Tutorial proposal
Title: DC and AC Microgrids

1. Presenter(s)

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2. Brief description

The DC and AC microgrids tutorial will cover a wide range of topics, going from the description of basic definitions to the analysis of existing pilot projects. Special focus will be given to the modelling and control of DC microgrids and to the important role of power electronic components in these systems.
The tutorial will consist of 7 modules. During the first module, the student will learn to differentiate the concepts of microgrid, smart grid and virtual power plant, as well as to distinguish the difference between a passive and an active distribution network. During the second module the topics of centralized and decentralized control will be addressed. In module 3, the lecture will focus on local controllers and in module 4 the operation of different power electronic elements will be discussed.
During the fifth module of the tutorial, the topic of DC microgrids will be covered. DC microgrids are still at an early stage and there are still many challenges to be tacked. During this lecture the student will be able to describe the main motivations and challenges for the implementation of DC microgrids. In module 6, the student will be able to explain the concepts of microgrid protection, adaptive protection, and to describe the effect of using a fault current source and fault current limitation in a microgrid. After having covered all these topics, in module 7 the student will be able to apply them by controlling and evaluating a given microgrid through a simulation tool. The student will work on an group assignment and will make a presentation explaining the results so that other students can learn from the findings. By the end of this lecture the student will have a broad picture of the state-of-the-art of DC and AC microgrids.

3. Outline

This is a 7-module tutorial, covering the main aspects of DC and AC microgrids. The subjects to be covered per module are listed below.

- 9:00 – 9:20 Module 1: What is a Microgrid? Introduction to control (Dr. Laura Ramrez)
- 9:30 – 9:50 Module 2: Intelligent Local Controllers (Dr. Laura Ramrez)
- 10:00 – 10:20 Module 3: Role of Power Electronics (Prof. Pavol Bauer)
- 10:30 – 10:50 Module 4: DC Microgrids (Prof. Pavol Bauer and Dr. Laura Ramrez)
- 11:00 – 11:20 Module 5: Microgrid Protection (Dr. Laura Ramrez)
- 11:30 – 12:30 Module 6: Microgrid Example (Dr. Laura Ramrez)

Each of the first 5 modules has a duration of 20 minutes and will consist of lectures prepared by the presenters. There is time for questions/break after each module. Module 6 has a duration of 1 hour and will include the simulation of a simple microgrid.

4. Publications

- Selecting a suitable battery technology for the photovoltaic battery integrated module, Vega Garita, V., Hanif, A., Narayan, N., Ramirez Elizondo, L. & Bauer, P., 2019, In : Journal of Power Sources. 438, p. 1-11 11 p., 227011.
- State-Space Modeling of DC Distribution Systems: Experimental Validation, an der Blij, N. H., Ramirez-Elizondo, L. M., Spaan, M. T. J., Li, W. & Bauer, P., 2019, 2019 10th International Conference on Power Electronics and ECCE Asia (ICPE 2019 - ECCE Asia) . IEEE, p. 1-6 6 p. 8796855.
- Energy Management System for the Photovoltaic Battery Integrated Module, Vega-Garita, V., Faizal Sofyan, M., Narayan, N., Ramirez Elizondo, L. & Bauer, P., 2 Dec 2018, In : Energies. 11, 12, p. 1-20 20 p., 3371.
- Stability Constrained Gain Optimization of Droop Controlled Converters in DC Nanogrids, Bandyopadhyay, S., Ramirez-Elizondo, L. & Bauer, P., 22 Oct 2018, 2018 International Power Electronics Conference (IPEC-Niigata - ECCE Asia 2018). IEEE, p. 1426-1434 9 p. 8507814
- Energy Management System with PV Power Forecast to Optimally Charge EVs at the Workplace, van der Meer, D., Mouli, G. R. C., Mouli, G. M-E., Elizondo, L. R. & Bauer, P., 1 Jan 2018, In : IEEE Transactions on Industrial Informatics. 14, 1, p. 311-320 10 p., 7763845.
- A State-Space Approach to Modelling DC Distribution Systems, van der Blij, N. H., Ramirez-Elizondo, L. M., Spaan, M. T. J. & Bauer, P., 2018, In : IEEE Transactions on Power Systems. 33, 1, p. 943-950 8 p.

5. Presenter's biography (IEEE style)

Dr. Laura Ramirez Elizondo is assistant professor at the DC Systems, Energy Conversion & Storage group. In 2003, she received her bachelor's degree in Electrical Engineering and her bachelor's degree in Music with a major in Piano at the Universidad de Costa Rica. She graduated with honours from her M.Sc. studies in Electrical Power Engineering at Delft University of Technology in 2007. Laura worked on her PhD project from September 2007 to December 2011. In 2013, she was awarded with the Erasmus Energy Science Award. Currently, as assistant professor, she is involved in the projects STW Perspektief P13-21: Smart Energy Management and Services in Buildings and Grids (SES-BE); KI Switch 2 Smart Grids: Flexible and future power links for smart grids (FLINK) and the ERA-NET SMARTGRID+ project "DC SMART: DC Distribution Smart Grids".

Prof. dr. Pavol Bauer is currently a full Professor with the Department of Electrical Sustainable Energy 0f Delft University of Technology and head of DC Systems, Energy Conversion and Storage group. He received Masters in Electrical Engineering at the Technical University of Kosice ('85), Ph.D. from Delft University of Technology ('95) and title prof. from the president of Czech Republic at the Brno University of Technology (2008) and Delft University of Technology (2016). He is also honorary professor at Politehnica University Timisioira in Romania. From 2002 to 2003 he was working partially at KEMA (DNV GL, Arnhem) on different projects related to power electronics applications in power systems. He published over 110 journal and over 400 conference papers in his field (with H factor Google scholar 38, Web of Science 25), he is an author or co-author of 8 books, holds 5 international patents and organized several tutorials at the international conferences. He has worked on many projects for industry concerning wind and wave energy, power electronic applications for power systems such as Smarttrafo; HVDC systems, projects for smart cities such as PV charging of electric vehicles, PV and storage integration, contactless charging; and he participated in several Leonardo da Vinci, H2020 and Electric Mobility Europe EU projects as project partner (ELINA, INETELE, E-Pragmatic, Micact, Trolly 2.0, OSCD) and coordinator (PEMCWebLab.com-Edipe, SustEner, Eranet DCMICRO). He is a Senior Member of the IEEE ('97), former chairman of Benelux IEEE Joint Industry Applications Society, Power Electronics and Power Engineering Society chapter, chairman of the Power Electronics and Motion Control (PEMC) council, member of the Executive Committee of European Power Electronics Association (EPE) and also member of international steering committee at numerous conferences.