

## **Short Curriculum Vitae of Luca FERRARINI**

Prof. Luca Ferrarini receives a MSc summa cum laude in Electronic Engineering in 1988 at Politecnico di Milano, while in 1990 he receives CEFRIEL Master diploma in *Information Technologies for Industrial Process Control*.

Since 1990 he has been working at Dipartimento di Elettronica e Informazione of Politecnico di Milano, where is currently Full Professor teaching various courses of industrial automation and modeling of discrete production systems.

He is co-author of 7 patents, 5 national and 2 European, on the *design, testing and validation of the control system of industrial processes*.

Additionally, he has co-authored more than 180 scientific contributions including journal papers, conference presentations, educational and research books, book chapters, editorials.

Since 2008 he has been teaching at Shanghai Tongji University courses of basic and advanced automatic control and is responsible for the tracks in *Information Technology Engineering* and *Mechanical and Production Engineering*.

He is a *Senior Member* of IEEE. He is member of IEEE IES Technical Committee on Industrial Agents and of IFAC Technical Committee T5.1 on Manufacturing Control. He also collaborates with IEC, ISA, and ANIPLA (Associazione Nazionale Italiana Per L'Automazione), the Italian National Association for Automation of which he was national president in 2003 and 2004, and since then vice-president.

Prof. Ferrarini has been the coordinator for Politecnico di Milano of many research projects, both national and European, in the field of manufacturing systems automation and efficiency of energy systems, with the common goal to bring innovative ICT solutions to enhance performance of and optimize energy and production automated systems. To mention a few at EU level, they include TORERO (TOtal life cycle web-integRatEd contROl), PABADIS'PROMISE (Plant Automation BAsed on DIstributed Systems PROduct Oriented ManufacturIng Systems for re-configurable Enterprises), VAN (Virtual Automation Network), MEDEIA (Model-Driven Embedded System Design Environment for the Industrial Automation Sector), CASSANDRA (A multivariate platform for assessing the impact of strategic decisions in electrical power systems). On the national level, research and technology transfer focuses on modelling and control of energy systems for final uses, modeling and automation of production systems, 3D simulation of automated machines and robotic applications, and agent-based control. Recent projects include OASYS, MOOM, UtilTech, Enertech, EnergeticaMente and PowerCity. He has also been involved in the application of functional safety analysis and risk-based assessments of IEC/EN 61508 and IEC 61511, devoted to process control systems to power and production system.

In 2009, he is *co-founder* of Enertech Solution, a start-up company devoted to energy efficiency and energy automation and hosted inside the Incubator of Politecnico di Milano, after a special prize won in a national business plan competition.

His research interests include discrete-event systems and Petri nets; control system development methodology for industrial distributed control and automation systems; modeling, simulation and control of manufacturing processes and systems; monitoring and control of electro-thermal energy systems; energy efficiency and renewables integration and control, model-based and data-driven predictive control.

### **List of relevant Projects coordinated by Luca FERRARINI**

- A. STEER (Support Tool for Energy Efficiency pROgrammes in medical centres), funded under H2020 in 2014-2018, is devoted to hospitals and medical centers, with the specific goal of modeling and control of energy consumption in different scenarios and decision support on the most appropriate energy reduction plan for the medium-long term.
- B. CASSANDRA European Project (2011-2014), funded under FP7 programme. The project aims to build a platform for the realistic modeling of the energy market stakeholders, also involving small-scale consumers. CASSANDRA

main outcomes will be the aggregation methodology and the framework of key performance indicators for scenario assessment, as well as an expandable software platform that providing different energy stakeholders with the ability to model the energy market, in order to assess scenarios for their own purposes.

- C. Within the collaborative research project DERRI - Distributed Energy Resources Research Infrastructure - funded under the European FP7 programme, the following specific projects have been carried out:
- 2011: SEMBAD - Smart Energy Management In Buildings And Districts. In cooperation with - Risø National Laboratory for Sustainable Energy, DTU, Denmark Technical University, (Denmark), within SYSLAB, a full scale distributed laboratory for experimental testing of distributed intelligent power systems.
  - 2012: SREI-MG - Smart Buildings and Renewable Energy Integration in Micro Grids. In cooperation with Technical University of Sofia, Bulgaria, Power Electronics Laboratory (PEL).
  - 2013: OSMOTIC - Optimal Smart Micro grid management and Intelligent Control. In cooperation with - Risø National Laboratory for Sustainable Energy, DTU, Denmark Technical University, (Denmark)
- D. UTILTEC. The aim is the design and development of an innovative ICT-based low-cost infrastructure for electrical energy management, monitoring and remote load control for public utilities, residential customers and tertiary field.
- E. ENERTEC. The aim is the design and development of a management system for any kind of energy sources and exploitations at customer side, including distributed generation, demand response, load control, and safety issues
- F. ENERGETICA MENTE. The aim is to design and implement an ICT solution for the management and control of the centralized heating system of apartment buildings endowed with distributed accounting system for heat consumption.
- G. PowerCity. It aims to the engineering of a new product which integrates photovoltaic, insulated glazing, window, electrical connection, monitoring and diagnosis systems. BiPV (Building Integrated PhotoVoltaics) modules are designed in standard formats to facilitate mounting, but are customizable in terms of shape, dimensions, color, transparency, typology and positioning of photovoltaic cells.

### **List of recent publications of Luca FERRARINI**

#### ***A. Books***

1. Alberto Elia, Luca Ferrarini, Carlo Veber, "Ethernet-based Automation Networks: real-time communication and functional safety", ISA ("The Instrumentation, Systems, and Automation Society"; was "Instrument Society of America") series on Distributed Industrial Automation 2008. Product ISBN/ID: 978-1-934394-77-9. [www.isa.org](http://www.isa.org)
2. Luca Ferrarini and Carlo Veber (editors), "Modeling, Control, Simulation and Diagnosis of Complex Industrial and Energy Systems", ISA series on Distributed Industrial Automation 2008, Product ISBN/ID: 978-1-934394-90-8. [www.isa.org/modeling](http://www.isa.org/modeling).
3. Luca Ferrarini and Carlo Veber, "IEC 61499: uno standard per l'automazione industriale", Pitagora Editrice, 2004.
4. Luca Ferrarini and Luigi Piroddi, "Esercizi di Controllo Logico con Reti di Petri", Pitagora Editrice, 2002.
5. Luca Ferrarini, "Automazione Industriale: Controllo Logico con Reti di Petri", Pitagora Editrice, 2001.

#### ***B. International Journals***

6. Aida Brankovic, Matteo Matteucci, Marcello Restelli, Luca Ferrarini, Luigi Piroddi, Andrea Spelta, Fabrizio Zausa, "Data-driven indicators for the detection and prediction of stuck-pipe events in oil&gas drilling operations" in Upstream Oil and Gas Technology, Volume 7, May 2021, doi.org/10.1016/j.upstre.2021.100043.
7. S. Rastegarpour, R. Scattolini and L. Ferrarini, "Performance improvement of an air-to-water heat pump through linear time-varying MPC with adaptive COP predictor," in Journal of Process Control, Volume 99, March 2021, Pages 69-78, doi.org/10.1016/j.jprocont.2021.01.006.

8. L. Ferrarini, S. Rastegarpour and L. Caseri, "Predictive Control-Oriented Models of a Domestic Air-to-Water Heat Pump Under Variable Conditions," in *IEEE Robotics and Automation Letters*, vol. 5, no. 4, pp. 5363-5369, Oct. 2020, doi.org/10.1109/LRA.2020.3007474.
9. S. Rastegarpour, S. Gros, L. Ferrarini, " MPC approaches for modulating air-to-water heat pumps in radiant-floor buildings ", *Control Engineering Practice*, vol. 95, Feb. 2020, doi.org/10.1016/j.conengprac.2019.104209.
10. S. Rastegarpour, L. Ferrarini, F. Palaiogiannis, "A Distributed Predictive Control of Energy Resources in Radiant Floor Buildings", *Journal of Dynamic Systems, Measurement and Control (ASME)*, 2019, doi:10.1115/1.4043935.
11. Le Anh Dao, Alireza Dehghani Pilehvarani, Luca Ferrarini and Achilleas Markou, "A Hierarchical Distributed Predictive Control Approach for Microgrids Energy Management", *Journal of Sustainable Cities and Society (Elsevier)*, vol. 48, July 2019, doi.org/10.1016/j.scs.2019.101536.
12. G. Kalogeras, S. Rastegarpour, C. Koulamas, A.P. Kalogeras, J. Casillas, L. Ferrarini, "Predictive Capability Testing and Sensitivity Analysis of a Model for Building Energy Efficiency", *International Journal of Building Simulation*, Springer, August 2019, doi.org/10.1007/s12273-019-0559-8.
13. C. Koulamas, A.P. Kalogeras, R. Pacheco-Torres, J. Casillas, L. Ferrarini, "Suitability analysis of modeling and assessment approaches in energy efficiency in buildings", *Energy and Buildings*, vol. 158 (2018), p. 1662-1682. ISSN 0378-7788, doi.org/10.1016/j.enbuild.2017.12.002 .L. Ferrarini and G. Mantovani, "Temperature Control of a Commercial Building with Model Predictive Control techniques", *IEEE Transactions on Industrial Electronics*, p. 2651 - 2660, Vol. 62, Issue 4, 2014. DOI: 10.1109/TIE.2014.2387095.
14. G. Mantovani, G. T. Costanzo, M. Marinelli, L. Ferrarini, "Experimental Validation of Energy Resources Integration in Microgrids via Distributed Predictive Control", *IEEE Transactions on Energy Conversion*, pag. 1-8, Volume: PP, Issue: 99, 2014, ISSN 0885 - 8969, DOI: 10.1109/TEC.2014.2362887.
15. L. Ocheana, D. Popescu, L. Ferrarini, "Group-based method for fault identification using the diagnoser approach", *Journal of control engineering and applied informatics*, Vol.15, No.4, December 2013, pages 66-76.
16. G. Costanzo, L. Ferrarini, G. Mantovani, A. Krusteva, M. Georgiev, and M. Antchev, "A hardware-in-the-loop simulation architecture for integration of Smart Buildings and distributed energy resources in Micro Grids", *Journal of Information technologies and control*, p. 7-13, Vol.2, 2013. DOI:10.2478/itc-2013-0007.
17. L. Ferrarini, J. Carneiro, "A Probabilistic Protection against Thermal Overloads of Transmission Lines" , *Electric Power Systems Research*, Volume 81, Issue 10, October 2011, Pages 1874–1880. DOI 10.1016/j.epr.2011.05.011 .
18. L. Ferrarini, J. Carneiro, "Preventing thermal overloads in transmission circuits via model predictive control" , *IEEE Transactions on Control System Technology*, Volume: 18 , Issue: 6, Digital Object Identifier: 10.1109/TCST.2009.2037921, 2010 , Page(s): 1406 - 1412.
19. L. Ferrarini, G. Fogliazza, G. Mirandola, C. Veber, "Metamodeling Techniques Applied to the Design of Reconfigurable Control Applications" , *EURASIP Journal on Embedded Systems*, Volume 2008, Article ID 748652, 9 pages, doi:10.1155/2008/748652 (published online).
20. L. Ferrarini, L. Piroddi, "Modeling and control of fluid transportation operations in production plants with Petri nets", *IEEE Transactions on Control Systems Technology*, Vol. 16, n. 5, pp. 1090-1098, 2008.
21. L. Piroddi, M. Cossalter, L. Ferrarini, "A Resource Decoupling Approach for Deadlock Prevention in FMS", *Int. Journal of Advanced Manufacturing Technology*, DOI: 10.1007/s00170-007-1319-y, December 2007 (published online).
22. A. Castelnuovo, L. Ferrarini, L. Piroddi, "An incremental Petri nets approach to the modeling of manufacturing systems", *IEEE Transactions on Automation Science and Engineering*, Vol. 4, n. 3, pp. 424-434, July 2007.
23. L. Ferrarini and C. Veber, " Control function design and implementation of distributed automation systems for manufacturing applications", *International Journal of Manufacturing Research (IJMR)*, 2006 - Vol. 1, No.4 pp. 442 - 465.
24. C. Schwab, M. Tangermann, L. Ferrarini, C. Veber, A. Kalogeras, "Web based Methodology for Distributed Control Systems", *ATP (Automation Technology in Practice) International Journal, IFAC Affiliated Journal*, 2006 No. 3, p. 41 - 52.
25. R. Cordone, L. Ferrarini and L. Piroddi, "Enumeration Algorithms for Minimal Siphons with Place Constraints in Petri nets ", *IEEE Transactions on System, Man and Cybernetics, Part A*, Volume 35, Issue 6, Nov. 2005, p.844 - 854.
26. L. Ferrarini and L. Piroddi, "Modular design and implementation of a logic control system for a batch process" *Computers & Chemical Engineering journal*, Volume 27, Issue 7, p. 983-996, July 2003 .
27. L. Ferrarini and L. Piroddi, "Front-Tracking Centralized Motor Control in a Paper-Making Process", *IFAC Journal Control Engineering Practice*, Gran Gretagna, Vol. 10, p. 1111-1125.

28. L. Ferrarini and E. Carpanzano, "A Structured Methodology for the Design and Implementation of Control and Supervision Systems for Robotic Applications", IEEE Transactions on Control System Technology, vol 10, n-2, marzo 2002, Stati Uniti d'America, pag. 272-279, 2003.
29. C. Maffezzoni, L. Ferrarini and E. Carpanzano, "Object-Oriented Models For Advanced Automation Engineering", IFAC Journal Control Engineering Practice, vol 7, 1999, Gran Bretagna, pag. 957-968.
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33. L. Ferrarini and M. Trioni, "Modeling Shared Resources with Generalized Synchronization within a Petri Net Bottom-up Approach", IEEE Transactions on Systems, Man and Cybernetics, vol. 26, n° 04, agosto 1996, pag. 653-659.
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35. C. Maffezzoni and L. Ferrarini, "A characteristic lines based method to build finite dimensional models of heat exchangers", Mathematical Modeling of Systems, ottobre 1995, vol. 1 n° 3, pag. 141-166.
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41. L. Ferrarini and C. Maffezzoni, "Dynamic design of the fast start-up of a Benson boiler", Journal A, Dec. 1989, vol. 30, n°4, pag.7-16.

### **C. Books contributions**

42. L. Ferrarini, C. Veber et al, "Utilization of Advanced Control Devices and Highly Autonomous Systems for the Provision of Distributed Automation Systems", in Distributed manufacturing: paradigms, concepts, solutions and examples, Springer-Verlag, London, 2010, ISBN978-1-84882-706-6, DOI 10.1007/978-1-84882-707-3, Hermann Khunle Editor, 2009.
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44. L. Ferrarini, "Computer Aided Design of Logic Controllers with Petri Nets", in Petri Nets in Flexible and Agile Automation (Kluwer Academic Publishers, Norwell, MA, Stati Uniti d'America), Mengchu Zhou Ed., 1995, ISBN: 0-7923-9557-3.
45. L. Ferrarini and M. Trioni, "Optimizing structural analysis of extended Petri nets models", Lecture Notes in Control and Information Science *n. 199* on Analysis and Optimization of Systems - Discrete Event Systems (Guy Cohen and Jean-Pierre Quadrat Eds.), Springer Verlag, giugno 1994, Gran Bretagna, pag. 183-190.

### **D. Internationl Conferences (only recent papers)**

46. L. A. Dao, L. Ferrarini, D. La Carrubba, "Improving Solar and PV Power Prediction with Ensemble Methods", IFAC World Congress, Berlin, July 2020.

47. Soroush Rastegarpour, Luca Ferrarini, Sebastien Gros, "Economic NMPC for Multiple Buildings Connected to a Heat Pump and Thermal and Electrical Storages", IFAC World Congress, Berlin, July 2020.
48. Luca Ferrarini, Soroush Rastegarpour, Lorenzo Caseri, "Predictive control-oriented models of a domestic air-to-water heat pump under variable conditions", IEEE International Conference on Automation Science and Engineering, Hong Kong, China August 2020.
49. L. Ferrarini and R. Babini, "Digital Techniques for Energy Optimization in a University Building: a case study," 2020 25th IEEE International Conference on Emerging Technologies and Factory Automation (ETFA), Vienna, Austria, 2020, pp. 844-850, doi: 10.1109/ETFA46521.2020.9212118.
50. Soroush Rastegarpour, Lorenzo Caseri, Luca Ferrarini, "Experimental Validation of the Control-Oriented Model of Heat Pumps for MPC Applications", IEEE International Conference on Automation Science and Engineering, Vancouver, BC, Canada, 22-26 August 2019, p.1249-1255, <https://doi.org/10.1109/COASE.2019.8843211>.
51. Luca Ferrarini, Ehsan Fathi, Samuele Disegna, Soroush Rastegarpour, "Energy consumption models for residential buildings: a case study", IEEE International Conference on Emerging Technologies and Factory Automation, Zaragoza, Spain, 10-13 September 2019, p.673-678, <https://doi.org/10.1109/ETFA.2019.8869151>.
52. Pacheco-Torres Rosalia, Cerro-Prada Elena, Soroush Rastegarpour, Luca Ferrarini, "Modeling Calibration and Energy Dynamic Simulation of Heating Radiant Floors with Phase Change Materials", 4th Building Simulation and Optimization Conference, Cambridge, UK, 11-12 September 2018, p.382-388.
53. Soroush Rastegarpour, Mahshid Ghaemi, Luca Ferrarini, "A Predictive Control Strategy for Energy Management in Buildings with Radiant Floors and Thermal Storage", SICE International Symposium on Control Systems (SICE ISCS), Tokyo City University, Tokyo, Japan, March 9-11, 2018, p.67-73, DOI: 10.23919/SICEISCS.2018.8330158.
54. M. Delfanti, D.Falabretti, L. A. Dao, L. Piroddi and L. Ferrarini, "Smart City Vizzate Project: Development and Field Test of an Architecture for the Local Dispatching of Distribution Networks", International AEIT Annual Conference, 2017.
55. S. Rastegarpour, L. Ferrarini, "Cross-validation of Sliding Mode Control strategies for radiant floor temperature control", 22nd IEEE International Conference on Emerging Technologies And Factory Automation, (ETFA), 2017.
56. S. Rastegarpour, L. Ferrarini, R. Pacheco-Torres, A. Kalogeras, C. Koulamas, "Sensitivity analysis of medical centers energy consumption with EnergyPlus", 22nd IEEE International Conference on Emerging Technologies And Factory Automation, (ETFA), 2017.
57. R. Pacheco-Torres, L. A. Dao, and L. Ferrarini, "Scenario-based sensitivity analysis of energy dynamic behavior in residential buildings with radiant floors", 22nd IEEE International Conference on Emerging Technologies And Factory Automation, (ETFA), 2017.
58. S. Rastegarpour, A. Petretti, Y. Ghanizadeh and L. Ferrarini, "A multivariable self-tuning controller for a D-Type Water Tube Industrial Boiler", 14th International Conference on Informatics in Control, Automation and Robotics (ICINCO), 2017.
59. L. Ferrarini, S. Rastegarpour, A. Petretti, "An adaptive underfloor heating control with external temperature compensation", 14th International Conference on Informatics in Control, Automation and Robotics (ICINCO), 2017.
60. L. A. Dao, L. Ferrarini, and L. Piroddi, "MPC-Based Management of Energy Resources in Smart Microgrids", 14th International Conference on Informatics in Control, Automation and Robotics (ICINCO), 2017. L. A. Dao, L. Piroddi, and L. Ferrarini, Ensemble Methods For Pv Production Prediction From Meteo Services, 6th IEEE International Conference on Clean Electrical Power, Santa Margherita, Italy, June 2017.
61. Soufiane Meddouri, Soroush Rastegarpour, Luca Ferrarini and Kassa Idjdarene, A Nonlinear Lyapunov-Based Control For Autonomous Variable-Speed Wind Turbine, 6th IEEE International Conference on Clean Electrical Power, Santa Margherita, Italy, June 2017.
62. E. Pizzi, A. Bouchrit, A. Petretti, L. Ferrarini, Performance improvement for online schedulers for packaging systems 2016 IEEE International Conference on Automation Science and Engineering (CASE) Fort Worth, Texas, 2016, Pages: 1243 - 1248, DOI: 10.1109/COASE.2016.7743549.
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65. L. Ferrarini, G. Mantovani and M. Pagliarini, " Improving Energy Efficiency in Large Buildings with Thermal Stratification", IFAC World Congress, Cape Town, South Africa, 24-29 Aug 2014, p. 4885 - 4890.

66. L. Ferrarini, G. Mantovani and G. Costanzo, "A Distributed Model Predictive Control approach for the integration of flexible loads, storage and renewables", IEEE International Symposium on Industrial Electronics, Istanbul, Turkey, 1-4 Jun 2014, p. 1700 - 1705. DOI: 10.1109/ISIE.2014.6864871.
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