- D. Maffiodo, R. Sesana, S. Gabetti, and A. Colombo. Innovative force sensor for indoor climbing holds. *Journal of Sports Engineering and Technology*, **2020**.
- H. Ahn and A. Colombo. Abstraction-based Safety Verification and Control of Cooperative Vehicles at Road Intersections. *IEEE Transactions on Automatic Control*, 65:4061–4074, **2020**.
- H. Ahn, A. Rizzi, and A. Colombo Robust supervisors for intersection collision avoidance in the presence of legacy vehicles. *International Journal of Control, Automation and Systems*, **2019**.
- N. Tomiati, A. Colombo, and G. Magnani. A Nonlinear Model of Bicycle Shimmy. *Vehicle Systems Dynamics*, 57:315–335, **2019**.
- A. Colombo and F. Della Rossa. Composition of Least Restrictive Controllers, with Application to Collision Avoidance in Multiagent Systems. *IEEE Transactions on Automatic Control*, 63:3972–3978, **2018**.
- A. Colombo, N. Del Buono, L. Lopez, and A. Publiese. Computational techniques to locate crossing/sliding regions and their sets of attraction in non-smooth dynamical systems. *Discrete and Continuous Dynamical Systems Series B*, 23:2911–2934, **2018**.

- G. Rodrigues de Campos, F. Della Rossa, and A. Colombo. Safety verification methods for human-driven vehicles at traffic intersections: optimal driver-adaptive supervisory control. *IEEE Transactions on Human-Machine Systems*, 41:27–84, **2018**.
- A. Colombo, G. Rodrigues de Campos, and F. Della Rossa. Control of a city road network: distributed exact verification of traffic safety. *IEEE Transactions on Automatic Control*, 62:4933–4948, **2017**.
- E. Dallal, A. Colombo, D. Del Vecchio, and S. Lafortune. Supervisory Control for Collision Avoidance in Vehicular Networks Using Discrete Event Abstractions. *Discrete Event Dynamic Systems*, 27:1-44, **2017**.
- A. Colombo. A choice between smooth and nonsmooth models. *Trends in Mathematics*, 8:43-47, **2017**.
- F. Bizzarri, A. Colombo, F. Dercole, and G. Storti Gajani. Necessary and sufficient conditions for the noninvertibility of fundamental solution matrices of a discontinuous system. *SIAM Journal on Applied Dynamical Systems*, 15:84–105, **2016**.
- C. Piccardi, A. Colombo and R. Casagrandi. Connectivity interplays with age in shaping contagion over networks with vital dynamics. *Physical Review E*, 91:022809, **2015**.
- A. Colombo and D. Del Vecchio. Least restrictive supervisors for intersection collision avoidance: A scheduling approach. *IEEE Transactions on Automatic Control*, 60:1515–1527, **2015**.
- A. Colombo and M. R. Jeffrey. The two-fold singularity of nonsmooth flows: Leading order dynamics in n-dimensions. *Physica D*, 263:1–10, **2013**.
- A. Colombo, M. di Bernardo, S. J. Hogan, and M. R. Jeffrey. Bifurcations of piecewise smooth flows: Perspectives, methodologies and open problems. *Physica D*, 241, 1845–1860, **2012**.
- F. Dercole, F. Della Rossa, A. Colombo, and Y. A. Kuznetsov. Two degenerate boundary equilibrium bifurcations in planar Filippov systems. *SIAM Journal on Applied Dynamical Systems*, 10:1525–1553, **2011**.
- A. Colombo and M. R. Jeffrey. Nondeterministic chaos, and the two-fold singularity in piecewise smooth flows. *SIAM Journal on Applied Dynamical Systems*, 10:423–451, **2011**.
- A. Colombo and F. Dercole. Discontinuity induced bifurcations of nonhyperbolic cycles in nonsmooth systems. *SIAM Journal on Applied Dynamical Systems*, 9:62–83, **2010**.
- A. Colombo, M. di Bernardo, E. Fossas, and M. R. Jeffrey. Teixeira singularities in 3D switched feedback control systems. *Systems and Control Letters*, 59, 615–622, **2010**.
- T. Insperger, P. Wahi, A. Colombo, G. Stépán, M. di Bernardo, and S. J. Hogan. Full characterization of act-and-wait control for first-order unstable lag processes. *Journal of Vibration and Control*, 16:1209–1233, **2010**.
- A. Colombo and U. Galvanetto. Stable manifolds of saddles in piecewise smooth systems. *CMES, Computer Modeling in Engineering & Sciences*, 53:235–254, **2009**.
- A. Colombo, P. Lamiani, L. Benadero, and M. di Bernardo. Two-parameter bifurcation analysis of the buck converter. *SIAM Journal on Applied Dynamical Systems*, 8:1507–1522, **2009**.
- M. R. Jeffrey and A. Colombo. The two-fold singularity of discontinuous vector fields. *SIAM Journal on Applied Dynamical Systems*, 8:624–640, **2009**.
- F. Bizzarri, M. Storace, and A. Colombo. Bifurcation analysis of an impact model for forest fire prediction. *International Journal of Bifurcation and Chaos*, 18:2275–2288, **2008**.
- A. Colombo. Boundary intersection crossing bifurcation in the presence of sliding. *Physica D*, 237:2900–2912, **2008**.
- A. Colombo, F. Dercole, and S. Rinaldi. Remarks on metacommunity synchronization with application to prey-predator systems. *The American Naturalist*, 171:430–442, **2008**. The paper was highlighted in Faculty of 1000 Biology: <http://www.f1000biology.com/article/id/1104173/evaluation>.

A. Colombo and S. Rinaldi. Chaos in two-party democracies. *International Journal of Bifurcation and Chaos*, 18:2133–2140, **2008**.

A. Colombo, M. di Bernardo, S. J. Hogan, and P. Kowalczyk. Complex dynamics in a hysteretic relay feedback system with delay. *Journal of Nonlinear Science*, 17:85–108, **2007**.

Conference Papers

M. Bahraini, M. Zanon, A. Colombo, and P. Falcone. Communication Demand Minimization for Perturbed Networked Control Systems with Coupled Constraints. In *IEEE Conference on Decision and Control*. **2023**.

M. Secco, M. Giannotti, A. Colombo, and F. Garzotto. Multisensory Climbing in the Magic Room In *Interact*. **2023**.

M. Bahraini, A. Colombo, M. Zanon, and P. Falcone. Robust Control Invariance for Networked Control Systems with Output Feedback. In *IEEE Conference on Decision and Control*. **2022**.

Monoli, C., Simoni, G., Tuhtan, J., Palermo, E., Galli, M. and Colombo, A. Motion Analysis of Therapeutic Climbing: A Rehabilitation Tool for Children with Cerebral Palsy. In *27th Congress of the European Society of Biomechanics*. **2022**.

Colombo, A., Canina, M., Ferrise, F., Dozio, N., Brondolin, R., Parise, C, and Maj, R. ACCEPT - A Sensorized Climbing Wall for Motor Rehabilitation In *5th International Rock Climbing Research Congress*. **2021**.

M. Bahraini, M. Zanon, A. Colombo, and P. Falcone. Receding-horizon robust online communication scheduling for constrained networked control systems. In *European Control Conference*. **2019**.

A. Colombo, M. Bahraini and P. Falcone. Measurement Scheduling for Control Invariance in Networked Control Systems. In *IEEE Conference on Decision and Control*. **2018**.

F. Bizzarri, A. Brambilla, A. Colombo, and S. Callegari. Constant-Time Discontinuity Map for Forward Sensitivity Analysis to Initial Conditions: Spurs Detection in Fractional-N PLL as a Case Study. In *International Symposium on Circuits and Systems*. **2017**.

H. Ahn, A. Colombo, and D. Del Vecchio. Experimental Testing of Semi-autonomous Multi-vehicle Control for Collision Avoidance at Intersections. In *IEEE/RSJ International Conference on Intelligent Robots and Systems*. **2015**.

A. Colombo. Numerically Efficient Robustness Test for Nonlinear Circuit Models. In *International Symposium on Circuits and Systems*. **2015**.

A. Colombo, and H. Wymeersch. Cooperative intersection collision avoidance in a constrained communication environment. In *IEEE International Conference on Intelligent Transportation Systems*. **2015**.

G. Rodrigues 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 *IEEE Conference on Decision and Control*. **2015**.

H. Ahn, A. Colombo, and D. Del Vecchio. Supervisory control for intersection collision avoidance in the presence of uncontrolled vehicles. In *American Control Conference*. **2014**.

A. Colombo. A mathematical framework for cooperative collision avoidance of human-driven vehicles at intersections. In *International Symposium on Wireless Communication Systems*, pages 449–453. **2014**.

F. Della Rossa and A. Colombo. Bifurcation analysis of a power converter highlights open problems in piecewise smooth system theory. In *ENOC*. **2014**.

L. Bruni, A. Colombo, and D. Del Vecchio. Robust multi-agent collision avoidance through scheduling. In *IEEE Conference on Decision and Control*. **2013**.

- A. Colombo and A. Girard. An approximate abstraction approach to safety control of differentially flat systems. In *European Control Conference*. **2013**.
- E. Dallal, A. Colombo, D. Del Vecchio, and S. Lafortune. Supervisory control for collision avoidance in vehicular networks using discrete event abstractions. In *American Control Conference*. **2013**.
- E. Dallal, A. Colombo, D. Del Vecchio, and S. Lafortune. Supervisory control for collision avoidance in vehicular networks with imperfect measurements. In *IEEE Conference on Decision and Control*. **2013**.
- U. Galvanetto and A. Colombo. Computation of the basins of attraction in non-smooth dynamical systems. In *Proceedings of the IUTAM Symposium on Nonlinear Dynamics for Advanced Technologies and Engineering Design, Aberdeen*. **2013**.
- A. Colombo and D. Del Vecchio. Efficient algorithms for collision avoidance at intersections. In *Hybrid Systems: Computation and Control* **2012**.
- A. Colombo and D. Del Vecchio. Supervisory control of differentially flat systems based on abstraction. In *IEEE Conference on Decision and Control*. **2011**.
- A. Colombo and D. Del Vecchio. Enforcing safety of cyberphysical systems using flatness and abstraction. In *IEEE/ACM Second International Conference on Cyber-Physical Systems*. **2011**.
- M. di Bernardo, A. Colombo, and E. Fossas. Two-fold singularity in nonsmooth electrical systems. In *Proceedings of the 2011 IEEE International Symposium on Circuits and Systems*. **2011**.
- F. Dercole, F. Della Rossa, A. Colombo, and Y. A. Kuznetsov. Codimension-two singularities on the stability boundary in relay control systems. In *IFAC World Congress*. **2011**.
- A. Colombo and U. Galvanetto. On the boundaries of basins of attraction in piecewise smooth systems. In *COMPENG2010, Complexity in Engineering*, pages 100–102. **2010**.
- A. Colombo and F. Dercole. Border collision of nonhyperbolic fixed points. *Proceedings of CHAOS09, second IFAC meeting related to analysis and control of chaotic systems*. **2009**.

Personal Interests

Free climbing, mountaineering, and photography

I am a national mountaineering instructor (INA) of the Italian Alpine Club (CAI)