ICIT 2021 Special Session

Superconducting Applications for Electrical Energy Systems

Francisco Ferreira da Silva

Francisco Silva was born in Lisbon, Portugal, in 1994. He received his M.Sc. in 2018 in Electrical and Computer Engineering from Instituto Superior Técnico (IST), University of Lisbon. Currently, he is in his second year of Ph.D., with the subject being on the design and prototype of a full superconductive modular axial-flux electrical motor, configuring HTS Bulks and/or CORC® wires. He is also a supervisor of M.Sc. thesis regarding superconductor bulks in MagLev systems and bulks and tapes using in electrical machines. He participated in the HTS Modelling 2018 Workshop, afterward publishing a technical paper about the subject of is M.Sc. This year, he participated in the ASC 2020 conference, with a submitted abstract and an oral discussion moderator.

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Wescley de Sousa

Wescley Tiago Batista de Sousa was born in São Paulo, Brazil, in 1983. He received the B.Sc. degree in physics from the State University at Ponta Grossa, UEPG, Brazil, in 2008, and the M.Sc. and D.Sc. Degrees in electrical engineering from the Federal University of Rio de Janeiro, UFRJ, Brazil, in 2011 and 2015. Respectively, between 2009 and 2012, he was with Electric Power Research Center (CEPEL, Brazil). From 2015 to 2016, he was a Post-doctoral Researcher and Sub-Coordinator of the Laboratory of Applied Superconductivity (LASUP) at the Federal University of Rio de Janeiro UFRJ, Brazil. Since 2016, he has been a Researcher at the Institute for Technical Physics (ITEP) in the Karlsruhe Institute of Technology (KIT – Germany). His area of expertise is developing suitable simulation tools for superconducting equipment to be used in power systems. He is also a board member of the HTS Modelling Workgroup (the international group for the modeling of high-temperature superconductors)

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Antonio Morandi

Antonio Morandi holds a Ph.D. in Electrical Engineering. Since 2006 he has been with the Department of Electrical, Electronic and Information Engineering, where is appointed professor of Elements of Electrical Engineering, Electric Energy Storage and Applied Superconductivity. He is also a supervisor of Ph.D. programs on Applied Superconductivity. His research interests are on power applications of High-Temperature Superconductors and advanced energy systems. He has coordinated several research projects in this field funded by Public Agencies and by private companies. He has contributed to the superconducting power apparatus (FCL and SMES) and modeling and design tools. Antonio Morandi is the author of about 50 technical papers published in international journals and conferences. He is the inventor of two patents. He is a reviewer of research projects in the European Commission's energy sector, the Italian Ministry of Education, Universities, and Research and foreign research institutes. He has given several invited talks at international conferences and research associations and has moderated several technical discussions. He is a member of the Italian mirror Committee IEC TC90 – Superconductivity and is a member of the International Steering Committee on HTS Modelling. He has been a member of program committees at international conferences. He has been the chairman of the 5th International Workshop on Numerical Modelling of High-Temperature Superconductors, Bologna-Italy, 2016. Antonio Morandi is a member of the ESAS board. He is a senior member of IEEE and serves as a technical editor for IEEE Transaction on Applied Superconductivity.

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Paulo José da Costa Branco

P. J. da Costa Branco (M'91). Since 2005, he is an Associate Professor (with Habilitation in 2012) with the Department of Electrical and Computer Engineering, Scientific Area of Energy, Instituto Superior Tecnico, Universidade de Lisboa, Lisbon, Portugal. Currently, his research covers 1) Photovoltaic (PV) systems operation and maintenance (PV O&M): multi-objective optimization to minimize the economic and energy costs over the life-cycle; 2) Operation of induction generators when isolated from the power grid and under variable speed in the pump as working turbines (PATs); 3) Criticality in the smart grid operation environment: definition of reliability models for both cyber and power equipment, and 4) The use of bulk high-temperature superconducting materials inserted in the magnetic circuit of electromechanical systems to increase its power density. He is a member of the Industrial Electronics Society and the IEEE Power & Energy Society. Member of the IEEE Council on Superconductivity in the representation of the IEEE Power & Energy Society. His scientific and experiential knowledge can be better attested at https://orcid.org/0000-0002-7072-5184

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-Technical Outline of the Session and Topics:

Studies on the use of superconducting technology as increased since the days of first-generation superconductors and their uses in high-field magnetics. Nowadays, the research also includes superconducting materials to re-design the current technology used in the world's electrical energy systems. New motors, partial or fully superconducting, are being researched, with the potential of higher efficiencies, and higher power densities, for applications such as powertrain for vehicles, including in ships and airplanes. DC/AC superconducting transmission lines and transformers also share the same potential advantages regarding their efficiency and high-power density. In railed transportation, the use of superconducting magnetic levitation (MagLev) systems is a well-studied topic, with some countries already having full-scale working prototypes. For energy storage, the superconducting magnetic energy storage (SMES) also shows several advantages over conventional energy storage, such as its capacity to deliver its energy faster, have lower losses due to its superconductivity, and being motionless. All in all, superconductivity is a vast area, with several applications in our current electrical energy system.

This session is then to be focused on the applications of superconductors in electrical energy systems. The main applications are in the design of systems that integrate or re-design the electrical energy system. The main concerns in this session are the design of these new systems, not only in their energy or power delivering capabilities but also in their electromagnetic, thermic and mechanical behavior. Having a higher complexity than the conventional ones, all these systems need to be studied in detail in all aspects. In this sense, full multi-physics simulations and experimental research are the key aspects of researching these topics and the clear advantages they have over the conventional systems used.

The Guest Editors are inviting submissions for this Special Issue, "Superconducting Applications for Electrical Energy Systems." This Special Issue will deal with novel superconducting technologies that innovate or integrate today's electrical energy systems. Topics of interest for publication include but are not limited to:

Topics of the Session

- Superconducting Electrical Motors and Generators;
- Superconducting Transformers;
- Power transmission using HTS cables;
- Superconducting Fault Current Limiters (SFCL);
- Magnetic Levitation (MagLev) Systems;
- Superconducting Bearings;
- Superconducting Magnetic Energy Storage (SMES);
- Superconducting Wireless Power Transfer
- Electric power grid studies using HTS devices.
- Cryogenics for Superconducting Devices and System Integration