

Giacomo Galuppini

Curriculum Vitae

University of Pavia, Faculty of Engineering

Department of Electrical, Computer and Biomedical Engineering

Identification and Control of Dynamic Systems Lab.

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Languages

Italian Mother tongue

English Professional working proficiency



Short Biography

Giacomo Galuppini received the Ph.D. in Electronics, Computer Science and Electrical Engineering from the University of Pavia, Italy, in February 2020. From May 2019 to August 2020 he was Research Fellow at the Department of Civil Engineering and Architecture, University of Pavia, Italy. From September 2020 to February 2023 he was a Postdoctoral Associate in Prof. Braatz's Group, Department of Chemical Engineering, Massachusetts Institute of Technology, Cambridge, Massachusetts, US. He is currently Assistant Professor at the Department of Electrical, Computer and Biomedical Engineering, Faculty of Engineering, University of Pavia, Italy.

His main research interests include Model Predictive Control, optimisation and control of Water Distribution Networks and Urban Drainage Systems, modelling and control of Li-ion batteries, control of magnetic field in Fast Field Cycling Nuclear Magnetic Resonance and Magnetic Resonance Imaging.

Academic and Research Appointments

- Feb.2023-present **Assistant Professor** (RTDa) at the Department of Electrical, Computer and Biomedical Engineering, Faculty of Engineering, University of Pavia, Pavia, Italy.
- Sept.2020-Feb.2023 **Postdoctoral Associate** in Prof. Braatz's Group, Department of Chemical Engineering, Massachusetts Institute of Technology, Cambridge, Massachusetts, US.
- May.2019-Aug.2020 **Research Fellow** (Assegno di Ricerca) at the Department of Civil Engineering and Architecture, Faculty of Engineering, University of Pavia, Pavia, Italy.

Research Groups and Other Affiliations

- 2019 Aberdeen Biomedical Imaging Centre, University of Aberdeen, Aberdeen, UK
2019 GIDRM - Gruppo Italiano Discussione Risonanze Magnetiche

Research Topics

- Model Predictive Control theory and applications.
- Modelling and control of Li-ion batteries.
- Urban Flash Flood (UFF) risk assessment and management.
- Optimisation and control of Water Distribution Networks (WDNs) and Urban Drainage Systems (UDSs).
- Control of magnetic field in Fast Field Cycling Nuclear Magnetic Resonance (FFC-NMR) and Magnetic Resonance Imaging (FFC-MRI).

Research Projects

- 2023-present **Unit PI and Task Leader** (Task 2.4 System design specification for smart BMS with enhanced data management and connectivity) in ***EcoMobility***.
Partners: the EcoMobility Project Consortium consists of 47 partners and 9 countries (Austria, Belgium, Germany, Greece, Italy, Latvia, Netherlands, Spain, Turkey).
Funded within the Key Digital Technologies Joint Undertaking (KDT JU), in collaboration with the Horizon Europe (HORIZON) Framework Programme and National Authorities (Grant ID: 101112306).
- 2020-2023 **Participant in *D3BATT: Data-Driven Design of Li-ion Batteries***,
Partners: Massachusetts Institute of Technology (USA), Toyota Research Institute (USA), Stanford University (USA).
Funded by Toyota Research Institute.
- 2019-2020 **Participant in *NEWFRAME: NETWork-based Flood Risk Assessment and Management of Emergencies***.
Partners: University of Pavia (IT), Istituto Universitario di Studi Superiori "IUSS" Pavia (IT).
Funded by Cariplo Foundation.
- 2016-2019 **Participant in *IDentIFY: Improving Diagnosis by Fast Field-Cycling MRI***.
Partners: University of Aberdeen (UK), Centre National De La Recherche Scientifique Cnrs (FR), Commissariat A L'energie Atomique Et Aux Energies Alternatives (FR), Institut National De La Sante' Et De La Recherche Medicale (FR), Institut Polytechnique De Grenoble (FR), International Electric Company Oy (FI), Stelar Srl (IT), Technische Universitaet Ilmenau (GE), Universita' Degli Studi Di Torino (IT), Universite' Grenoble Alpes (FR), Uniwersytet Warmińsko Mazurski W Olsztynie (PO).
Funded by the European Union (EU H2020, Grant ID: 668119).

Collaboration with Companies

- 2022-present **Collaboration with Medtronic Inc., Minneapolis, MN.**
Development of first-principle and data-driven interpretable models for lifetime prediction of Li-ion batteries.
- 2016-2020 **Collaboration with Stelar S.r.l., Mede, Italy.**
Design of a Field Frequency Lock for Fast Field Cycling Nuclear Magnetic Resonance and Magnetic Resonance Imaging applications.

Collaborations

- 2022-present **Collaboration with University of Bergamo, Bergamo, Italy.**
Nonlinear Model Predictive Control algorithms.
- 2020-present **Collaboration with University of Naples, Naples, Italy.**
Modelling, Optimisation and Control of Smart Water Networks.
- 2020-present **Collaboration with University of Catania, Catania, Italy.**
Modelling, Optimisation and Control of Water Networks.

Education

- Sep.2016-Sep.2019 **Ph.D in Electronic, Computer Science and Electrical Engineering** at the Identification and Control of Dynamic Systems Laboratory, Faculty of Engineering, University of Pavia, Pavia, Italy.
Ph.D. position founded by Stelar s.r.l.
Ph.D. topics: modelling and control of Fast Field Cycling Nuclear Magnetic Resonance; real time control for Water Distribution Networks; control of systems affected by deadzone nonlinearity. Advisor: Prof. L. Magni.
- Sep.2014-Sep.2016 **M.Sc. in Computer Engineering** (Embedded and Control Systems) at the University of Pavia.
Thesis: Study for a digital Field Frequency Lock system for Fast Field Cycling Nuclear Magnetic Resonance applications. Advisor: Prof. L. Magni.
Final mark: 110/110 cum Laude.
- Sep.2011-Sep.2014 **B.Sc. in Electronic and Computer Engineering** (Computer Engineering) at the University of Pavia.
Thesis: Performance analysis of handbikes from postural data. Advisor: Prof. L. Magni.
Final mark: 110/110 cum Laude.

Teaching Experience

- a.y. 2023/2024 to present **Faculty Instructor** (Docente Titolare) of **Identificazione e Ottimizzazione** at University of Pavia (6 CFU, 50 hours per academic year).
- a.y. 2023/2024 to present **Faculty Co-Instructor** (Co-Docente) of **Systems and Control Colloquia II** at University of Pavia (PhD Course, 3 CFU, 10 hours per academic year).
- a.y. 2016/17 to 2019/2020 **Teaching Assistant** (Tutor) of **Controlli Automatici e Fondamenti di Automatica** at University of Pavia (20 hours per academic year).
- a.y. 2017/18 to 2018/19 **Teaching Assistant** (Tutor) of **Industrial Control** at University of Pavia (14 hours per academic year).
- Feb. 2019 **Trainer** at the **NMR Relaxometry Data Analysis: Theory and Software Training School**, Pavia, 18-22/02/2019. School organised within the CA 15209 European Network on NMR Relaxometry.

Student Supervision

1D Unsteady flow modelling for open channel simulation in Water Drainage Systems (Master, Co-advisor. Advisor: prof. E. Creaco).

Probabilistic Modelling of Users' Demand in Water Distribution Networks (Master, Co-advisor. Advisor: prof. E. Creaco).

Pressure Regulation in Water Distribution Systems. (Bachelor, Co-advisor. Advisor: prof. L. Magni).

A bi-objective Approach to the Optimal Design of Linear Regulators for Linear Resonant Systems. (Bachelor, Advisor. Co-advisor: prof. L. Magni).

Stochastic Optimal Control of Lithium-Ion Battery Operations (Bachelor, Co-advisor. Advisors: prof. R. D. Braatz, A. Doria).

Identification of Approximate Elastic Unsteady Flow Models in Water Distribution Systems (Bachelor, Co-advisor. Advisor: prof. L. Magni).

Pressure Control in a Water Distribution System. (Bachelor, Co-advisor. Advisor: prof. L. Magni).

PID Control of a Hydraulic Line. (Bachelor, Co-advisor. Advisor: prof. L. Magni).

PID Control of a DC Motor: Automatic Tuning and Performance Analysis. (Bachelor, Co-advisor. Advisor: prof. L. Magni).

Model Identification of a Laboratory Scale Overhead Travelling Crane Affected by Deadzone. (Bachelor, Co-advisor. Advisor: prof. L. Magni).

Identification and Control of a Laboratory Scale Overhead Travelling Crane. (Bachelor, Co-advisor. Advisor: prof. D. Raimondo).

Predictive Control of a Laboratory Scale Overhead Travelling Crane. (Bachelor, Co-advisor. Advisor: prof. D. Raimondo).

Identification and Control of a Solar Tracker. (Bachelor, Co-advisor. Advisor: prof. D. Raimondo).

Editorial Activity

Associate Editor *Wiley Optimal Control Applications and Methods.*

Guest Editor *MDPI Sustainability - Special Issue (Open) "Modeling, Control and Optimization for Smart Water Systems".*

Reviewer *IEEE Transactions on Control System Technology.*
Elsevier Control Engineering Practice, Water Research.
ASCE Journal of Water Resources Planning and Management.
MDPI Water, Mathematics, Applied Sciences, Processes, Energies, Machines.

List of Publications

Schaeffer, J., **Galuppini, G.**, Rhyu, J., Asinger, P. A., Droop, R., Findeisen, R., & Braatz, R. D. (2024). Cycle Life Prediction for Lithium-ion Batteries: Machine Learning and More. *Accepted for presentation at the 2024 American Control Conference (ACC), Toronto, ON, Canada.*

Schimperna, I., **Galuppini, G.**, & Magni, L. (2024). Recurrent Neural Network based MPC for systems with input and incremental input constraints. *Accepted for publication on IEEE Control Systems Letters.*

Lo Presti, J., Giudicianni, C., Toffanin, C., Creaco, E., Magni, L., & **Galuppini, G.** (2024). Combining Clustering and Regularised Neural Network for Burst Detection and Localization and Flow/Pressure Sensor Placement in Water Distribution Networks. *Accepted for publication on Journal of Water Process Engineering.*

Liang, Q., **Galuppini, G.**, Gomadam, P. M., Tamirisa, P. A., Lemmerman J. A., Mazack, M. J., Sullivan, M. G., Braatz, R. D., & Bazant, M. Z. (2024). Physics-based Modeling of Pulse and Relaxation of High-rate Li/CF_x-SVO batteries in Implantable Medical Devices. *Accepted for publication on Journal of Power Sources.*

Galuppini, G., Liang, Q., Tamirisa, P. A., Lemmerman J. A., Sullivan, M. G., Mazack, M. J., Gomadam, P. M., Bazant, M. Z. & Braatz, R. D. (2024). Improving Diagnostics and Prognostics of Implantable Cardioverter Defibrillator Batteries with Interpretable Machine Learning Models. *Accepted for publication on Journal of Power Sources.*

Galuppini, G., Berliner, M. D., Lian, H., Zhuang, D., Bazant, M. Z., & Braatz, R. D. (2024). Efficient computation of robust, safe, fast charging protocols for lithium-ion batteries. *Control Engineering Practice, 145, 105856.*

<https://doi.org/10.1016/j.conengprac.2024.105856>

Galuppini, G., Creaco, E. F., & Magni, L. (2023). Real-Time Pressure Control in Water Distribution Networks: Stability Guarantees via Gain-Scheduled Internal Model Control. *IEEE Transactions on Control Systems Technology.*

10.1109/TCST.2023.3325546

Galuppini, G., Creaco, E. F., & Magni, L. (2023). Multinode Real-Time Control of Pressure in Water Distribution Networks via Model Predictive Control. *IEEE Transactions on Control Systems Technology. Special Issue: State-of-the-art Applications of Model Predictive Control.*

10.1109/TCST.2023.3291555

Galuppini, G., Berliner, M. D., Lian, H., Zhuang, D., Bazant, M. Z., & Braatz, R. D. (2023). Efficient computation of safe, fast charging protocols for multiphase lithium-ion batteries: A lithium iron phosphate case study *Journal of Power Sources, 580, 233272.*

<https://doi.org/10.1016/j.jpowsour.2023.233272>.

Galuppini, G., Berliner, M. D., Cogswell, D. A., Zhuang, D., Bazant, M. Z., & Braatz, R. D. (2023). Nonlinear identifiability analysis of Multiphase Porous Electrode Theory-based battery models: A Lithium Iron Phosphate case study. *Journal of Power Sources, 573, 233009.*

<https://doi.org/10.1016/j.jpowsour.2023.233009>.

Galuppini, G., Magni, L., & Ferramosca, A. (2023). Nonlinear MPC for Tracking Piecewise-Constant Reference Signals: the Positive Semidefinite Stage Cost Case. *IFAC-PapersOnLine, 56(1), 210-215.*

<https://doi.org/10.1016/j.ifacol.2023.02.036>

Galuppini, G., Creaco, E., & Magni, L. (2022). The in situ approach to model identification and control design for pressure regulation in Water Distribution Networks: An in silico evaluation. *Control Engineering Practice*, *120*, 105016.

10.1016/j.conengprac.2021.105016

Creaco, E., **Galuppini, G.**, & Campisano, A. (2021). Unsteady flow modelling of hydraulic and electrical RTC of PATs for hydropower generation and service pressure regulation in WDN. *Urban Water Journal*, 1-11.

<https://doi.org/10.1080/1573062X.2021.1992455>

Galuppini, G., Magni, L., & Ferrante, G. (2021). The Field-Frequency Lock for Fast Field Cycling Magnetic Resonance: from NMR to MRI. *Frontiers in Physics*, *9*, 360. **Special Issue: Innovations in MR Hardware from Ultra-Low to Ultra-High Field.**

10.3389/fphy.2021.688479

Galuppini, G., Creaco, E., & Magni, L. (2021). Sum-of-delay models for pressure control in Water Distribution Networks. *Control Engineering Practice*, *113*, 104844.

10.1016/j.conengprac.2021.104844

Creaco, E., **Galuppini, G.**, Campisano, A., & Franchini, M. (2021). Bottom-Up Generation of Peak Demand Scenarios in Water Distribution Networks. *Sustainability*, *13*, 31.

10.3390/su13010031

Galuppini, G., Creaco, E., & Magni, L. (2020). Bi-objective optimisation based tuning of pressure control algorithms for water distribution networks. *Control Engineering Practice*, *104*, 104632.

10.1016/j.conengprac.2020.104632

Galuppini, G., Creaco, E., & Magni, L. (2020). A gain scheduling approach to improve pressure control in water distribution networks. *Control Engineering Practice*, *103*, 104612.

10.1016/j.conengprac.2020.104612

Fiorillo, D., **Galuppini, G.**, Creaco, E., De Paola, F., & Giugni, M. (2020). Identification of Influential User Locations for Smart Meter Installation to Reconstruct the Urban Demand Pattern. *Journal of Water Resources Planning and Management*, *146(8)*, 04020070.

10.1061/(ASCE)WR.1943-5452.0001269

Galuppini, G., Quintilliani, C., Arosio, M., Barbero, G., Ghilardi, P., Manenti, S., Petaccia, G., Todeschini, S., Ciaponi, C., Martina, M.L.V. & Creaco, E. (2020). A Unified Framework for the Assessment of Multiple Source Urban Flash Flood Hazard: the Case Study of Monza, Italy. *Urban Water Journal*, 1-13.

10.1080/1573062X.2020.1734950

Creaco, E., **Galuppini, G.**, Campisano, A., Ciaponi, C. & Pezzinga, G. (2020). A Bi-Objective Approach for Optimizing the Installation of PATs in Systems of Transmission Mains. *Water*, *12(2)*, 330..

10.3390/w12020330

Galuppini, G., Magni, L., & Creaco, E. (2020). Stability and Robustness of Real Time Control in Water Distribution Networks. *Journal of Hydraulic Engineering*, *146(4)*, 04020023..

10.1061/(ASCE)HY.1943-7900.0001722

Galuppini, G., Rolfi, R., Toffanin, C., Raimondo, D., Xia, Y., Ferrante, G., & Magni, L. (2019). Towards a Model-Based Field-Frequency Lock for Fast-Field Cycling NMR. *Applied Magnetic Resonance*, 1-23.

10.1007/s00723-019-01130-y

Galuppini, G., Creaco, E., Toffanin, C., & Magni, L. (2019). Service Pressure Regulation in Water Distribution Networks. *Control Engineering Practice*, 86, 70-84.

10.1016/j.conengprac.2019.03.007

Galuppini, G., Magni, L. & Raimondo, D. M. (2018). Model Predictive Control of Systems with Deadzone and Saturation. *Control Engineering Practice*, 78, 56-64.

10.1016/j.conengprac.2018.06.010

Galuppini, G., Toffanin, C., Raimondo, D. M., Provera, A., Xia, Y., Rolfi, R., Ferrante, G., & Magni, L. (2017). Towards a Model-Based Field-Frequency Lock for NMR. *IFAC-PapersOnLine*, 50(1), 13020-13025.

10.1016/j.ifacol.2017.08.1999

Contributions to Congresses and Conferences

Presentations

Improving Diagnostics and Prognostics of ICD/CRT-D Batteries with Data-driven Interpretable Models. *Invited seminar, Medtronic Technical Forum Event/MECC Technical Fellow Seminar, 16/02/2022.*

Nonlinear MPC for Tracking Piecewise-Constant Reference Signals: the Positive Semidefinite Stage Cost Case. *SIDRA - Convegno Automatica 2023 Catania, 6-8/09/2023.*

Water 4.0: Real Time Control of Service Pressure in Water Distribution Networks. *SIDRA - Convegno Automatica 2023 Catania, 6-8/09/2023.*

Towards a Model-Based NMR Lock for Fast Field Cycling NMR: Experimental Validation. *11th conference on Fast Field Cycling NMR Relaxometry, Pisa, 5-7/06/2019.*

Towards a Model-Based Field-Frequency Lock for NMR. *Open/Invited Track: Control of Quantum Systems, 20th World Congress of the International Federation of Automatic Control, Toulouse, 9-14/07/2017.*

Modelling, Control and Simulation for a New FFC-NMR Lock System. *10th conference on Fast Field Cycling NMR Relaxometry, Mikotajki, - 5-7/06/2017.*

Towards a Model-Based NMR Lock for Fast Field Cycling NMR. *EUrelax Cost Action - European Network on NMR Relaxometry, Torino 29/2/2017-1/03/2017.*

Posters

Improving Diagnostics and Prognostics of ICD/CRT-D Batteries with Data-driven Interpretable Models. *2023 Medtronic Data & Analytics Symposium, 20-22/06/2023.*

A Novel Field-Frequency Lock for Fast Field Cycling NMR: Experimental Proof of Concept and Extension To MRI. *61st Experimental Nuclear Magnetic Resonance Conference, Baltimore, Maryland, 8-13/03/2020.*

Improved NMR Receiver Chain for Model Based Lock Implementation. *11th conference on Fast Field Cycling NMR Relaxometry, Pisa, - 5-7/06/2019.*

Towards a Model-Based Field-Frequency Lock for MRI: Handling the Effect of Field Gradients. *11th conference on Fast Field Cycling NMR Relaxometry, Pisa, - 5-7/06/2019.*

Towards a Model-Based Field-Frequency Lock for NMR. *SIDRA - Convegno Automatica 2017 Milano, 11-13/09/2017.*

A New Approach to Overcome 'Field Stability' Problem in FFC. NMR *EUrelax Cost Action - European Network on NMR Relaxometry, Torino 29/2/2017-1/03/2017.*

Publication-related Software

Supporting code for *Efficient Computation of Robust, Safe Fast Charging Protocols for Multiphase Lithium-ion-Batteries*. May, 2023 is available at: <https://github.com/GiacomoGaluppini/Efficient-Computation-of-Robust-Safe-Fast-Charging-Protocols-for-Lithium-ion-Batteries>

Supporting code for *Efficient Computation of Safe Fast Charging Protocols for Multiphase Lithium-ion-Batteries*. March, 2023 is available at: <https://github.com/GiacomoGaluppini/Efficient-Computation-of-Safe-Fast-Charging-Protocols-for-Multiphase-Lithium-ion-Batteries>

Supporting code for *Nonlinear identifiability analysis of multiphase porous electrode – Theory-based battery models*. March, 2023 is available at: <https://github.com/GiacomoGaluppini/Nonlinear-Identifiability-Analysis-of-Multiphase-Porous-Electrode---Theory-based-Battery-Models>

In compliance with the Italian legislative Decree no. 196 dated 30/06/2003, I hereby authorize you to use and process my personal details contained in this document.

Quanto dichiarato nel presente curriculum corrisponde a verità ai sensi delle norme in materia di dichiarazioni sostitutive di cui all'art. 46 e ss. del D.P.R. 445/2000. Autorizzo l'uso dei miei dati personali secondo il Decreto Legislativo 196 del 30 Giugno 2003 (Italia)

Pavia, 15/05/2024

A handwritten signature in black ink, appearing to read "Giacomo Geluffi". The signature is stylized and written over a horizontal line.