MASSIMO GUARNIERI

CURRICULUM VITAE

06/10/22

Born 1955

Education

- Graduated from classical high school with 60/60 in 1974.
- Master graduation in Electrical Engineering in Padua with 110 cum laude in 1979.
- Postgraduate diploma degree in Plasma Engineering and Controlled Thermonuclear Fusion in Padua with 30/30 cum laude in 1982.
- Master in Business Administration at CUOA (University Consortium of Business Administration) in 1986.
- PhD in Electrical Sciences in Rome (by titles) in 1987.

Professional career

- Researcher of the CNR (Italian National Research Center) in Padua from July 1982.
- University researcher of Electrical Engineering at University of Padua from April 1983.
- Associate Professor of Electrical Engineering at University of Padua from November 1992.
- Extraordinary Professor of Electrical Engineering at University of Padua from October 2000.
- Full Professor of Electrical Engineering at University of Padua since October 2003.

Teaching

- He teaches or has taught Electrical Engineering, Circuit Theory, Computational Electrical Engineering and History of Technology (starting the first such course at the University of Padua) offered in numerous Engineering Degree Courses.
- He held lectures and seminars for specialization and doctorate courses.
- He was appointed to a chair of Electrical Engineering at the University of Udine in the period 1989-1995.
- In October 2008 he was appointed to deliver a course on multiphysics modeling of fuel cells at the Italian PhD National School in Electrical Engineering "F. Gasparini".
- He was the President of the Council of the Master Degree Program in Electrical Engineering for 4 years from 2009.
- He was the Dean of Department Teaching Commission (which coordinates 10 undergraduate and graduate programs) for 4 years from 2009.

Research positions and appointments

- He was a visiting researcher at the UKAEA laboratories in Culham (UK) in 1984 and at General Dynamics in San Diego (USA) in 1986.
- He founded the Computational Electrotechnical Laboratory of the Department of Electrical Engineering (later merged into the Department of Industrial Engineering) in 2000.
- He founded the Electrochemical Energy Storage and Conversion Laboratory (EESCoLab) of the Department of Industrial Engineering in 2010 and still leads it.
- He was a member of the Scientific Commission of the University 2013-2015.
- He was a member of the Research Commission of the Department of Industrial Engineering in the period 2015-2019.
- He is a member of the governing board of the "Giorgio Levi Cases Energy Economics and Technical Studies Center" of the University of Padua, which promotes and supports research on new forms of energy, since 2018.
- He was chairman of the international workshop to discuss the results of the PRIN1998 project lead by prof. Guglielmo Rubinacci and the editor of the related final scientific report.
- He was co-organizer and chairman of invited sessions of the International Coupled Problems 2009, 2011, 2013, 2015 and 2017 Congresses.

- He was co-chairman of ISPE12 - XII International Symposium on Polymer Electrolytes, held in Padua from 29 August to 3 September 2010.
- He was track chairman of the 11th Biennial Conference on Engineering Systems Design and Analysis (ESDA2012) held in Nantes (France) in July 2012.
- He was co-chairman of the 7th German-Italian-Japanese Meeting of Electrochemists held in Padua in June 2014.
- He was session chairman at the 21st Solid State Ionics Conference held in Padua in June 2017.

Associative and institutional positions

- He is a member of the scientific associations IEEE (Institute of Electrical and Electronics Engineers, the largest scientific organization in the world), ECS (ElectroChemical Society) and AEIT (Italian Association of Electrotechnical Electronics, Computer Automation and Telecommunications).
- He was in charge of the Training and Profession thematic group of the professional association AEIT-ASTRI from 2004 to 2010.
- He is a member of the editorial board, associate editor and columnist of the IEEE Industrial Electronics Magazine (5 years H-index = 14.7).
- He is associate editor of Energies magazine (5 year H-index = 2.8).
- He is an associate editor of the Elsevier Encyclopedia of Energy Storage, for the Electrochemical Storage Section (to be published in 2022).
- He is a reviewer for high impact journals including Nature Energy, Advanced Materials, IEEE Industrial Electronics Magazine, Applied Energy, Journal of Power Sources.
- He was the official representative of the University of Padua in N.ERGHY, the association representing European universities and research institutes in the Fuel Cell and Hydrogen Joint Technology Initiative (FCH JTI) of the European Commission, which in the period 2014-2020 funded research for 1.3 billion euros.
- He is the official representative of the University of Padua in the Energy Storage program of EERA, the European Energy Research Association which collaborates in defining the financing programs of the European Commission in the energy field.
- He is a member of the Batteries Europe Working Group which is supporting the European Commission in defining the funding program on batteries for the period 2022-2030.
- He is a member of the IEEE European Public Policy Committee Working Group on Energy, which is consulting the European Commission in the energy field, since February 2021.
- He is an Expert of the Funding and Tender Opportunities of the European Commission since September 2018, for the evaluation of proposals presented at Horizon 2020, Horizon Europe, ERC, MSCA, ETN, ITN.
- He seats in the Executive Board of Flow Batteries Europe (FBE) from May 2021 and is the Chair of the Technological Committee of FBE.
- He is the Chair of the History Activity Committee of the of IEEE Italy Section.
- He coordinates the LEDS x Africa UNIPD student association, which is committed to bringing electricity from renewable sources to remote areas of Africa, to combat energy poverty.

International collaborations

- He has promoted collaborations with foreign universities that have resulted in exchanges (visiting scientist, visiting professor and visiting students funded by the University of Padua or by EC Erasmus programs), and in collaborative research, including:
- MoU (memorandum of understanding) with the University of Tennessee in Knoxville (USA)
- MoU with Tokyo University of Agriculture and Technology (J)
- Active collaborations: MIT di Boston (USA), Vanderbilt University di Nashville (USA), Fraunhofer-Institut für Chemische Technologie (Pfinztal, Germania), Skoltech University di Moskow (Russia), Chalmers University of Technology (Gothenburg, Svezia)
- Starting collaborations: Eindhoven University of Technology (Paesi Bassi), Christian-Albrechts-Universität (Kiel, Germania)

Participation and coordination of public-funded projects

- From 1980 to 2000 he worked at the RFX project, which led to the construction of the eponymous machine for research on controlled thermonuclear fusion (plasma currents of 2 megamps, supported by CNR-ENEA-EURATOM), with increasing responsibility up to the lead of the Magnetic System Group.

- PRIN1998 of MURST (Italian Ministry of University and Scientific Research): he led a sub-project on RFP machines within the project led by prof. Guglielmo Rubinacci.
- PRIN2002 of MURST: he was the local leader in the project led by prof. Giorgio Molinari (39,000 Euros).
- PRIN2004 of MURST: he was the local leader in the project led by prof. Andrea Stella (49,000 Euros).
- PRIN2006 of MURST: he was the local leader in the project led by prof. Andrea Stella (63,000 Euros).
- PRIN2008 of MURST: he was the deputy leader in the project led by prof. Andrea Stella (59,000 Euros).
- He led some research projects funded by the University of Padua.
- He led two projects for young graduate engineers funded by the Veneto Region with support from the European Social Fund (FES) in 2014-2015 (58,000 Euros).
- He led a research group for the 2011 Strategic Project of the University of Padua "From Materials for Membrane-Electrode Assemblies to Electric Energy Conversion and Storage Devices – MAESTRA" (810,000 Euros).
- He led the project "Next Generation VRFB Energy Storage Systems – NeGeVaESS" within the 2016 Program of the Giorgio Levi Cases Center for Energy Economics and Technology of the University of Padua (130,000 Euros).
- He is leading the project "Grid-optimized vanadium redox flow batteries: architecture, interconnection and economic factors – GoVBAIE" of the 2019 Program of the Giorgio Levi Cases Center for Economics and Energy Technology of the University of Padua (60,000 Euros).
- PRIN 2017 of MURST: he leads a sub-program of the project ''Holistic approach to EneRgy-efficient smart nanOGRIDS – HEROGRIDS'' led (PI) by prof. Paolo Mattavelli (593,000 Euro).

Private funded projects

He has developed several projects for the transfer of electromagnetic, electrical, energy storage and renewable energy technologies to institutions and companies, which have been supported by private funding and have also resulted in filing of patents.

One of these projects, commissioned by a Venetian service company, aimed at the recovery of a compromised industrial area of Porto Marghera (Venice) and its conversion into an industrial experimentation area for technologies related to renewable sources, with funding for 1,200.00 Euros from the MATTM (the Italian Ministry for the Environment). The project has allowed the realization of the Green Propulsion Laboratory of Veritas, which includes the design of two prototypes of fully electrified technical boats powered by lithium-ion and hydrogen batteries and fuel cells.

- He led the project ENI nr. 4310330019 (2019) "Miglioramento delle prestazioni della batteria a flusso", aimed at performance optimization of a prototype micrigrid with a flow battery of a major Italian multinational company in the energy sector (116,000 Euros).
- He leads the FIAMM Energy Technology project (2021) "Studio e modellazione termica analitica e numerica di moduli di batterie al litio" (154,000 Euros).

Scientific production

He is the author of ca 290 scientific publication (IRIS), 160 of which are indexed in Scopus. These publications include 33 books (with subsequent editions) on electromagnetism, electrical networks, electrical technologies and the history of technology, written as a co-author or sole author, which are used in several Italian universities.

In the last three year he has received the following citations in Scopus: 362 (2019), 346 (2020), 453 (2021).

He has registered seven patents.

He is listed in the World's Top 2% Scientists Ranking of the Stanford University (yearly and career).

Scientific activity

The initial scientific activity was on controlled thermonuclear fusion in magnetic confinement. He worked on the Eta Beta II project, the second experiment in this line carried out in Padua, for which he dealt with the engineering management of the experimental sessions and designed and guided the construction of the new power supplies, which made it possible to improve significantly the performance of the machine ("active crowbar systems": poloidal = 3.6 kV, 580 kJ; and toroidal = 1 kV, 20 kJ, with an investment of over 100 million lire in 1982). He worked on RFX, the third experiment for nuclear fusion research at Padua and still the largest in the world in the RFP (Reversed Field Pinch) line. Since graduation, he was committed to the preliminary studies for the coil system with an air core. The work on RFX then continued with a primary contribution from the definition of the design of the machine, which was crucial for obtaining national funding from ENEA and CNR and EU funding from EURATOM. Completed in 1992 thank to funding for over 180 billion lire (90 million euros), the machine is still one of the largest for experiments on thermonuclear plasmas and presents unique technological features. The machine was built within the RFX Consortium, a scientific

organization which employs over 100 graduate researchers and several master doctoral students, and collaborates with a number of foreign research centers: English (Culham Laboratory), Irish (University of Cork), Swedish (KTH Royal Institute of Technology - Stockholm), US (Los Alamos National Laboratory, Princeton Plasma Physics Laboratory, General Atomic in San Diego and University of Wisconsin in Madison) and Japanese (Naka Fusion Institute). Working within the Magnetic System Group, Massimo Guarnieri was committed to the manufacturing design and construction of large windings that form the magnetic system (Magnetizing Winding: 40 coils with a diameter up to 8 m, currents of 50 kA and voltages of 200 kV, capable of delivering 75MJ with a peak power of 10 GW, to induce plasma currents of 2 mega-amps; Primary winding: 16 coils of 6.25 kA, 17.5 kV, 1 MJ, 109 MW , to confine the plasma; -Toroidal winding: 48 coils with a diameter of 1 m, 18.3 kA, 7 kV, 128 MW, also to confine the plasma). He conceived and developed original computerized calculation tools, capable of studying and automatically optimizing their shapes to meet the required magnetic performance. He then participated in the management of contracts for their construction and supply, carried out by ABB, TIBB, Alsthom, and Schneider, respectively, with a total financial commitment of over 10 billion lire in 1990. He also conceived, designed and managed the construction of the highly complex control and protection system of RFX (made by Siemens). Within the RFX program, he held positions of increasing responsibility until he took the lead of the Magnetic System Group, which manages the system during the experimental sessions and studies tits future implementations.

In the following years he directed his interests on computational electromagnetism, starting the development of innovative integral formulations applied in the field of coupled problems (electromagnetics combined to mechanical and thermal issues). These methods have found application in the industrial field (in the processes of heat treatment of materials) and in the biomedical field (in the hyperthermic treatments of neoplasms).

Since twenty years, he leads the research group on "Electrochemical Energy Accumulation" of the Industrial Engineering Department, for which he created the "Computational Electrotechnical Laboratory" and the "Electrochemical Energy Storage and Conversion Laboratory" - EESCoLab. The group deals with the design and development of energy storage systems for the expansion of renewable resources, with both computer simulation and experimental activities. Devices studied are mainly fuel cells, electrolysers and flow batteries, as well as electric powertrains. The activities aim to develop, both numerically and experimentally, new technological solutions that can be transferred to the industrial world. The devices are designed both for stationary applications, in connection with grid and generators from renewable sources in the so-called smart grids, and for electric propulsion in next-generation vehicles and boats. As for the redox flow batteries, the research group built and put into operation an R&D plant with a 9kW and 27kWh vanadium redox flow battery (VRFB), where world-class performance was achieved.

Publications in the last 3 years

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3. **M. Guarnieri**: "Matthew Fontaine Maury the 19th-Century Forerunner of Big Data", *IEEE Industrial Electronics Magazine*, Vol. 12, No. 2, pp. 64-67, June 2018. DOI: 10.1109/MIE.2018.2827861.
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5. **M. Guarnieri**, A. Trovò, A. D'Anzi, P. Alotto, "Developing vanadium redox flow technology on a 9-kW 26-kWh industrial scale test facility: design review and early experiments", *Applied Energy*, 230 (2018) 1425-1434. DOI: 10.1016/j.apenergy.2018.09.021.
6. **M. Guarnieri**, A. Trovò, A. D'Anzi, G. Marini, A. Sutto, P. Alotto, "The VRFB Industrial-Scale Experiment at University of Padua," *The International Flow Battery Forum IFBF 2018*, Lausanne Switzerland, 10-12 July, 2018, pg. 50-51.
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13. **M. Guarnieri**: *Elettrotecnica circuitale,* libreriauniversitaria.it Edizioni, Padova, Seconda Edizione Febbraio 2019, pp. 603. ISBN: 978-88-3359-102-5.
14. **M. Guarnieri**, *Elementi di elettromagnetismo per l'Elettrotecnica*, Bologna: Società Editrice Esculapio, seconda edizione settembre 2019, pp. 142. ISBN 978-88-9385-120-6.
15. **M. Guarnieri**: "Messaging before the Internet – Early electrical telegraphs", *IEEE Industrial Electronics Magazine*, Vol. 13, No. 1, pp. 38-41+53, Mar. 2019. DOI: 10.1109/MIE.2019.2893466.
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17. A. Trovò, G. Marini, A. Sutto, P. Alotto, M. Giomo, F. Moro, **M. Guarnieri**, "Standby thermal model of a vanadium redox flow battery stack with crossover and shunt-current effects", *Applied Energy*, 240 (2019) 893-906. DOI: 10.1016/j.apenergy.2019.02.067.
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