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ENERGETIC MACROSCOPIC REPRESENTATION FOR CONTROL OF ENERGY CONVERSION SYSTEMS

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ABSTRACT

EMR is a graphical formalism that was introduced in 2000 by University of Lille to describe complex electromechanical systems. EMR has since been extended to complex multi-physical systems (thermal science, electrochemistry, fluid mechanics …) for energy conversion. EMR is based on the action-reaction principle to organize the interconnection of models of sub-systems according to the physical causality (i.e. integral causality). This description highlights energetic properties of the system (energy accumulation, conversion and distribution). Moreover, an inversion-based control can be systematically deduced from EMR using specific inversion rules. EMR is nowadays taught in Austria, Canada, China, Colombia, France, Portugal, Romania, Spain, Switzerland and Vietnam. EMR is used by industrial companies such as Alstom, Peugeot-Citroën, Groupe Renault, Sherpa Engineering, Siemens Mobility, Siemens Software, SNCF, Typhoon HIL, Valeo, etc. Moreover, EMR is the core of the on-going H2020 European Project PANDA, where University of Lille and Technical University of Cluj Napoca are collaborating on virtual and real testing of electrified vehicles.

This keynote will present the fundaments of EMR and an application to Battery Electric Vehicle will be detailed.

BIOGRAPHY

Alain BOUSCAYROL received Ph.D. degree in Electrical Engineering from Institut National Polytechnique de Toulouse, France, in 1995. From 1996 to 2005, he was Associate Professor at University of Lille, France, where he has been a Professor since 2005. From 2004 to 2019, he has managed the national network on Energy Management of Hybrid Electric Vehicles (MEGEVH) France. Since 2015, he has been coordinator of the CUMIM (Campus of University with Mobility based on Innovation and Neutral carbon) interdisciplinary programme of University of Lille. Since 2018, he has been co-director of the international research lab e-CAMPUS on sustainable mobility (France / Canada). He is coordinator of PANDA a European H2020 project on simulation and testing of electrified vehicles).

His research interests at the L2EP (Laboratory of Electrical Engineering) include graphical descriptions (Energetic Macroscopic Representation, http://www.emrwebsite.org/, etc.) for control of electric drives, wind energy conversion systems, railway traction systems, hybrid electric vehicles and hardware-in-the-loop simulation. His collaborative works with industry on electrified vehicles include PSA Peugeot Citroen, Nexter Systems, Siemens Mobility, Siemens Software, SNCF and Valeo. From 2014 to 2019, he was nominated Chair of the Vehicle Power Propulsion technical committee by IEEE Vehicular Technology Society. From 2014 to 2018 he was appointed Associate Editor of IEEE trans. on Vehicular Technology. Since 2016, has been elected Distinguished Lecturer by IEEE VTS. Since 2019, he has been appointed general chair of the steering committee of IEEE VPPC.

Mircea Ruba (M'10) received the PhD. degree in electrical engineering from Technical University of Cluj Napoca Romana. The topic of his PhD. Thesis was to develop a fault tolerant modular switched reluctance machine. His research activity is focused on power electronics, electrical machines, fault tolerance, batteries and electric vehicles. He is currently lecturer with the Technical University of Cluj Napoca Romania. He published over 90 conference papers, 5 books, 6 patents and membered over 20 research grants (FP7 and H2020). He is book editor with Intech and reviewed many papers for journals from the IEEE Transactions.