# Filippo Fabiani, Ph.D.


CURRENT POSITION & CONTACT

**Assistant Professor (Senior, RTD-B)**
DYSCO Research Unit
IMT School for Advanced Studies Lucca
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RESEARCH INTERESTS

Nonconvex game theory, learning-based and randomized methods for control and optimization, system theory

EDUCATION

**Ph.D.** (*cum laude*), Automatic Control – University of Pisa — May 2019

- Thesis: *Potential game theoretic control of complex multi-agent systems*
- Supervisor: Prof. A. Caiti, Prof. S. Grammatico (co-supervisor)

**M.Sc.** (*full marks*), Automatic Control Engineering – University of Pisa — Apr. 2015

- Thesis: *Fault detection and isolation on thrusters of an over-actuated marine vehicle*
- Supervisor: Prof. A. Caiti

**B.Sc.**, Bioengineering - University of Pisa — Dec. 2012

- Thesis: *A software system for testing parameter identifiability of biomedical models*
- Supervisor: Prof. A. Landi

RESEARCH EXPERIENCE

**Assistant Professor (Senior, RTD–B)** — Nov. 2023 – Today
DYSCO Research Unit
IMT School for Advanced Studies Lucca (IT)

**Assistant Professor (Junior, RTD–A)** — Sept. 2022 – Oct. 2023
DYSCO Research Unit
IMT School for Advanced Studies Lucca (IT)

**Post-doctoral Research Assistant** — Nov. 2019 – Aug. 2022
Department of Engineering Science – Control Group
University of Oxford (UK)
Supervisor: Prof. P. J. Goulart

**Post-doctoral Research Fellow** — Nov. 2018 – Oct. 2019
Delft Center for Systems and Control
Delft University of Technology (NL)
Supervisor: Prof. S. Grammatico

**Ph.D. Candidate** Nov. 2015 – Oct. 2018
Department of Information Engineering
University of Pisa (IT)
Supervisor: Prof. A. Caiti, Prof. S. Grammatico (co-supervisor)

**Research Fellow** Jun. 2015 – Sept. 2015
Research Center "E. Piaggio"
University of Pisa (IT)
Supervisor: Prof. A. Caiti

## Research Stays

**Harbin Institute of Technology, CH** Jan. 2024
School of Astronautics

**Delft University of Technology, NL** Nov. 2017 – Jun. 2018
Delft Center for Systems and Control
Supervisor: Prof. S. Grammatico, Prof. B. De Schutter
Topic: Mixed-integer game theoretic control, potential game theory, automated driving

**University of Udine, IT** May 2017
Department of Mathematics and Informatics
Supervisor: Prof. F. Blanchini
Topic: Set-theoretic and constrained control, decentralized optimization and control

## Teaching Activity

**Instructor** Spring 2024
Course: Optimization and Machine Learning for Dynamical Systems
Class hours: 60
University of Florence

**Teaching assistant** Trinity Term 2022
Course: LEGO football coursework
Class hours: 16
Department of Engineering Science, University of Oxford

**Teaching assistant (Ph.D. course)** Hilary Term 2022
Course: Introduction to Modern Control
Class hours: 30
CDT AIMS[1] – Department of Engineering Science, University of Oxford

**College tutor – Christ Church** Michaelmas Term 2021
Course: A1 (Mathematics) + A2 (Electronic and Information Engineering)
Class hours: 30
Department of Engineering Science, University of Oxford

**College tutor – Hertford** Michaelmas Term 2021
Course: A2 (Electronic and Information Engineering)
Class hours: 10
Department of Engineering Science, University of Oxford

**Teaching assistant** Trinity Term 2021
Course: LEGO football coursework
Class hours: 30
Department of Engineering Science, University of Oxford

[1] Centre for Doctoral Training in Autonomous Intelligent Machines & Systems

**Teaching assistant (Ph.D. course)** Hilary Term 2021
Course: Introduction to Modern Control
Class hours: 30
CDT AIMS – Department of Engineering Science, University of Oxford

**Teaching assistant (Ph.D. course)** Hilary Term 2020
Course: Introduction to Modern Control
Class hours: 30
CDT AIMS – Department of Engineering Science, University of Oxford

**Teaching assistant** Winter 2019
Course: Model Predictive Control – 4 ECTS
Class hours: 18
3mE – Delft Center for Systems and Control, Delft University of Technology

**Teaching assistant** Fall 2017
Course: Automatic Control – 6 CFU
Class hours: 20
Department of Civil and Industrial Engineering, University of Pisa

**Teaching assistant** Fall 2016 – Spring 2017
Course: Automatic Control – 9 CFU
Class hours: 30
Department of Civil and Industrial Engineering, University of Pisa

**Teaching assistant** Fall 2016
Course: Systems and Control Theory – 12 CFU
Class hours: 10
Department of Information Engineering, University of Pisa

**Teaching assistant** Spring 2016
Course: Systems and Control Theory – 12 CFU
Class hours: 20
Department of Information Engineering, University of Pisa

## Ph.D. Supervision

- Saugat Shahi, XXXIX Ph.D. Cycle (A.A. 2023-2026) –IMT School for Advanced Studies Lucca, Italy. Ph.D. in Systems Science - Learning and Control track.

## M.Sc. Theses Co-Advisor

- "Multi-Agent Deep Reinforcement Learning for Automated Highway Driving," M.Sc. program in Mechanical Engineering – Systems and Control, Delft University of Technology. Student: Lou Bakker. Academic year: 2018/2019.
- "Rilevamento di guasti sugli attuatori di un veicolo marino sovra-attuato tramite Analisi delle Componenti Principali," M.Sc. program in Automatic Control, University of Pisa. Student: Simone Della Tommasina. Academic year: 2015/2016.

## Participation in Research Projects

**Local Energy Oxfordshire (LEO)** Nov. 2019 – Aug. 2022
Website: `project-leo.co.uk`
Total budget: £40m
Financial support: UK Research and Innovation (UKRI) + private funding
Partners: Scottish and Southern Electricity Networks, Oxford City Council, Oxfordshire County Council, Low Carbon Hub, University of Oxford, Oxford Brookes University, Origami, Piclo, Nuvve, EDF
Role: Principal researcher in control and optimization – Workpackage 3

**Intelligent Autonomous Vehicles** Nov. 2018 – Oct. 2019
Website: `intelligent-vehicles.org/research/projects`
Total budget: €60k
Financial support: Delft University of Technology – 3mE Cohesion project
Role: Principal researcher in control and optimization

## Research Grants

**Erasmus+ Traineeship Grant** 2018-2019
Website: Erasmus+
Total budget: €1k
Financial support: European Community/TU Delft
Program: Mobility grant to attend workshops at the Politecnico di Torino

**Ph.D. Scholarship** 2015-2018
Website: Ph.D. @ University of Pisa
Total budget: €42k
Financial support: Italian Ministry for the Instruction, University and Research (MIUR)
Program: Ph.D. course in Information Engineering – Automatic Control

## Technological transfer activity

- "Progetto e sviluppo di software di isolamento e accomodamento guasti per il veicolo subacqueo autonomo sovra-attuato "V-Fides"", research contract funded by Research Center "E. Piaggio", University of Pisa, €4.5k, 2015.

## Participations to Scientific Events

**IEEE Conference on Decision and Control** Dec. 2023
Website: CDC'23 (Singapore, SGP)
Presented paper(s): "Counter-example guided inductive synthesis of control Lyapunov functions for uncertain systems"

**IEEE Conference on Decision and Control** Dec. 2022
Website: CDC'22 (Cancún, MEX)
Presented paper(s): "Proximal-like algorithms for equilibrium seeking in mixed-integer Nash equilibrium problems"

**Symposium on Mathematical Theory of Networks and Systems** Sept. 2022
Website: MTNS'22 (Bayreuth, DE)
Presented paper(s): "On the exact neural approximations of MPC laws"

**European Control Conference** July 2022
Website: ECC'22 (London, UK)
Presented paper(s): "Learning equilibria with personalized incentives in a class of nonmonotone games"

**IEEE Conference on Decision and Control** Dec. 2021
Website: CDC'21 (virtual)
Presented paper(s): "Probabilistic stabilizability certificates for a class of black-box linear systems", "Pursuing robust decision in uncertain traffic equilibrium problems"

**IEEE American Control Conference** May 2021
Website: ACC'21 (virtual)
Presented paper(s): "The optimal transport paradigm enables data compression in data-driven robust control"

**IEEE Conference on Decision and Control** Dec. 2020
Website: CDC'20 (virtual)
Presented paper(s): "On the robustness of equilibria in generalized aggregative games"

**IEEE Mediterranean Control Conference** Sept. 2020
Website: MED'20 (virtual)
Presented paper(s): "A forward-backward algorithm for decomposable semi-definite programs"

**IEEE Conference on Decision and Control** Dec. 2019
Website: CDC'19 (Nice, FRA)
Presented paper(s): "Charging plug-in electric vehicles as a mixed-integer aggregative game"

**European Control Conference** June 2019
Website: ECC'19 (Naples, ITA)
Presented paper(s): "Nash equilibrium seeking in potential games with double-integrator agents"

**IEEE Conference on Decision and Control** Dec. 2018
Website: CDC'18 (Miami, USA)
Presented paper(s): "On merging constraints and optimal control-Lyapunov functions", "A Mixed-Logical-Dynamical model for Automated Driving on highways"

**MTS/IEEE Oceans** Sept. 2016
Website: Oceans'16 (Monterey, USA)
Presented paper(s): "A passivity-based framework for coordinated distributed control of AUV teams: Guaranteeing stability in presence of range communication constraints"

**IFAC Conference on Control Applications in Maritime Systems** Sept. 2016
Website: CAMS'16 (Trondheim, NOR)
Presented paper(s): "A distributed, passivity-based control of autonomous mobile sensors in an underwater acoustic network"

**IEEE Conference on Control and Fault-Tolerant Systems** Sept. 2016
Website: SysTol'16 (Barcelona, SPA)
Presented paper(s): "A NLPCA hybrid approach for AUV thrusters fault detection and isolation"

## Invited Talks & Seminars

**Beijing Institute of Technology** January 2024
School of Automation
Title: "Rigorous machine learning methods for control and decision-making"

**University of Pisa** Dec. 2022
Department of Information Engineering
Title: "An overview on polytopic systems"

**Harbin Institute of Technology** April 2022
Short course (virtual)
Title: "Game Theory - An Introductory Taste"

**Harbin Institute of Technology** Oct. 2020
Overseas Postdoctoral Series (virtual)
Title: "Convergence in uncertain linear systems"

**University of Pisa** Feb. 2016
Research Center "E. Piaggio"
Title: "Positive invariance and fault tolerant controls"

## Academic Community Service

**Invited session**

- Organizer of the session on "Recent advancements in data-driven decision-making and control" – American Control Conference (ACC), 2024.

- Organizer of the session on "Risk Assessment in Learning-Based Control and Decision-Making" – 61st IEEE Annual Conference on Decision and Control (CDC), 2022.
- Organizer of the sessions on "Learning with Guarantees in Control and Decision-Making I/II" – 60th IEEE Annual Conference on Decision and Control (CDC), 2021.

**Editorial activity**

- Guest Editor – Special issue on "Recent Advances in Optimization and Games for the Control of Multiple Autonomous Vehicles", *IET Control Theory and Applications*, 2023.
- Guest Editor – Special issue on "Game Theory and Its Application in Energy Management and Power Systems", *Games* (ISSN 2073-4336), 2022.
- Guest Editor – Special issue on "Symmetry of Intelligent Systems: Learning Based Control and Filtering", *Symmetry* (ISSN 2073–8994), 2022.
- International Program Committee member – IFAC Conference on Nonlinear Model Predictive Control (NMPC) 2024.
- Program Committee member – Learning for Dynamics & Control Conference (L4DC) 2024.
- Conference Editorial Board – European Control Conference (ECC) 2022, 2023, 2024.

**Reviewer**

- Automatica
- IEEE Transactions on Automatic Control
- IEEE Transactions on Control of Network Systems
- IEEE Control Systems Letters

## Awards

- IEEE Control Systems Letters Outstanding Reviewer 2022

## Preprints

5. **F. Fabiani**, B. Stellato, D. Masti, and P. J. Goulart, "A neural network-based approach to hybrid systems identification for control," submitted to *Automatica*, 2024. (Available at `arxiv.org/abs/2404.01814`)
4. D. Masti, **F. Fabiani** and V. Breschi, "Boosting performance of direct model-reference controllers: A closed-loop estimation approach," submitted to the *IEEE Control Systems Letters*, 2024.
3. **F. Fabiani** and S. Sagratella, "On best-response algorithms for monotone Nash equilibrium problems with mixed-integer variables," submitted to the *SIAM Journal of Optimization*, 2023. (Available at `arxiv.org/abs/2310.09885`)
2. **F. Fabiani** and A. Bemporad, "An active learning method for solving competitive multi-agent decision-making and control problems," submitted to the *IEEE Transactions on Automatic Control*, 2023. (Available at `arxiv.org/abs/2212.12561`)
1. S. Yuan, Y. Wang, Z. Zhang and **F. Fabiani**, "Fast and safe spacecraft proximity and rendezvous: A hierarchical approach," submitted to the *IEEE Transactions on Aerospace and Electronic Systems*, 2022. (Under review)

## Journal Publications

19. **F. Fabiani** and P. J. Goulart, "Robust stabilization of polytopic systems via fast and reliable neural network-based approximations," *Int J. Robust Nonlinear Control*, 2024, DOI: 10.1002/RNC.7315

18. G. Carnevale, **F. Fabiani**, F. Fele, K. Margellos and G. Notarstefano, "Tracking-based distributed equilibrium seeking for aggregative games," *IEEE Transactions on Automatic Control*, 2024, DOI: 10.1109/TAC.2024.3368967

17. **F. Fabiani** and A. Simonetto, "Incentives and co-evolution: Steering linear dynamical systems with noncooperative agents ," *IEEE Transactions on Control of Network Systems*, 2023, DOI: 10.1109/TCNS.2023.3332780.

16. **F. Fabiani** and B. Franci, "On distributionally robust generalized Nash games defined over the Wasserstein ball," *Journal of Optimization Theory and Applications*, vol. 199, pp. 298–309, 2023.

15. **F. Fabiani**, A. Simonetto and P. J. Goulart, "Personalized incentives as feedback design in generalized Nash equilibrium problems," *IEEE Transactions on Automatic Control*, vol. 68, no. 12, pp. 7724–7739, 2023.

14. D. Masti, **F. Fabiani**, G. Gnecco and A. Bemporad, "Counter-example guided inductive synthesis of control Lyapunov functions for uncertain systems," *IEEE Control Systems Letters*, vol. 7, pp. 2047–2052, 2023.

13. **F. Fabiani** and P. J. Goulart, "Reliably-stabilizing piecewise-affine neural network controllers," *IEEE Transactions on Automatic Control*, vol. 68, no. 9, pp. 5201–5215, 2023.

12. G. Pantazis, **F. Fabiani**, F. Fele and K. Margellos, "Probabilistically robust stabilizing allocations in uncertain coalitional games," *IEEE Control Systems Letters*, vol. 6, pp. 3128–3133, 2022.

11. S. Yuan, **F. Fabiani** and S. Baldi, "Numerical optimization-based extremum seeking control of a class of constrained nonlinear systems via finite-time state transition." *Int J. Robust Nonlinear Control*, vol. 32, no. 11, pp. 6379–6394, 2022.

10. **F. Fabiani**, K. Margellos and P. J. Goulart, "Probabilistic feasibility guarantees for solution sets to uncertain variational inequalities," *Automatica*, vol. 137, pp. 110120, 2022.

9. **F. Fabiani**, M. A. Tajeddini, H. Kebriaei and S. Grammatico, "Local Stackelberg equilibrium seeking in generalized aggregative games," *IEEE Transactions on Automatic Control*, vol. 67, no. 2, pp. 965–970, 2022.

8. **F. Fabiani**, K. Margellos and P. J. Goulart, "Probabilistic stabilizability certificates for a class of black-box linear systems," *IEEE Control Systems Letters*, vol. 6, pp. 584–589, 2022.

7. F. Blanchini, D. Casagrande, **F. Fabiani**, G. Giordano, D. Palma and R. Pesenti, "A threshold mechanism ensures minimum-path flow in lightning discharge," *Scientific Reports*, 11(1), 1–9, 2021.

6. **F. Fabiani**, G. Belgioioso, F. Blanchini, P. Colaneri and S. Grammatico, "Convergence in uncertain linear systems," *Automatica*, vol. 119, pp. 109058, 2020.

5. **F. Fabiani** and S. Grammatico, "Multi-vehicle automated driving as a generalized mixed-integer potential game," *IEEE Transactions on Intelligent Transportation Systems*, vol. 21, no. 3, pp. 1064–1073, 2020.

4. F. Blanchini, D. Casagrande, **F. Fabiani**, G. Giordano and R. Pesenti, "Network-decentralized optimization and control: an explicit saturated solution," *Automatica*, vol. 103, pp. 379–389, 2019.

3. G. Belgioioso, **F. Fabiani**, F. Blanchini and S. Grammatico, "On the convergence of discrete-time linear systems: a linear time-varying Mann iteration converges iff its operator is strictly pseudocontractive," *IEEE Control Systems Letters*, vol. 2, no. 3, pp. 453–458, 2018.

2. **F. Fabiani**, D. Fenucci and A. Caiti, "A distributed passivity approach to AUV teams control in cooperating potential games," *Ocean Engineering*, vol. 157, pp. 152–163. 2018.

1. S. Mintchev, R. Ranzani, **F. Fabiani** and C. Stefanini, "Towards docking for small scale underwater robots," *Autonomous Robots*, vol. 38, no. 3, pp. 283–299, 2015.

## Conference Publications

28. B. Franci, **F. Fabiani** and L. Zino, "Generalized Nash equilibrium problems under partial-decision information with biased agents," *Decision and Control (CDC), 2024 IEEE 63rd Annual Conference on*, IEEE. (Under review)

27. A. Peruffo, D. Masti, D. Grande and **F. Fabiani**, "Fault-tolerant control of autonomous underwater vehicles: An inductive synthesis approach," *Decision and Control (CDC), 2024 IEEE 63rd Annual Conference on*, IEEE. (Under review)

26. G. Carnevale, **F. Fabiani**, F. Fele, K. Margellos and G. Notarstefano, "Distributed equilibrium seeking in aggregative games: linear convergence under singular perturbations lens," *Decision and Control (CDC), 2024 IEEE 63rd Annual Conference on*, IEEE. (Under review)

25. **F. Fabiani**, B. Franci, M. Schmidt and M. Staudigl, "A mixed-integer-programming-based Gauss-Seidel method for multi-leader-multi-follower games," *Decision and Control (CDC), 2024 IEEE 63rd Annual Conference on*, IEEE. (Under review)

24. G. Pantazis, F. Fele, **F. Fabiani**, S. Grammatico and K. Margellos, "Probably approximately correct stability of allocations in uncertain coalitional games with private sampling," in *6th Annual Learning for Dynamics & Control Conference*, 2024. (Accepted)

23. B. Franci and **F. Fabiani**, "Sharing beliefs to learn Nash equilibria," in *2024 European Control Conference (ECC)*. IEEE, 2024. (Accepted)

22. D. Masti, **F. Fabiani**, G. Gnecco and A. Bemporad, "Counter-example guided inductive synthesis of control Lyapunov functions for uncertain systems," *Decision and Control (CDC), 2023 IEEE 62nd Annual Conference on*, IEEE.

21. M. Fochesato, **F. Fabiani** and J. Lygeros, "Generalized uncertain Nash games: Reformulation and robust equilibrium seeking," in *2023 European Control Conference (ECC)*. IEEE, 2023, pp. 1–6.

20. **F. Fabiani**, B. Franci, S. Sagratella, M. Schmidt and M. Staudigl, "Proximal-like algorithms for equilibrium seeking in mixed-integer Nash equilibrium problems," *Decision and Control (CDC), 2022 IEEE 61st Annual Conference on*, pp. 4137–4142, IEEE.

19. **F. Fabiani** and B. Franci, "A stochastic generalized Nash equilibrium model for platforms competition in the ride-hail market," *Decision and Control (CDC), 2022 IEEE 61st Annual Conference on*, pp. 4455–4460, IEEE.

18. G. Pantazis, **F. Fabiani**, F. Fele and K. Margellos, "Probabilistically robust stabilizing allocations in uncertain cooperative games," *Decision and Control (CDC), 2022 IEEE 61st Annual Conference on*, IEEE.

17. **F. Fabiani**, A. Simonetto and P. J. Goulart, "Learning equilibria with personalized incentives in a class of nonmonotone games," in *2022 European Control Conference (ECC)*. IEEE, 2022, pp. 2179–2184.

16. **F. Fabiani**, "Pursuing robust decisions in uncertain traffic equilibrium problems," *Decision and Control (CDC), 2021 IEEE 60th Annual Conference on*, pp. 5116-5121, IEEE.

15. **F. Fabiani**, K. Margellos and P. J. Goulart, "Probabilistic stabilizability certificates for a class of black-box linear systems," *Decision and Control (CDC), 2021 IEEE 60th Annual Conference on*, IEEE.

14. **F. Fabiani** and P. J. Goulart, "The optimal transport paradigm enables data compression in data-driven robust control," *2021 American Control Conference (ACC), IEEE 2021*, pp. 2412-2417, IEEE.

13. **F. Fabiani**, K. Margellos and P. J. Goulart, "On the robustness of equilibria in generalized aggregative games." *Decision and Control (CDC), 2020 IEEE 59th Annual Conference on*, pp. 3725–3730, IEEE.

12. **F. Fabiani** and S. Grammatico, "A forward-backward algorithm for decomposable semi-definite programs." *Proceedings of the 28th IEEE Mediterranean Control Conference, Saint-Raphaël, France*. IEEE, 2020. pp. 580-585.

11. C. Cenedese, **F. Fabiani**, M. Cucuzzella, J. M. A. Scherpen, M. Cao and S. Grammatico, "Charging plug-in electric vehicles as a mixed-integer aggregative game." *Decision and Control (CDC), 2019 IEEE 58th Annual Conference on*, pp. 4904–4909, IEEE.

10. F. Blanchini, D. Casagrande, **F. Fabiani**, G. Giordano and R. Pesenti, "A network-decentralised strategy for shortest-path-flow routing." *Decision and Control (CDC), 2019 IEEE 58th Annual Conference on*, pp. 1126–1131, IEEE.

9. **F. Fabiani** and A. Caiti, "Nash equilibrium seeking in potential games with double-integrator agents," in *2019 18th European Control Conference (ECC)*. IEEE, 2019, pp. 548–553.

8. F. Blanchini, **F. Fabiani** and S. Grammatico, "On merging constraint and optimal control-Lyapunov functions." *Decision and Control (CDC), 2018 IEEE 57th Annual Conference on*, pp. 2328–2333, IEEE.

7. **F. Fabiani** and S. Grammatico, "A Mixed-Logical-Dynamical model for Automated Driving on highways." *Decision and Control (CDC), 2018 IEEE 57th Annual Conference on*, pp. 1011–1015, IEEE.

6. G. Belgioioso, **F. Fabiani**, F. Blanchini and S. Grammatico, "On the convergence of discrete-time linear systems: a linear time-varying Mann iteration converges iff its operator is strictly pseudocontractive." *Decision and Control (CDC), 2018 IEEE 57th Annual Conference on*.

5. G.M. Gasparri, **F. Fabiani**, M. Garabini, L. Pallottino, M. Catalano, G. Grioli, R. Persichini and A. Bicchi, "Robust optimization of system compliance for physical interaction in uncertain scenarios." In *Humanoid Robots (Humanoids), 2016 IEEE-RAS 16th International Conference on*, pp. 911–918, IEEE.

4. **F. Fabiani**, D. Fenucci, T. Fabbri and A. Caiti, "A passivity-based framework for coordinated distributed control of AUV teams: Guaranteeing stability in presence of range communication constraints." In *OCEANS 2016 MTS/IEEE Monterey*, pp. 1–5, IEEE.

3. **F. Fabiani**, D. Fenucci, T. Fabbri and A. Caiti, "A distributed, passivity-based control of autonomous mobile sensors in an underwater acoustic network." *IFAC-PapersOnLine*, vol. 49, no. 23, pp. 367–372.

2. **F. Fabiani**, S. Grechi, S. Della Tommasina and A. Caiti, "A NLPCA hybrid approach for AUV thrusters fault detection and isolation." In *Control and Fault-Tolerant Systems (SysTol), 2016 3rd Conference on*, pp. 111–116. IEEE.

1. A. Caiti, F. Di Corato, **F. Fabiani**, D. Fenucci, S. Grechi and F. Pacini, "Enhancing autonomy: Fault detection, identification and optimal reaction for over-actuated AUVs." In *OCEANS 2015 MTS/IEEE Genova*, pp. 1–6, IEEE.