

Stefano Leonori

RESEARCH ACTIVITY

In the last decades, several governments are implementing different energy policies to encompass a sustainable energy future. These policies promote the increasing use of Renewable Energy Sources (RESs), electric vehicles and the application of demand response programs. However, the increasing penetration of distributed RESs and fast charging stations, since are characterized by stochastic and intermittent behaviours, requires a modernization of the whole electric distribution infrastructure for a better control and management of power transients, energy flows oscillations and bidirectionalities. The installation of grid-connected Microgrids (MGs) can be a suitable solution for a bottom-up modernization of the distribution grid into a smart grid. MGs are defined as "groups of interconnected loads and distributed energy resources that act as a single controllable entity with respect to the grid". Their realization requires the equipment of energy storage devices, power converters and ICT infrastructures able to efficiently monitor, control and manage the MG energy flows including the energy exchanged with the grid by means of the design of a suitable Energy Management System (EMS). My research activity has been centred on the application of machine learning techniques for the synthesis of a MG EMS. The EMS here formulated is in charge to define in real time how to distribute the MG energy flows. For EMS design, fuzzy systems have been preferred over other possibilities since rule based inferential systems, other than being featured by low computational cost, allow a better interpretation of the overall decision rule.

During my PhD, different algorithms for data driven FIS synthesis have been investigated, relying on Computational Intelligence techniques, and exploiting a hybrid evolutionary-fuzzy approach. Results have been compared with (optimal) benchmark solutions computed by assuming to know a priori the whole time series of the loads and energy generation.

In the last year my research activity focused on the realization of an autonomous robot applied to smart agriculture for multi-purpose operations as irrigation, seeding as well as high precision operations like image recognition and soil sampling. The robot is composed by three power systems, two truck and one trolley. The trucks are in charge to fulfil the path planning and the trolley to operate on the ground. Since this latter is featured by a light weight to minimize the soil compaction it is devoid of any power train motors. Namely, a funicular system is in charge to move it on a work line. Specifically, two winches installed on the trucks pull and release their respective ropes tied to the trolley to move it on the work-line and at the end of it, the trolley is lifted by the closest truck and put on the next work line.

WORK ACTIVITY

2020-2021

Postdoc

Postdoc at DIET (Department of Information Engineering, Electronics and Telecommunications), University of Rome "La Sapienza" and PoMoS (cluster for sustainable mobility) lab.

Topic of my research:

State of the art analysis and design of energy system (sizing and control) for applications oriented to the sustainable agriculture.

(Analisi dello stato dell'arte, individuazione comparativa di architetture evolute, progettazione di soluzioni (energetiche e di controllo) per applicazioni di agricoltura sostenibile)

Main activities:

- Participation the SPOS project. It is national project (PON-Piano Operativo Nazionale) which consists in the realization of a multi-purpose autonomous system applied for smart agriculture composed by three robots.
- My tasks foreseen the communication with partners, supervision of the project, writing documents and reports, coding the software used for the autonomous navigation, interconnect the system devices and control the power systems, work on the firmware and choose the hardware.
- The project foreseen the development of a small-scale prototype for preliminary tests and debugging activities on the power train system, the hardware, firmware and software.
- Robot Operating System (ROS) developer, the system software have been developed in ROS, C++, Python, Gazebo, the adoption of a CAN protocol communication for the power train systems interconnected with the main boards through Arduino boards.
- Battery Management System design through machine learning techniques and neural networks, the work has been published on journal.
- Counseling activities as smart grid and automotive expert for BRAGAMORO group and ENEL.

Minor activities: Professor Assistant, students' supervisor, writing and reviewing of scientific papers in the field of smartgrids and sustainable mobility.

2019-2020

Postdoc

at Ce.R.S.I.Te.S (Research Center for Sustainable and Innovative Technologies) of University of Rome "La Sapienza" - Polo Pontino.

Topic of my research: "Application of machine learning techniques for microgrids energy management system modelling".

Main activities:

- Publication of a software on "Adaptive Neuro Fuzzy Inference System Synthesis by Clustering Techniques" (<https://gitlab.com/labcoin/anfis-toolbox>),
- Energy Management System Design and optimization for a prosumer nanogrid and Battery Management System Design by Neural Networks for a regional (POR) project named MODular Smart Energy System (MOSES) (<https://www.bragamoro.com/it/progetto-moses-pr-1.html>),
- Counseling activities as smart grid expert for IMPREME group.

Minor activities: Innovation Manager, member of the POMOS (Sustainable Mobility Research Center) research team at Cisterna di Latina, Professor Assistant and master students' supervisor, writing and reviewing of scientific papers in the field of smartgrids and sustainable mobility.

TEACHING ACTIVITY

- 2021 Seminary on "Machine Learning Techniques For Energy Systems" at the Summer School of Information Engineering (SSIE) – "Silvano Pupolin".
- 2017-2021 Four years of teaching activity for the Electrical Engineering course at La Sapienza. Every year, the activity includes 30 hours (3 CFU) of lectures, exam surveillance, correction of exercises, supply of teaching material with texts, links to websites, presentations and youtube videos for distance learning during the COVID emergency.
- 2018-2019 Tutor of the Master "Strategies of Energy Management Systems" (SEMS) at La Sapienza held by Prof. Livio de Santoli.
- 2019-2020 Tutor activities for Master Students and Seminars, supporting the teaching activity of Prof. Fabio Massimo Frattale Mascioli, Prof. Antonello Rizzi..
- 2019-2020 Co-tutor of a Master thesis on "A Physical Inspired Ensemble Neural Networks Model for Electrochemical Cells State Estimation" defended by Gabriele Perri.

EDUCATION AND TRAINING

- 2015-2019 **PhD in ICT**
 University of Rome La Sapienza, via Eudossiana 18, 00184, Rome, Italy
 - Thesis: Machine Learning Techniques for Microgrid Energy Management System Modelling and Design.
 - Tutor & Co-Tutor Prof. Fabio Massimo Frattale Mascioli & Prof. Antonello Rizzi.
 - Feb.-Aug. 2017 Visiting Scholar at the Center for Automotive Research-Ohio State University (OH-USA) under the supervision of Prof. Giorgio Rizzoni.
- 2012-2014 **Master's degree in Energy Engineering - Renewable Energy Sources**
 University of Rome La Sapienza, via Eudossiana 18, 00184, Rome, Italy
 - Thesis: "Energy Management of an Electric Vehicle: Control System Design with Fuzzy Logic for the Power Flows Managing". Tutor: Prof. Fabio Giulii Capponi, vote: 110/110 summa cum laude.
- 2008-2012 **Bachelor's degree in Energy Engineering**
 University of Rome La Sapienza, via Eudossiana 18, 00184, Rome, Italy
 - Thesis: "Experimental Evaluation of Tars Inside a Steam Reforming Process". Tutor: Prof. Vincenzo Naso, vote: 104/110.

PERSONAL SKILLS

Mother tongue(s) italian
 Other language(s)

	UNDERSTANDING		SPEAKING		WRITING
	Listening	Reading	Spoken interaction	Spoken production	
English	C1	C1	C1	C1	C1

Computer skills	Microsoft Office, Matlab, Simulink, Matpower, Simscape, Python, keras, TensorFlow, Octave, C, C++, AutoCAD, Xfoil, ROS, Gazebo, Code Composer Studio, Dialux, Comsol, Solid Edge, Latex, Tikz, Embedded Microcontroller Systems, Machine Learning models training and implementation.
Driving licence	B
Boating licence	Sailing and motor without limits (over 12 miles).

ADDITIONAL INFORMATION**Coursera**

Deep Learning Certificate (5 courses):" Through five interconnected courses, learners develop a profound knowledge of the hottest AI algorithms, mastering deep learning from its foundations (neural networks) to its industry applications (Computer Vision, Natural Language Processing, Speech Recognition, etc.)".

Peer Reviewer

MDPI reviewer board member (https://www.mdpi.com/journal/energies/submission_reviewers). Peer Review activities for the following journals and conferences: IEEE Open Access, Energies, IEEE Transactions on Emerging Topics in Computational Intelligence, Engineering Reports, Applied on Soft Computing, Applied Energy, IEEE World Congress on Computational Intelligence 2018, Frontiers, Utilities Policy. For further information most of my reviews are reported on Publons. My Publons ID: T-7712-2019.

ROS-The Construct

These courses have been followed: ROS Navigation in 5 days, ROS Basics in 5 Days (Python), URDF for Robot Modelling.

PUBLICATIONS

- ENERGIES, 2021, "A Physically Inspired Equivalent Neural Network Circuit Model for SoC Estimation of Electrochemical Cells", Stefano Leonori, Luca Baldini, Antonello Rizzi and F. M. Frattale Mascioli, *Energies*. DOI: <https://doi.org/10.3390/en14217386>.
- IJEPES, 2021, "Intelligent Energy Flow Management of a Nanogrid Fast Charging Station Equipped with Second Life Batteries", Stefano Leonori, Giorgio Rizzoni, F. M. Frattale Mascioli and Antonello Rizzi, *International Journal of Electrical Power and Energy Systems*. DOI: <https://doi.org/10.1016/j.ijepes.2020.106602>.
- ASOC, 2020, "A Generalized Framework for ANFIS Synthesis Procedures by Clustering Techniques", Stefano Leonori, Alessio Martino, Massimiliano Luzi, Antonello Rizzi and F. M. Frattale Mascioli, *Applied Soft Computing*. DOI: [10.1016/j.asoc.2020.106622](https://doi.org/10.1016/j.asoc.2020.106622).
- APEN, 2020, "Microgrid Energy Management Systems Design by Computational Intelligence Techniques", Stefano Leonori, Alessio Martino, Antonello Rizzi and F. M. Frattale Mascioli, *Applied Energy*. DOI: [10.1016/j.apenergy.2020.115524](https://doi.org/10.1016/j.apenergy.2020.115524).
- ASOC, Nov.2019, "Optimization strategies for Microgrid energy management systems by Genetic Algorithms", Stefano Leonori, Maurizio Paschero, Antonello Rizzi and F. M. Frattale Mascioli. DOI: [10.1016/j.asoc.2019.105903](https://doi.org/10.1016/j.asoc.2019.105903).
- TETCI, June 2019 "ANFIS Microgrid Energy Management System Synthesis by Hyperplane Clustering Supported by Neurofuzzy Min-Max Classifier" Stefano Leonori, Alessio Martino, Antonello Rizzi and F. M. Frattale Mascioli, *IEEE Transaction on Emerging Topics*. DOI: [10.1109/TETCI.2018.2880815](https://doi.org/10.1109/TETCI.2018.2880815).
- WCCI, July 2018 "Microgrid Energy Management by ANFIS Supported by an ESN Based Prediction Algorithm" Stefano Leonori, Maurizio Paschero, Antonello Rizzi and F. M. Frattale Mascioli, *WCCI 2018, Rio de Janeiro, Brazil*. DOI: [10.1109/IJCNN.2018.8489018](https://doi.org/10.1109/IJCNN.2018.8489018).

- WIRN, June 2017 “FIS Synthesis by Clustering for Microgrid Energy Management Systems” Stefano Leonori, Maurizio Paschero, Antonello Rizzi and F. M. Frattale Mascioli, WIRN 2017, Vietri sul Mare, Italy. [//doi.org/10.1007/978-3-319-95098-36](https://doi.org/10.1007/978-3-319-95098-36).
- IJCCI, Oct 2017 “ANFIS Synthesis by Clustering for Microgrids EMS Design” Stefano Leonori, Alessio Martino, Antonello Rizzi and F. M. Frattale Mascioli, IEEE-IJCCI 2016, Madeira, Portugal. DOI:10.5220/0006514903280337.
- FUZZ-IEEE.2017, Jul 2016 “An optimized microgrid energy management system based on FIS-MO-GA paradigm” Stefano Leonori, Maurizio Paschero, Antonello Rizzi and F. M. Frattale Mascioli, FUZZ-IEEE 2016, Napoli, Italy. DOI: 10.1109/FUZZ-IEEE.2017.8015438.
- IECON, Oct 2016 “Optimization of a Microgrid Energy Management System based on a Fuzzy Logic Controller” Stefano Leonori, Enrico De Santis, Antonello Rizzi and F.M. Frattale Mascioli, IEEE-IECON 2016, Firenze, Italy. DOI:10.1109/IECON.2016.7793965.
- WCCI, Aug 2016 “Multi Objective Optimization of a Fuzzy Logic Controller for Energy Management in Microgrids”, Stefano Leonori, Enrico De Santis, Antonello Rizzi and F. M. Frattale Mascioli, IEEE-WCCI 2016, Vancouver, Canada. 10.1109/CEC.2016.7743811.

Dati personali Autorizzo il trattamento dei miei dati personali ai sensi del Decreto Legislativo 30 giugno 2003, n. 196 "Codice in materia di protezione dei dati personali". Stefano Leonori

Roma il 17/11/2021
Stefano Leonori