Curriculum Vitae of Prof. Mario Paolone, PhD

Personal Information

Family name:	*Paolone*
First (given) name:	*Mario*
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Education

2002, *March*	Ph.D. in Electrical Engineering, University of Bologna, Italy
1998, *March*	Degree in Electrical Engineering (5 years), University of Bologna, Italy

Employment History

2017 – present	Full Professor, Chair, Distributed Electrical Systems Laboratory, EPFL, Switzerland
2011 – 2017	Associate Professor / Head of the EOS Holding Chair, Distributed Electrical Systems Laboratory, EPFL, Switzerland
2005 – 2011	Assistant Professor, Power Systems Laboratory, University of Bologna, Italy
2005, 2006	Scientific advisor, Ferrari F1 Gestione Sportiva, Maranello, Italy
2002, 2003	Guest researcher, University of Florida, Gainesville, USA
2002 – 2005	Post-doc, University of Bologna, Italy
1998 – 2002	PhD student, Power Systems Laboratory, University of Bologna, Italy
1998	Researcher for A.R.E.A. in the context of the Italian National Program for Environmental Research

Institutional Responsibilities

2017 – present	Member of the Swiss Federal Energy Research Commission (CORE)
2017 – present	Chair of the EPFL Energy Centre Directorate
2017 – present	Member of the Executive Committee of the European Energy Research Alliance (EERA)
2012 – present	Director of the Swiss Competence Centre for Energy Research "Future Swiss Electrical Infrastructure"

Approved Research Projects

Selection of approved research projects relevant to the application.

2018 – 2022	OSMOSE - Optimal System-Mix Of flexibility Solutions for European electricity, *European Union Program H2020*
2017 – 2019	Formal stability assessment of hybrid distribution grids based on the correct modelling of the effect of synchronization of the power electronics interfaces, *Swiss National Science Foundation*
2012 – 2016	Cyber-secure Data and Control Cloud for Power Grids, *European Union Program FP7*
2012 – 2016	Advanced Control of Distribution Networks with the Integration of Dispersed Energy Storage Systems, *EOS Holding, Switzerland*
2014 – 2017	Measurement tools for Smart Grid stability and quality ENG52 SmartGrid II, *European Metrology Program*
2014 – 2015	A High-Pressure Electrolyser for Long-Term Energy Storage in Electrical Microgrids, *Verband Schweizerischer Elektrizitätsunternehmen*
2013 – 2017	Smart Grids, Smart Buildings and Smart Sensors for Optimized and Secure Management of Electricity Distribution using Dedicated Microelectronic ICs and Real-Time ICT, *Swiss National Science Foundation*
2014 – 2016	The theoretical and application Study on a Metering and Intelligent tool for Low Voltage grid control Enhancement, *Swiss Federal Office of Energy*
2014 – 2018	Integration of Intermittent Widespread Energy Sources in Distribution Networks: Scalable and Reliable Real Time Control of Power Flows, *Swiss National Science Foundation*
2014 – 2016	Système pilote de stockage d'énergie de 500kWh/500 kW pour le contrôle des réseaux électriques de distribution avec génération distribuée, *Vaud Canton, Switzerland*

Supervision of Doctoral Theses

Doctoral students supervised at the École Polytechnique Fédérale de Lausanne.

2015	Konstantina Christakou , *Real-Time Optimal Controls for Active Distribution Networks: From Concepts to Applications*
2016	Paolo Romano, *DFT-based Synchrophasor Estimation Algorithms and their Integration in Advanced Phasor Measurement Units for the Real-time Monitoring of Active Distribution Networks*
2016	Stela Sarri, *Methods and Performance Assessment of PMU-based Real-Time State Estimation of Active Distribution Networks*
2016	Reza Razzaghi, *Fast Simulation of Electromagnetic Transients in Power Systems: Numerical Solvers and their Coupling with the Electromagnetic Time Reversal Process*
2016	Mostafa Nick, *Exact Convex Modeling of the Optimal Power Flow for the Operation and Planning of Active Distribution Networks with Energy Storage Systems*
2016	Maryam Bahramipanah, *Advanced Control of Distribution Networks with the Integration of dispersed Energy Storage Systems*
2016	Lorenzo Enrique Reyes Chamorro, *Real-Time Control Framework for Active Distribution Networks: Theoretical Definition and Experimental Validation*
2016	Gina Steinke, *Medium voltage DC-DC converter for DC distribution networks: The multistage stacked boost Architecture*
2017	Ramanunni Parakkal Menon, *Model Predictive Control Strategies for Polygeneration Systems*
2017	Mohammad Azadifar, *Characteristics of Upward Lightning Flashes*
2017	Marco Pignati, *Synchronism Mechanisms for the Real-Time Observation and Protection of Active Distribution Networks*
2017	Lorenzo Zanni, *Advanced State Estimation Processes of Active Distribution Networks using Synchrophasor Measurements*
ongoing	Yihui Zuo, *Formal assessment of the dynamic stability of bulk power systems in presence of distributed energy storage systems*
ongoing	Asja Derviskadic, *Wide area synchronized sensing technologies of modern electrical grids*
ongoing	Andreas Martin Kettner, *Real-Time Assessment of Dynamic Stability in Low-Voltage AC Microgrids Controlled by Explicit Power Setpoint Methods*
ongoing	Enrica Scolari, *Inclusion of power generation stochasticity in explicit control frameworks for the real-time control of microgrids*
ongoing	Zhaoyang Wang, *Time-Reversal based Processes to locate Discontinuities and Faults in Power Grids*

Memberships in Panels, Boards, etc. and Individual Scientific Reviewing Activities

2014 – present	Editor-in-Chief of the Elsevier International Journal "Sustainable Energy Grids and Networks"
2014 – present	Associate Editor of the IEEE Transactions on Industrial Informatics
2016 – present	Member of the Council of the Power Systems Computation Conference
2017 – 2018	Guest Associate Editor of the IEEE Transactions on Smart Grids, special section on "Theory and Application of PMUs in Power Distribution Systems"
2015 – 2016	Guest Associate Editor of the IEEE Transactions on Power Delivery, special section on "Advances in the Simulation of Power System Transients"

Active Memberships in Scientific Societies, Fellowships in Renowned Academies

2010 – present	IEEE Senior Member

Organization of Conferences

- Chairperson (Technical Program Committee), Power Systems Computation Conference (PSCC) 2018, Dublin, Ireland
- Vice-Chair (Technical Program Committee), Power Systems Computation Conference (PSCC) 2016, Genova, Italy
- Co-Chairperson of the 9th International Conference on Power Systems Transients (IPST) 2009, Kyoto, Japan)

Prizes, Awards, Fellowships

- Best IEEE Transactions on EMC paper award for year 2017, "On Lightning Electromagnetic Field Propagation Along an Irregular Terrain", vol. 58, nr. 1, February 2016, pp. 161-171.
- 2013 IEEE EMC Technical Achievement Award for *"Outstanding contributions to the modelling of electromagnetic field interaction to complex power networks".*
- Best paper award at the 13th International Conference on Probabilistic Methods Applied to Power Systems (PMAPS, sponsored by IEEE PES), July 7-10, 2014, Durham, UK. Paper: *Probabilistic Assessment of the Process-Noise Covariance Matrix of Discrete Kalman Filter State Estimation of Active Distribution Networks.*
- Basil Papadias Best Paper award at the 2013 IEEE PowerTech, June, 16-20, 2013, Grenoble, France. Paper: *On the Use of Electromagnetic Time Reversal to Locate Faults in Series-Compensated Transmission Lines.*
- Best paper award at the 2008 International Universities Power Engineering Conference (UPEC, sponsored by IEEE PES), Sept. 1-4, 2008, Padua, Italy. Paper: *Analysis of Black-Startup and Islanding Capabilities of a Combined Cycle Power Plant.*

Major Scientific Achievements

Advanced Power Systems Monitoring

Prof. Paolone has developed new algorithms and devices for the estimation of the so-called *synchrophasors*. Prof. Paolone developed the first phasor measurement unit (PMU) for Active Distribution Networks. The innovation came from algorithms that, for the first time, were able to perform measurements of synchrophasors with parts-per-millions accuracy levels irrespective of the signal dynamics and distortion. These devices opened a new way to operate electrical distribution networks by integrating monitoring, protection and control functionalities, which is an essential step for the massive deployment of distributed renewable energy sources.

It is worth mentioning the endeavour of Prof. Paolone to bridge the gap between scientific research and practical applications. Indeed, he played an active role in international organizations like CIGRE. Within this international framework, he actively participated to the development of Technical Guide of the Cigre WG C4.34 *Application of Phasor Measurement Units for monitoring power system*. Prof. Paolone's algorithms were licensed to industrial partners that develop state-of-the-art power systems automation processes.

Planning, State Estimation and Control Processes in Active Power Distribution Systems

On the subject of *state estimation* of active distribution grids, Prof. Paolone has been the first in proposing real-time PMU-based state estimation processes for active distribution networks. He recently discussed the performances of clusters of known estimation processes (i.e., weighted least square and discrete Kalman filters) to the specific case of synchrophasor-based real-time state estimation of active distribution grids.

Concerning the topic of *real-time control* of active distribution networks, he has recently proposed a framework called *COMMELC – Composable method for real-time control of active distribution networks with explicit power setpoints*. It targets to control an electrical grid in real time, even if the grid has very little inertia, as is typical when there is a large amount of distributed generation. It solves the problems of quality of service and energy balance without major investment. The framework provides a kind of *Power Grid Operating System* that allows device controllers for intelligent buildings, e-car charging systems, etc. to be easily connected and provide real time support to the grid. The peculiarity of this framework is that it allows to directly control the targeted grid by defining explicit and real-time setpoints for active/reactive power absorptions/injections obtained by solving an optimization problem. The framework is capable to solve this challenging problem by introducing a common abstract model and a dedicated aggregation process protocol. In particular, energy resources advertise their state to a grid agent, using a device independent description. A grid agent controls its resource using a single algorithm, common to all grid agents. The goal of this control framework is to maintain the system in safe state of operation while trying to satisfy the resources' willingness to produce/absorb power. A formal aggregation method is also proposed in a way such that subsystems can be aggregated into virtual devices that hide their internal complexity. It has been formally shown that the proposed method can easily cope with systems of any size or complexity. This control framework has been the first proposed to treat the problem of real-time control of power grids (i.e., with refresh rates of hundreds of ms) using explicit control setpoints obtained from the solution of an optimisation problem.

With respect to the subject of *planning* and *control processes* in active power distribution systems, Prof. Paolone has recently contributed with developments related to the use of the so-called Optimal Power Flow problem (OPF) applied to radial power grids. The proposed formulation, based on the method of multipliers, as well as on a primal decomposition of the OPF problem, has been used to solve a wide area of problems related to planning (e.g., optimal planning of distributed energy storage systems) and operation (e.g., voltage control and line congestion management) of active power distribution systems.

Advanced Signal Processing for Fault-Location Procedures in Active Distribution Networks

Another fundamental contribution of Prof. Paolone concerns the topic of advanced *signal processing for fault-location procedures in active distribution networks*. He contributed to the development of new approaches for the emergency operation of electrical networks after faults. The innovation is based on the determination of the time-invariant characteristics of post-fault signals. Prof. Paolone proposes fault-location procedures based on the analysis of the electromagnetic transients originated by the fault and associated with the traveling waves triggered by the fault itself. The developed procedures make use of the *continuous wavelet analysis*. Prof. Paolone was the first to propose the definition of a *general class of mother wavelets* by using the fault transient signal itself, thus generalizing the process of the wavelet analysis and avoiding its performance-dependency on standard mother wavelets. In a more recent work, he was the first to introduce the idea of *time reversal in fault-location*. The resulting algorithms have been implemented into a new class of smart relays integrating protection and fault-location functionalities.

Lightning interaction and protection of power systems

With reference to the topic of *lightning interaction and protection of power systems* with particular reference to distribution networks, Prof. Paolone has developed advanced models for the numerical calculation of overhead lines and buried cables response against external high-pulse electromagnetic fields. The models and computational tools developed by Prof. Paolone make it possible to analyse the response of topologically-complex power distribution systems to LEMP (lightning electromagnetic pulses), taking into account the presence of protection devices (i.e., grounded conductors/shielding wires

and surge protective devices). Within this context, Prof. Paolone conducted, with the University of Florida, an important experimental campaign in years 2002 and 2003 carried out at the International Center on Lightning Research Tests (ICLRT), Camp Blanding, Florida. During this campaign, he obtained unique experimental data on voltages and currents induced on full-scale overhead and buried transmission lines, induced by nearby artificially-initiated lightning.

Prof. Paolone has also proposed a new and efficient numerical integration scheme of the so-called Agrawal et al. coupling model, which can handle efficiently both frequency dependencies of line parameters (ground and wires impedances) and nonlinear phenomena (corona). The numerical tool he has developed is now integrated into the well-known ElectroMagnetic Transient Program (EMTP-RV) and allows the modelling of the response of any topologically-complex electrical distribution power systems to lightning.

It is worth mentioning the endeavour of Prof. Paolone to bridge the gap between scientific research and practical applications. Indeed, he played an active role in international organizations like IEEE, CIGRE and CIRED. Within this international framework, he actively participated to the development of several Standards and Guides, which are now widely used and highly appreciated by the engineering community. In particular, he was actively involved in the elaboration of the 2004 and 2010 editions of the IEEE Std 1410 *IEEE Guide for Improving the Lightning Performance of Electric Power Overhead Distribution Lines* in which the models he developed were included as reference for the computation lightning performance of distribution lines. He has also played a key role within the Lightning Subcommittee of the IEEE EMC TC5.

Research Output of Prof. Mario Paolone, PhD (last 5 years)

The list of publications can also be found online on EPFL infoscience.

Publications in International Peer-Reviewed Scientific Journals

[1] Xiang Gao, F. Sossan, M. Liserre and M. Paolone, "Concurrent Voltage Control and Dispatch of Active Distribution Networks by means of Smart Transformer and Storage", IEEE Trans. on Industrial Electronics, 2018 (accepted, in press).

[2] A. Derviškadić, P. Romano and M. Paolone, "Iterative-Interpolated DFT for Synchrophasor Estimation: a Single Algorithm for P and M-class compliant PMUs", IEEE Trans. on Instrumentation and Measurements, 2018 (accepted, in press).

[3] C. Wang, J.-Y. Le Boudec and M. Paolone, "Controlling the Electrical State via Uncertain Power Injections in Three-Phase Distribution Networks", IEEE Trans. on Smart Grids, 2018 (accepted, in press).

[4] M. Nick, R. Cherkaoui and M. Paolone, "Optimal Planning of Distributed Energy Storage Systems in Active Distribution Networks Embedding Grid Reconfiguration", IEEE Trans. on Power Systems, 2018 (accepted, in press).

[5] A. Kettner and M. Paolone, "On the Properties of the Power Systems Nodal Admittance Matrix", IEEE Trans. On Power Systems, 2018 (accepted, in press).

[6] M. Nick, R. Cherkaoui, J.-Y. Le Boudec, and M. Paolone, "An Exact Convex Formulation of the Optimal Power Flow in Radial Distribution Networks Including Transverse Components", IEEE Trans. On Automatic Control, 2018 (accepted, in press).

[7] E. Scolari, F. Sossan and M. Paolone, "Photovoltaic Model-Based Solar Irradiance Estimators: Performance Comparison and Application to Maximum Power Forecasting", IEEE Trans. On Sustainable Energy, 2018 (accepted, in press).

[8] E. Stai, L. Reyes. F. Sossan, J.-Y. Le Boudec and M. Paolone, "Dispatching Stochastic Heterogeneous Resources Accounting for Grid and Battery Losses", IEEE Trans. on Smart Grids, 2018 (accepted, in press).

[9] K. Christakou, A. Abur and M. Paolone, "Voltage Control in Active Distribution Networks Under Uncertainty in the System Model: A Robust Optimization Approach", IEEE Trans. on Smart Grids, 2018 (accepted, in press).

[10] C. Wang, A. Bernstein, J-Y Le Boudec, and M. Paolone, "Explicit Conditions on Existence and Uniqueness of Load-Flow Solutions in Distribution Networks", IEEE Trans. on Smart Grids, 2018 (accepted, in press).

[11] S. Barreto Andrade, M. Pignati, G. Dán, J.-Y. Le Boudec and M. Paolone, "Undetectable Timing-Attack on Linear State-Estimation by Using Rank-1 Approximation", IEEE Trans. on Smart Grids, 2018 (accepted, in press).

[12] M. Bahramipanah, D. Torregrossa, R. Cherkaoui and M. Paolone, "A Decentralized Adaptive Model-Based Real-time Control for Active Distribution Networks Using Battery Energy Storage Systems", IEEE Trans. on Smart Grids, 2018 (accepted, in press).

[13] A. Derviškadić, P. Romano, M. Pignati and M. Paolone, "Architecture and Experimental Validation of a Low-Latency Phasor Data Concentrator", IEEE Trans. on Smart Grids, 2018 (accepted, in press).

[14] C.L. Bak, A. Borghetti, J. Glasdam, J. Hjerrild, F. Napolitano, C.A. Nucci, M. Paolone, "Vacuum circuit breaker modelling for the assessment of transient recovery voltages: application to various network configurations", Electric Power Systems Research, Volume 156, March 2018, Pages 35–43.

[15] M. Bahramipanah, D. Torregrossa, R. Cherkaoui and M. Paolone, "Enhanced Equivalent Electrical Circuit Model of Lithium-based Batteries Accounting for Charge Redistribution, State of Health and Temperature Effects", IEEE Trans. on Transportation Electrification, vol. 3, no. 3, pp. 589- 599, August 2017.

[16] A. Kettner and M. Paolone, "Sequential Discrete Kalman Filter for Real-Time State Estimation in Power Distribution Systems: Theory and Implementation", IEEE Trans. on Instrumentation and Measurements, vol. 66, no. 9, pp. 2358 - 2370, September 2017.

[17] C. Wang, A. Bernstein, J. Y. Le Boudec and M. Paolone, "Existence and Uniqueness of Load-Flow Solutions in Three-Phase Distribution Networks," IEEE Trans. on Power Systems, vol. 32, no. 4, pp. 3319-3320, July 2017.

[18] L. Zanni, J.-Y. Le Boudec, R. Cherkaoui and M. Paolone, "A Prediction-Error Covariance Estimator for Adaptive Kalman Filtering in Step-Varying Processes: Application to Power-System State Estimation", IEEE Trans. on Control Systems Technology, vol. 25, no. 5, pp. 1683 - 1697, Sept. 2017.

[19] E. Namor, D. Torregrossa, R. Cherkaoui and M. Paolone, "Parameter Identification of a Lithium-Ion Cell single-particle model through Non-Invasive Testing", Journal of Energy Storage, vol. 12, Aug. 2017, pp. 138-148.

[20] K. Christakou, D.-C. Tomozei, J.-Y. Le Boudec, M. Paolone, "AC OPF in Radial Distribution Networks - Part II: An Augmented Lagrangian-based OPF Algorithm, Distributable via Primal Decomposition", Electric Power Systems Research, vol.150, pp. 24-35, Sept. 2017

[21] A. Codino, Z. Wang, F. Rachid and M. Paolone, "An Alternative Method for Locating Faults in Transmission Line Networks Based on Time Reversal", IEEE Trans. on Electromagnetic Compatibility, vol. 59, no. 5, pp. 1601-1612, October 2017.

[22] G. Frigo, D. Colangelo, A. Derviškadić, M. Pignati, C. Narduzzi and M. Paolone, "Definition of Accurate Reference Synchrophasors for Static and Dynamic Characterization of PMUs", IEEE Trans. on Intrumentation and Measurements, vol. 66, no. 9, pp. 2233 - 2246, Sept. 2017.

[23] R. Razzaghi, G. Lugrin, F. Rachidi and M. Paolone, "Assessment of the Influence of Losses on the Performance of the Electromagnetic Time Reversal Fault Location Method", IEEE Trans. on Power Delivery, vol. 32, no. 5, pp. 2303-2312, October 2017.

[24] K. Christakou, D.-C. Tomozei, J.-Y. Le Boudec, M. Paolone, "AC OPF in radial distribution networks – Part I: On the limits of the branch flow convexification and the alternating direction method of multipliers", Electric Power Systems Research, vol. 143, pp. 438-450, Feb. 2017.

[25] M. Azadifar, F. Rachidi, M. Rubinstein, V. A. Rakov, M. Paolone, D. Pavanello, "Bipolar Lightning Flashes Observed at the Säntis Tower: Do We Need to Modify the Traditional Classification ?", Journal of Geophysical Research: Atmospheres, vol. 121, 2016.

[26] E. Scolari, F. Sossan and M. Paolone, "Irradiance Prediction Intervals for PV Stochastic Generation in Microgrid Applications", Solar Energy, vol. 139, p. 116–129, Dec. 2016.

[27] F. Sossan, E. Namor, R. Cherkaoui and M. Paolone, "Achieving the Dispatchability of Distribution Feeders through Prosumers Data Driven Forecasting and Model Predictive Control of Electrochemical Storage", IEEE Trans. on Sustainable Energy, vol. 7, no. 4, pp: 1762 – 1777, Oct. 2016.

[28] D. Torregrossa, Ying Xiao, B. Fahimi and M. Paolone, "Non-Parametric Estimation of Surface Temperature of Li-ion Cells using Thermal Impulse Response", IEEE Trans. on Transportation Electrification, vol. 2, no. 4, pp: 407– 416, Dec. 2016.

[29] M. Pignati, L. Zanni, P. Romano, R. Cherkaoui and M. Paolone, "Fault Detection and Faulted Line Identification in Active Distribution Networks Using Synchrophasors-based Real-Time State Estimation" IEEE Trans. on Power Delivery, vol. 32, no. 1, pp: 381– 392, Feb. 2017.

[30] S. Azizi, M. Sanaye-Pasand, and M. Paolone, "Locating Faults on Untransposed, Meshed Transmission Networks Using a Limited Number of Synchrophasor Measurements," IEEE Trans. on Power Systems, vol. 31, no. 6, pp. 4462-4472, Nov. 2016.

[31] R. Razzaghi, M. Mitjans, F. Rachidi, M. Paolone, "An automated FPGA real-time simulator for power electronics and power systems electromagnetic transient applications", Electric Power Systems Research, vol. 141, pages 147–156, December 2016.

[32] M. Azadifar, F. Rachidi, M. Rubinstein, V.A. Rakov, M. Paolone, D. Pavanello, S. Metz, "Fast initial continuous current pulses versus return stroke pulses in tower-initiated lightning", Journal of Geophysical Research – Atmospheres, vol. 121, issue 11, pp. 6425-6434, June 2016.

[33] M. Nick, O. Alizadeh Mousavi, R. Cherkaoui, and M. Paolone, "Security Constrained Unit Commitment with Dynamic Thermal Line Rating", IEEE Trans. on Power Systems, vol. 31, no. 3, pp. 2014 - 2025, May 2016.

[34] R. P. Menon, M. Paolone, F. Maréchal, "Intra-day electro-thermal model predictive control for polygeneration system in microgrids", Energy, vol. 104, 1 June 2016, pp. 308–319.

[35] M. Bahramipanah, R. Cherkaoui and M. Paolone, "Decentralized Voltage Control of Clustered Active Distribution Network by means of Energy Storage Systems", Electric Power Systems Research, vol. 136, July 2016, pages 370–382.

[36] S. Sarri, L. Zanni, M. Popovic, J.-Y. Le Boudec, and M. Paolone, "Performance Assessment of Linear State Estimators Using Synchrophasor Measurements", IEEE Trans. on Instrumentation and Measurement, vol. 65, no. 3, pp. 535-548, March 2016.

[37] D. Li, M. Azadifar, F. Rachidi, M. Rubinstein, M. Paolone, D. Pavanello, S. Metz, Q. Zhang, Z. Wang, "On Lightning Electromagnetic Field Propagation Along an Irregular Terrain", IEEE Trans. on Electromagnetic Compatibility, vol. 58, no. 1, pp. 161-171, Feb. 2016.

[38] D. Torregrossa and M. Paolone, "Modelling of Current and Temperature Effects on Supercapacitors Ageing. Part I: Review of Driving Phenomenology", Journal of Energy Storage, vol. 5, February 2016, pp. 85–94.

[39] D. Torregrossa and M. Paolone, "Modelling of Current and Temperature Effects on Supercapacitors Ageing. Part II: State-of-Health Assessment", Journal of Energy Storage, vol. 5, February 2016, pp. 95–101.

[40] D. Torregrossa, J.-Y. Le Boudec and M. Paolone, "Model-free computation of ultra-short-term prediction intervals of solar irradiance", Solar energy, vol. 124, p. 57-67, 2016.

[41] M. Azadifar, F. Rachidi, M. Rubinstein, M. Paolone, G. Diendorfer, H. Pichler, W. Schulz, D. Pavanello, C. Romero, "Evaluation of the Performance Characteristics of the European Lightning Detection Network EUCLID in the Alps Region for Upward Negative Flashes Using Direct Measurements at the Instrumented Säntis Tower", Journal of Geophysical Research – Atmospheres, vol. 121, issue 2, pp. 595-606, Jan. 2016.

[42] X. Guillaud, O. Faruque, A. Teninge, A.H. Hariri, L. Vanfretti, M. Paolone, V. Dinavahi, P. Mitra, G. Lauss, C. Dufour, P. Forsyth, A.K. Srivastava, K. Strunz, T. Strasser, A.A. Davoudi, "Applications of Real-Time Simulation Technologies in Power and Energy Systems", IEEE Power and Energy Technology Systems Journal, vol.2, no.3, pp.103-115, Sept. 2015.

[43] O. Faruque, T. Strasser, G. Lauss, V. Jalili-Marandi, P. Forsyth, C. Dufour, V. Dinavahi, A. Monti, P. Kotsampopoulos, J. A. Martinez, K. Strunz, M. Saeedifard, X Wang, D. Shearer, M. Paolone, R. Brandl, M. Matar,

A. Davoudi, R. Iravani, "Real-Time Simulation Technologies for Power Systems Design, Testing, and Analysis", IEEE Power and Energy Technology Systems Journal, Vol. 2, Issue: 2, 2015, pp: 63 – 73.

[44] A. Bernstein, L. E. Reyes Chamorro, J.-Y. Le Boudec and M. Paolone, "A composable method for real-time control of active distribution networks with explicit power set points. Part I: Framework", Electric Power Systems Research, vol. 125, August 2015, Pages 254-264.

[45] L. E. Reyes Chamorro, A. Bernstein, J.-Y. Le Boudec and M. Paolone, "A composable method for real-time control of active distribution networks with explicit power set points. Part II: Implementation and validation", Electric Power Systems Research, vol. 125, August 2015, Pages 265-280.

[46] D. Torregrossa, K. Toghill, G. Amstutz, G. Hubert and M. Paolone, "Macroscopic Indicators of Fault Diagnosis and Ageing in Electrochemical Double Layer Capacitor", Journal of Energy Storage, vol. 2, August 2015, pp 8-24.

[47] M. Paolone, Editorial, Sustainable Energy, Grids and networks, vol. 1, pp. A1-A3, March 2015.

[48] W.K. Chai, N. Wang, K.V. Katsaros, G. Kamel, G. Pavlou, S. Melis, M. Hoefling, B. Vieira, P. Romano, S. Sarri, T.T. Tesfay, B. Yang, F. Heimgaertner, M. Pignati, M. Paolone, M. Menth, M. E. Poll, M. Mampaey, H.H.I. Bontius, C. Develder, "An Information-Centric Communication Infrastructure for Real-Time State Estimation of Active Distribution Networks," IEEE Trans. on Smart Grid, vol. 6, Issue 4, pp. 2134-2146, July 2015.

[49] M. Nick, R. Cherkaoui, M. Paolone, "Optimal siting and sizing of distributed energy storage systems via alternating direction method of multipliers," Int. Journal of Electrical Power & Energy Systems, Vol. 72, November 2015, Pages 33-39.

[50] F. Sossan, H. Bindner, H. Madsen, D. Torregrossa, L. Reyes and M. Paolone, "A MPC energy replacement strategy for electric space heating including cogeneration of a fuel cell-electrolyzer system", Int. Journal of Electrical Power and Energy Systems, vol. 62, pp. 879–889, 2014.

[51] K. Christakou, D.-C. Tomozei, M. Bahramipanah, J.-Y. Le Boudec and M. Paolone, "Primary Voltage Control in Active Distribution Networks via Broadcast Signals: The Case of Distributed Storage", IEEE Trans. on Smart Grid, vol. 5, Issue 5, pp. 2314-2325, Sept. 2014.

[52] P. Romano and M. Paolone, "Enhanced Interpolated-DFT for Synchrophasor Estimation in FPGAs: Theory, Implementation and Validation of a PMU Prototype", IEEE Trans. On Instrumentation and Measurements, vol. 63, num. 12, pp. 2824 - 2836, Dec. 2014.

[53] K.V. Katsaros, W.K. Chai, N. Wang, G. Pavlou, H. Bontius and M. Paolone, "Information-centric networking for machine-to-machine data delivery: a case study in smart grid applications," IEEE Network Magazine, vol.28, no.3, pp.58,64, May-June 2014.

[54] J. Paknahad, K. Sheshyekani, F. Rachidi, M. Paolone and A. Mimouni, "Evaluation of Lightning-Induced Currents on Cables Buried in a Lossy Dispersive Ground," IEEE Trans. on Electromagnetic Compatibility, vol. 56, num. 6, p. 1522-1529, 2014.

[55] J. Paknahad, K. Sheshyekani, F. Rachidi and M. Paolone, "Lightning Electromagnetic Fields and Their Induced Currents on Buried Cables. Part II: the Effect of a Horizontally Stratified Ground", IEEE Trans. on Electromagnetic Compatibility, vol. 56, num. 5, p. 1146-1154, Oct. 2014.

[56] R. Razzaghi, C. Foti, M. Paolone, F. Rachidi, "A Method for the Assessment of the Optimal Parameter of Discrete-Time Switch Model", Electric Power Systems Research, vol. 115, Pages 80-86, October 2014.

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Patents and Licenses

Patents

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Oral Contributions to International Conferences

Invited Lectures, Keynotes and Speeches at International Conferences

- M. Paolone, *A Composable Method for Real-Time Control of Microgrids with Explicit Power Setpoints*, IEEE 3rd Int. Conference on Electrical and Information Technologies, Rabat, Morocco, Nov. 15-18, 2017.
- M. Paolone, *Aggregation of Power Capabilities of Heterogeneous Resources for the Real-Time Optimal Control of Active Distribution Networks*, IEEE PES General Meeting, Chicago, July 29, 2017.
- M. Paolone and J.-Y. Le Boudec, *On the exact formulation and convexification of AC-OPF problems in radial power networks*, IEEE PES PowerTech Conference, Machester, UK, June 18-22, 2017.
- M. Paolone, *A dispatched-by-design architecture for distribution systems: the EPFL Dispatchable Feeder*, CINERGY-FP7 Marie Curie, Politecnico di Torino, Italy, Oct. 17th, 2016.
- M. Paolone, *Control of Microgrids and Active Distribution Networks: Situation Awareness and Aggregation*, Swiss-US Energy Innovation Days, UC Berkeley, San Francisco, USA, August, 2016.

- M. Paolone, *Modern controls of microgrids*, International Renewable Energy Agency (IRENA), The Age of Renewable Power, May 2016, Bonn, Germany, May 12, 2016.
- M. Paolone, *Advanced control of active distribution networks with the integration of dispersed energy storage systems*, Renewable Distributed Generation Forum, École Polytechnique Fédérale de Lausanne, April 13, 2016, Lausanne, Switzerland.
- M. Paolone, *Information-centric communication infrastructure for real-time state estimation of distribution networks using PMUs*, IEEE Energycon, April 4-9, 2016, KU Leuven, Belgium.
- M. Paolone, *A Composable Framework for Real-Time Control of Active Distribution Networks with Explicit Power Setpoints*, Symposium on Smart Grids, May 18, 2015, Shandong, China.
- M. Paolone, *Experimental micro-grid on the campus of the Swiss Federal Institute of Technology of Lausanne*, Asia Clean Energy Summit, October 28-29, 2014, Singapore.
- M. Paolone, *Information-centric communication infrastructure for real-time state estimation of distribution networks using synchrophasor measurements*, 18th Power Systems Computation Conference, August 18-22, 2014, Wroclaw, Poland.
- M. Paolone, *Synchrophasor-Based Real-Time State Estimation in Active Distribution Networks: the EPFL DEMO*, 18th Power Systems Computation Conference, August 18-22, 2014, Wroclaw, Poland.
- M. Paolone, *Application of Electromagnetic Time Reversal to Fault Location in transmission and distribution power systems*, 2014 IEEE International Symposium on Electromagnetic Compatibility, August 3-9, Raleigh, NC, USA.
- M. Paolone, *A Composable Method for Real-Time Control of Microgrids with Explicit Power Setpoints*, IEEE PES General Meeting, July 27-31, 2014, Washington DC, USA.
- M. Paolone, *C-DAX: A Cyber-Secure Data and Control Cloud for Power Grids*, IEEE PES General Meeting, July 27-31, 2014, Washington DC, USA.
- M. Paolone, *Synchrophasor Fundamentals: from Computation to Implementation*, IEEE PES General Meeting, July 21-25, 2013, Vancouver, Canada.

Invited Seminars in Universities and Research Centres

- M. Paolone, *The Augmented-Relaxed Optimal Power Flow (AR-OPF): an Exact Convex Formulation for Optimal Power Flow in Radial Distribution Networks*, Technical University of Denmark, May 4, 2017.
- M. Paolone, *A dispatched-by-design architecture for distribution systems: the EPFL Dispatchable Feeder*, Politecnico di Torino, October 17, 2016.
- M. Paolone, *Smart grid situation awareness with particular reference to PMU-based state estimation*, Politecnico di Torino, October 17, 2016.
- M. Paolone, *Advanced control of active distribution networks with the integration of dispersed energy storage systems*, University of Genova, April 19, 2016, Genova, Italy.
- M. Paolone, *A Composable Method for Real-Time Control of Microgrids with Explicit Power Setpoints*, IBM Research, September 8, 2015, Zurich, Switzerland.
- M. Paolone, *Performance Assessment of Synchrophasor-Based Linear State Estimators*, Northeastern University, August 4, 2015, Boston, MA, USA.
- M. Paolone, *Real-Time Control of electrical grids with Explicit Power Setpoints*, Dagstuhl Seminar, Feb 23-27, 2015, Dagstuhl, Germany.
- M. Paolone, *A Composable Method for Real-Time Control of Microgrids with Explicit Power Setpoints*, Univ. of Kiel, May 26, 2014, Kiel, Germany.

Outreach Activities

On a different level, Prof. Paolone also provided introductory talks on science subjects to teenagers and children representing the potential future students of our school. These activities include visits and introductory lessons to high schools, *open doors* events at EPFL and Swiss newspapers, radios and TV programmes (e.g., RTS, Italian National Television, and the news journal l'Espresso)

General Contributions to Science

Chair and Vice-Chair of the Technical Programme Committees of the 20th and 19th Power Systems Computation Conferences (PSCC 2016, PSCC 2018).

The PSCC has become one of the most outstanding events in the research area of Power Systems. Indeed, PSCC provides a truly international forum for the regular exchange of knowledge and experience on the latest developments in this area of research. More specifically, PSCC addresses theoretical developments and computational aspects with respect to power system applications. There is an emphasis on modelling and simulation for understanding a system of components, plant or actors, the interactions between them and their collective behaviour, and methods to inform decision-making in power

systems. In view of the above, the PSCC is unanimously considered as the most important conference in the research area of Power Systems.

The duties of the TPC Chair and Vice-Chair refer to the establishment, deployment and follow-up of all aspects related to the conference technical programme including the TPC definition and paper review and selection process.

The nomination to *Technical Programme Committee Chair (2018) and Vice-Chair* (2016) also involves the *nomination into the conference Executive Board*. At the same time, Prof. Paolone is member of the Council of this prestigious conference.

Editor-in-Chief of the Elsevier International Journal "Sustainable Energy Grids and Networks" since June 2014.

The Elsevier journal Sustainable Energy, Grids and Networks (SEGAN) is an international peer-reviewed publication for theoretical and applied research dealing with energy, information grids and power networks, including smart grids from super to micro grid scales. More specifically, SEGAN welcomes papers describing fundamental advances in mathematical, statistical or computational methods with application to power and energy systems, as well as papers on applications, computation and modelling in the areas of electrical and energy systems with coupled information and communication technologies. SEGAN is the first interdisciplinary journal that aims to bring together researchers from academia and industry from across Energy, Engineering, Computer Science, Mathematics and Energy Policy/Regulation.

Prof. Paolone has been asked by Elsevier to establish this journal in 2014. A top-level editorial board has been established with the most prominent researchers active in the area of Smart Grids and Power Systems (see http://www.journals.elsevier.com/sustainable-energy-grids-and-networks/editorial-board/ for further details).

The journal has published 7 issues and is already considered as one of the most selective journals (*current acceptance rate is of 13%*) publishing contributions in the areas of (i) *theoretical developments in planning and operation of electrical and energy systems*, (ii) *data analysis and computation for power and energy systems*, (iii) *integrated operation of information and communication technologies in electrical and energy systems*, (iv) *modelling and analysis of modern and future electrical and energy systems* as well as (v) *sustainability assessment of electrical and energy systems*.

Associate Editor of the IEEE Transactions on Industrial Informatics since 2014.

This IEEE Transactions is one of the most well established journals in the area of computer science. Specifically, the scope of the journal considers the industry's transition towards more knowledge-based production and systems organization and considers production from a more holistic perspective, encompassing not only hardware and software, but also people and the way in which they learn and share knowledge.

Within this framework, the journal has recently decided to cover also the area of Smart Grids with particular reference to the topic of data-driven analysis of electrical and energy systems since it is considered as one of the most prominent examples of the *Internet-of-Things*. In this respect, the Editorial Board of this transaction has identified and invited Prof. Paolone as the new associated editor responsible for this area.

Participation in Working Groups of IEEE and Cigré

Prof. Paolone has been extremely active as secretary and member of various IEEE and Cigré working groups. All these working groups had (or have) the duty to define new international standard or technical brochures. Here below a list of these memberships and contributions is given.

- Member and contributor of the Cigré WG C4.34 "Application of Phasor Measurement Units for monitoring power system".
- Member and contributor of the Cigré WG C4.503 "Numerical Techniques for the Computation of Power Systems, from Steady-State to Switching Transients".
- Member and contributor of the IEEE WG for the IEEE Standard 1410 "IEEE Guide for Improving the Lightning Performance of Electric Power Overhead Distribution Lines".
- Member, contributor and secretary of the Cigré WG. C4.501 "Guide for Numerical Electromagnetic Analysis Methods: Application to Surge Phenomena and Comparison with Circuit Theory-Based Approach".
- Member and contributor of the Joint Cigré/Cired WG C4.402 "Protection of Medium Voltage and Low Voltage Networks against Lightning – Part 2: Lightning protection of Medium Voltage Networks"
- Member and contributor of the Cigré WG C4.409 "Lightning Protection of Wind Turbine Blades" and Cigré WG C4.410 "Lightning Striking Characteristics to Very High Structures".

Membership in Scientific Committees of International Symposia

Prof. Paolone has been Member of the Scientific Committees of the most relevant International Symposia in the area of Smart Grids and Power Systems. A non-exhaustive list is given here below:

- Power Systems Computation Conference
- IEEE Power and Energy Society PowerTech
- IEEE Power and Energy Society Conference on Innovative Smart Grid Technologies
- IEEE International Energy Conference

- International Conference of Power Systems Transients
- International Conference on Lightning Protection

Other Artifacts with Documented Use

International Standards

[119] Cigré Technical Brochure 702, "Application of phasor measurement units for monitoring power system dynamic performance", Cigré WG C4.34, September 2017

[120] Cigré Technical Brochure 550, "Lightning Protection of Low-Voltage Networks", Cigré WG C4.408, August 2013.

[121] Cigré Technical Brochure 543, "Guideline for Numerical Electromagnetic Analysis Method and its Application to Surge Phenomena", Cigré WG C4.501, June 2013.

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