



## Matteo Saviozzi

Fixed-term assistant professor

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### *Education and training*

2017

#### **PhD in Electrical Engineering**

Distributed Energy Resources Strategies for the Management of Uncertainties in the Future Electric System

Università di Genova - Genova - IT

2012

#### **Master Degree in Applied Mathematics**

Methodological and Applied Issues of Electric Systems Math Modelling

Università di Genova - Genova - IT

2010

#### **Bachelor Degree in Mathematics**

Localization of Matrix Eigenvalues

Università di Genova - Genova - IT

### *Academic experience*

2022 - ONGOING

#### **Assistant Professor (RTD-B Tenure Track)**

Università di Genova - Genova - IT

2020 - 2022

#### **Research Fellow (RTD-A)**

Università di Genova - Genova - IT

2019 - 2020

#### **Adjunct Professor**

Università di Genova - Genova - IT

2020 - ONGOING

#### **Member of Technical Committee**

International Federation of Automatic Control (IFAC)

2018 - ONGOING

#### **Member of Working Group C6/2.34 'Flexibility Provision from Distributed Energy Resources'**

CIGRE

2016 - 2019

**Post-doctoral Researcher**

Università di Genova - Genova - IT

2015 - 2016

**Visiting PhD Scholar**

University of Colorado - Boulder - US

2013

**Visiting PhD Scholar**

University of Strathclyde - Glasgow - GB

***Language skills***

**English**

Proficient

***Teaching activity***

-Chair - Optimizazion Methods for Power Systems, 2021-2022, 2022-2023, Master Degree: 'Electrical Engineering', Polytechnic School, Università di Genova

-Chair - Automation and Control for Electric Marine Applications, 2020-21, 2021-2022, 2022-2023, Bachelor Course: 'Maritime Science and Technology', Polytechnic School, Università di Genova

-Adjunct Professor - Algebra, 2019/2020, Bachelor Course: 'Maritime Science and Technology', Università di Genova;

-Teaching Assistant - Analisi Matematica II, 2018/2019, 2019/2020, Polytechnic School, Università di Genova.

***Postgraduate research and teaching activity***

**Supervision of PhD students, residents and post-doctoral fellows**

Co-supervisor of PhD Thesis: Simulation, forecasting, and control in power system analytics: methodological aspects and applications; Student: Gabriele Mosaico, Institution: Polytechnic School - University of Genova; Department: Department of Electrical, Electronics and Telecommunication Engineering and Naval Architecture (DITEN); PhD in Science and Technology for Electrical, Naval Engineering and Complex Systems for Mobility, Cycle: XXXIV.

***Research interests***

The main field of research is related to the study, the implementation and the effects of the penetration of the distributed generation, from renewable and conventional resources, in the distribution networks and to the management of the energy consumption. In particular, my principal interests are optimization algorithms, distribution management systems,

forecasting of load/renewable energy resources, load modelling, load/energy management, buildings modelling and control, and probabilistic security assessment.

## **Grants**

**2021 - ONGOING**

### **Development of techniques for probabilistic security assessment in realistic electrical networks**

Ricerca sul Sistema Energetico - RSE S.p.A. - IT

Participant

The activity is in continuity with a previous collaboration between RSE and the University of Genoa, in which an optimization algorithm was developed for the management of electrical network security problems. In this activity the formulation of the optimization problem will be extended by considering various aspects. In particular: 1) The problem will be decomposed by exploiting the Benders decomposition, which allows a significant improvement in the computational efficiency of the optimization algorithm especially in the presence of a considerable number of constraints (typical situation in the case of analysis of real extended electrical networks). 2) A loadflow AC formulation of the problem will be introduced in order to take into account the constraints on voltages and reactive power flows. 3) The set of contingencies will not be established conventionally, but will be identified on the basis of the combination of the vulnerability curves of the components with the forecast of the weather threats.

**2020 - 2021**

### **Energy Services Connected to the Aggregate management of resources in the electrical system**

Dipartimento di Ingegneria Elettrica e dell'Informazione Maurizio Scarano dell'Università degli Studi di Cassino e del Lazio M

Participant

The e-SCALE project has developed and validated a complete management service for the aggregates of generation and / or consumption resources of the electricity system. In particular, the activity covered by the contract concerned: 1) The definition of technical and economic reference scenarios for the management of services dedicated to aggregators (industrial sector, buildings, distributed generation). 2) The analysis of models for the evaluation and optimization of ancillary services. 3) The definition and implementation of system use scenarios for different types of users.

**2020**

### **Techniques for probabilistic security assessment applications**

Ricerca sul Sistema Energetico - RSE S.p.A.

Participant

The activity involved the implementation in Matlab-GAMS language of an

Application Function (AF) for the solution of a probabilistic Security-Constrained Optimal Power Flow (OPF) problem, expressed as a 'chance-constrained' OPF capable of appropriately managing the uncertainties of renewable generation and load generation forecasts.

2018 - 2021

### **OSMOSE - Optimal System-Mix Of flexibility Solutions for European electricity**

European Commission

Horizon 2020 (Grant 773406) - Participant

The OSMOSE project aimed to improve the understanding and consideration of flexibility needs and resources in future power systems. The 33 partners implemented four largescale demonstrators under the leadership of Transmission System Operators (TSOs). In parallel, they worked on three theoretical Work Packages (WP) dealing with modelling and standardization.

2017 - 2021

### **PODCAST - Optimization of distribution networks through smart meter data and distributed battery energy storage systems**

CSEA - Cassa per i servizi energetici e ambientali

Piano Triennale 2012-2014 della Ricerca di Sistema Elettrico nazionale e Piano Operativo Annuale 2013 - Participant

The PODCAST project aims at providing innovative operational tools for the use of distribution-networks monitoring data at various levels (measures in primary stations and substations, smart metering in LV, state estimation through direct monitoring, and pseudo-measures), in order to provide services to:

- 1) Distribution System Operator (DSO): Development of algorithms for the optimization of distribution-network operational management – regarding the large-scale introduction of non-programmable renewable sources (especially, PV) – by using controllable storage systems alongside to the control of reactive-component compensation systems; super-conductive based technologies are excluded from the project.
- 2) Transmission System Operator (TSO): Development of functionalities for aggregating and formalizing technical/operational information about the distribution network structure and state; the DSO can provide such information for the optimization of dispatching policies (load profile and local production).
- 3) Production and Load Aggregator (PLA): Development of functionalities for modeling and managing heterogeneous electric loads and distributed generation – particularly effective for the use of smart-meter data – with reference to the development of autonomous Energy Communities, including of residential, industrial, and service-sector users.

2017 - 2019

## **PREDICT - Adaptive Energy Efficiency Platform for the Reduction of Energy Consumption in non-Residential Buildings**

Regione Liguria

Programma Operativo Regionale (POR) 2014-2020. Obiettivo Investimenti in favore della crescita e delloccupazione Asse 1 RICERCA E INNOVAZIONE (OT1). - Participant

PREDICT project will deliver and demonstrate an intelligent energy management platform to reduce building energy consumption in an enduring and reliable way.

PREDICT proactively supports managers to reach the efficiency objectives by providing automatic and semi-automatic tool for energy optimization and self-analysis and predictive control.

PREDICT discovers, fine tune and actuate data driven “personalized” optimization energy usage strategies taking into account, and interacting with, the many influencing elements in the context of the building (building usage, weather conditions, occupants’ behaviors, variable energy costs,...) and targeting the building life cycle.

To meet the technical challenge, PREDICT provides a comprehensive approach to energy auditing, usage optimisation and control over the long period and supports building management decision making driven by data and real performance assessment.

2016 - 2019

## **MIGRATE - Massive InteGRation of power Electronic devices**

European Commission

Horizon 2020 (Grant 691800) - Participant

The objective of MIGRATE is:

- to develop and validate innovative, technology-based solutions in view of managing the pan-European electricity system experiencing a proliferation of Power Electronics (PE) devices involved in connecting generation and consumption sites. This overarching goal is split into two components combining two time horizons:
  - in the short to medium term, incremental technologybased solutions are needed to operate the existing electric HVAC system configuration with a growing penetration of PE-connected generation and consumption, based on novel methods and tools,
  - in the long term, breakthrough technology-based solutions are needed to manage a transition towards an HVAC electric system where all generation and consumption is connected via 100% PE, based on innovative control algorithms together with new grid connection standards.

2011 - 2014

## **SMARTGEN - Study development and validation of methodologies and tools for the management of active**

## **power distribution networks including renewable energy sources**

CSEA Cassa per i servizi energetici e ambientali

Piano Triennale 2006-2008 della Ricerca di Sistema Elettrico nazionale - Participant

SmartGen will propose electric power and control system solutions for an intelligent management of generation and electric loads in active distribution networks equipped with small and medium size generators and storage units so as to meet technical and economic constraints.

The project aims to define the architecture of a Distribution Management System (DMS) for portion of electric distribution networks capable of managing problems of optimization, power flow control, voltage control, supply of auxiliary services from distributed generators and loads. Control logics for compensation devices will be developed in order to mitigate grid disturbances. Possible emergency conditions and restoration will be also analyzed. Innovative protection systems will be analyzed and proposed. The set-up of some models of distribution networks with distributed generation for validating the analysis on simulators and on test sites to be selected along the project development.

2013

## **DERmanagement Distributed Energy Resources management and control in a microgrid environment**

European Union

Progetto DERri Distributed Energy Resources Research Infrastructure - European PF7 Programme - Participant

The project developed, implemented and experimentally validated an algorithm for the energy management of a low voltage microgrid. The methodology is able to control in real time the available resources (loads, generation, storage systems, etc.) in order to optimize the energy at the point of common coupling with the main grid.

2011 - 2015

## **AFTER A Framework for electrical power systems vulnerability identification defense and restoration**

European Union

European PF7 Programme - Participant

AFTER project addresses the challenges posed by the need for vulnerability evaluation and contingency planning of the energy grids and energy plants considering also the relevant ICT systems used in protection and control. Project emphasis is on cascading events that can cause catastrophic outages of the electric power systems.

The main addressed problems are related to high impact wide spread multiple contingencies, the most significant wide area criticality. This kind of contingencies and the following cascading effects can be caused by deliberate acts of terrorism, sabotage, criminal activity, malicious behaviour etc or they can simply be caused by a combination of accidents, natural

disasters, negli-gence.

Both risk analysis and risk mitigation will be pursued.

In particular, two major objectives are addressed.

The first is to develop a methodology and tool for the integrated, global vulnerability analysis and risk assessment of the interconnected Electrical Power Systems considering their interdependencies.

This objective meets the TSO (Transmission System Operator) need to overcome current approaches based on separate evaluations of either power system or ICT system. Further, the adoption of risk concepts allows a more in-depth, quantitative evaluation of the security of the electrical power system.

The second objective is to develop algorithms and tools supporting contingency planning in a two-fold approach:

- preventing or limiting system disruption, by means of physical security techniques and defence plans; and
- re-establishing the system after a major disruption, by means of restoration plans.

To this aim, AFTER propose the use of the global risk assessment methodologies as a support to defence plan design. A language to model defence plans functionalities and ICT architecture is de-veloped. New defence plan concepts are also introduced to cope with emergency situations.

#### 2021 - ONGOING

### **PNRM NEFERIS Energy efficiency e cyber security delle infrastrutture strategiche (Part II).**

Leonardo S.p.A.

Participant

The working group of the Intelligent Electrical Energy System has defined, starting from what was developed in the first part of the Neferis project, a methodology for the analysis of cyber risk and electrical reliability of microgrids and in particular of Smart Military District (SMD). This work is part of a document that provided the Ministry of Defense with the functional technical specifications for the management of safety and energy efficiency of SMD.

#### 2019 - 2020

### **Optimal management and control of conventional renewable generation and storage systems in the context of energy system evolution**

Hitachi ABB Power Grids - Genova

Participant

The research contract with Hitachi ABB Power Grids is focused on the

following topics: 1) Tools and algorithms for electric load prediction oriented to commercial / industrial applications and to Energy Community. 2) e-mobility: modeling, charging and forecasting tools. 3) Optimal sizing of storage devices. 4) Reliability analysis of microgrid control systems

2019 - 2022

### **Load modeling project development and fine-tuning of thermal models of LV transformers and analysis of consumption data**

ABB S.p.A. Bergamo.

Participant

The main activities of this research contract can be summarized in: 1) Analysis of consumption data with energy efficiency goals (calculation of the phase imbalance, recognition of motor start-up, etc.). 2) Development of thermal models of distribution transformers using the available UNIGE data on a real distribution network. 3) Implementation and fine-tuning of the grid models developed in the previous activities on the OPAL-RT real-time calculation environment used by UNIGE-DITEN for the evaluation of the performance of the protections in case of overvoltages (HVRT) on wind power plants.

2019 - 2020

### **Control models and techniques for the provision of flexibility services**

Ricerca sul Sistema Energetico - RSE S.p.A

Participant

The purpose of the study was to analyze the potential of the predictive control technique known as 'Model Predictive Control' (MPC) to operate frequency regulation services using both generators connected to the grid by electronic converters and electrochemical storage systems. In particular, two control algorithms have been developed, one for "stand-alone" storage systems and one for an integrated storage-wind farm system.

2018 - 2019

### **PNRM NEFERIS Energy efficiency e cyber security delle infrastrutture strategiche (Part I).**

Leonardo S.p.A.

Participant

The working group of the Intelligent Electrical Energy System has defined, starting from what was developed in the first part of the Neferis project, a methodology for the analysis of cyber risk and electrical reliability of microgrids and in particular of Smart Military District (SMD). This work is part of a document that provided the Ministry of Defense with the functional technical specifications for the management of safety and energy efficiency of SMD.

2018



## **Identification of the minimum thermal load requirements for frequency regulation and development of new functions for the analysis of the electrical system**

Ricerca sul Sistema Energetico - RSE S.p.A

Participant

The activity involved the development and updating of the ISAP (Integrated Security Assessment Platform) software platform, developed by RSE, with the support of the University of Genova. The platform, built in Matlab environment, integrates various tools for analyzing the static and dynamic security of the electrical system and the efficient prototyping of new calculation functions, in order to carry out comprehensive analyzes of the possible safety problems of the electrical system, both with deterministic methods both with probabilistic methods, and to develop and test new methodologies and methods of synergistic use of the tools integrated within the platform.

2017 - 2019

### **Microgrid optimization**

ABB Power Grids Italy S.p.A. - Genova

Participant

The main objective of this research activity was to define and implement an optimization algorithm for the energy management of a microgrid composed of: diesel generators, storage systems, CHP systems, photovoltaic systems, wind systems and non-controllable loads. The algorithm was implemented in the Matlab-AMPL environment and was validated through simulations and experimental tests

2018 - 2019

### **Assessment of battery storage systems potential**

REF-E

Participant

The work carried out in this research contract concerned the study of the Italian electricity transmission network within Enel's 'Assessment of battery storage systems potential' project. Different market scenarios developed by REF-E were tested in two different network models (2020 network and 2030 network, according to the interventions planned by TERNA). The static analysis performed on different scenarios described the impact of the market in Italy, highlighting possible limits and criticalities. Finally, the study was focused on the possible benefits that new installations of storage systems can bring in terms of voltage regulation.

2016 - 2017

### **Study and development of models for optimal sizing of storage systems coupled to grid connected renewable generation**

ABB Power Grids Italy S.p.A. Genova

Participant

The main task of this collaboration with ABB Power Grids was to develop a

tool for the optimal sizing of a storage system that is able to compensate for forecast errors and fluctuations in a renewable production plant. The proposed optimization algorithm is based on a probabilistic Monte-Carlo type approach. This allows us to consider the different weather conditions that occur in a calendar year and that can influence the production of a renewable source plant.

**2017 - 2018**

### **Intelligent Load Management (ILM) functions developed for Emax**

ABB Power Grids Italy S.p.A. Bergamo

Participant

The activity led to the definition of an algorithm for the energy management of a microgrid. Its formulation was designed to be used on low voltage circuit-breakers (for example Emax, produced by ABB) which are able to manage controllable resources (generators, storage systems and loads) within a distributed approach, and scalable. The developed technique is capable of: 1) Control the energy consumption at the PCC (Point of Common Coupling), with the possibility to participate in Active Demand Response programs or to provide flexibility / energy reserve, when the microgrid is connected to the prevailing grid. 2) Control of the frequency profile, when the microgrid operates in island mode.

**2015 - 2016**

### **Management and control of the electrical load for the provision of auxiliary services including grid security aspects**

Ricerca sul Sistema Energetico - RSE S.p.A.

Participant

The project developed a methodology for the probabilistic calculation of the Network Transfer Capacity (NTC) between different areas of the same network. This procedure is based on the coupled use of the Point Estimate Method (PEM) and the Third Order Polynomial (TPN) Transformation. The approach was implemented within the ISAP platform, and was compared with a conventional technique for the NTC evaluation.

**2015 - 2016**

### **Load management and control in microgrids including methodologies and technologies for load and generation forecasting**

ABB Power Grids Italy S.p.A. Genova

Participant

The research contract involved the performance of two distinct activities: 1) Analysis of the techniques and methodologies present in the literature regarding the prediction of the load and renewable generation. 2) Analysis of the state of the art and identification of significant use cases relating to solutions for managing the load and / or energy of a microgrid.

2014 - 2015

### **RES validation forecast**

ABB Power Grids Italy S.p.A. Genova

Participant

The goal of this research project was to define a methodology for the validation of forecasting techniques for renewable source generation plants. In particular, the following activities were carried out: 1) Definition of performance indices for the evaluation of forecasting techniques. 2) Definition of a validation procedure for the forecasting tools considered. 3) Identification of the inputs necessary for each single instrument object of the study. 4) Evaluation of forecasting techniques according to the proposed validation procedure

2013 - 2014

### **Transfer capacity modeling (NTC) for the development of calculation functions**

Ricerca sul Sistema Energetico - RSE S.p.A.

Participant

The activity involved the development of deterministic and probabilistic methodologies for the calculation of the Net Transfer Capacity (NTC). These have been implemented within the ISAP (Integrated Security Assessment Platform) electrical system security assessment platform. During this research contract, the ISAP platform was updated to allow the definition of simulation scenarios and to allow the implementation of new features.

### ***Editorial activity***

1-Member of the Technical Committee on Power and Energy Systems (TC 6.3) of "International Federation of Automatic Control (IFAC)", from Oct. 2020

2-Member of the Scientific Committee of "International Conference on the European Energy Market (EEM)", Stockholm (Sweden), 16-18 Sep. 2020

3-Member of the Scientific Committee of "International Conference and Exhibition on Electrical Power Quality and Utilization (EPQU)", Krakow (Poland), 12-14 Sep. 2020

4-Member of the Technical Committee Program of "IEEE International Forum on Research and Technologies for Society and Industry (RTSI)", Firenze, 9-12 Sep. 2019

5-Reviewer - International Journals: IEEE Transaction on Industrial Electronics, IEEE Transaction on Sustainable Energy, IEEE Transaction on Industry Applications, IEEE Transaction on Smart Grids, IEEE Access, Electric Power System Research, International Journal of Electrical Power and Energy Systems, Energies, Applied Sciences

6-Reviewer - International Conferences: IEEE PES Powertech, Convegno Annuale Internazionale AEIT, Power Systems Computation Conference (PSCC), IEEE International Conference on Environmental and Electrical Engineering (EEEIC), IEEE PES Innovative Smart Grids Technologies Conference (ISGT).