Tutorial proposal title

Fundamentals, Modulation and Control of MMC

Presenter(s):

Professor Remus Teodorescu, Department of Energy Technology, Aalborg University;ret@et.aau.dk

Associate Professor Laszlo Mathe; Department of Energy Technology, Aalborg University;lam@et.aau.dk

Associate Professor Cristian Lascu; Department of Energy Technology, Aalborg University;lam@et.aau.dk

Brief description:

During the last decade the new Modular Multilevel Converter (MMC) technology adopted by Siemens, ABB and Alstom has demonstrated clear advantages in terms of scalability, reduced losses and footprint in comparison with two-level VSC in HVDC applications and it is expected to grow rapidly and enter other applications like Large Statcom and Drives and LV. The new multi-module structure has posed serious challenges to modulation, balancing, control and simulation . In this respect the proposed tutorial is aiming in understanding the fundamental principles, modulation and control.

Outline:

- **MMC Fundamentals**
  - MMC principle of operation
  - Applications
  - Modelling and Simulation
- **MMC Modulation**
  - Modulation methods with and without carrier
  - Capacitor voltage balancing strategies for the modulators
- **Dynamics and Control**
  - Dynamic model
  - Internal and output current control
  - Control under unbalanced conditions

Relevant publications:

K. Sharifabadi; L. Harnefors; H.P. Nee; S. Norrga; R. Teodorescu Design, Control and Application of Modular Multilevel Converters for HVDC Transmission Systems" Wiley, ISBN 9781118851562

L. Mathe, P. Burlacu, and R. Teodorescu, "Control of Modular Multilevel Converter with reduced internal data exchange," IEEE Transactions on Industrial Informatics, vol. PP, pp. 1-1, 2016.

A. Sangwongwanich, L. Mathe, R. Teodorescu, C. Lascu, and L. Harnefors, "Two-dimension sorting and selection algorithm featuring thermal balancing control for modular multilevel converters," in 2016 18th European Conference on Power Electronics and Applications (EPE'16 ECCE Europe), 2016, pp. 1-10.

Mattia Ricco, Laszlo Mathe and Remus Teodorescu: "New MMC Capacitor Voltage Balancing using Sorting-less Strategy in Nearest Level Control," in 2016 Energy Conversion Congress and Expo (ECCE 2016 Milwaukee, WI)

Presenter's biography:

Remus Teodorescu received the Dipl.Ing. degree in electrical engineering from Polytechnical University of Bucharest, Romania in 1989, and PhD. degree in power electronics from University of Galati, Romania, in 1994. In 1998, he joined Aalborg University, Department of Energy Technology, power electronics section where he currently works as a professor. He is a Fellow Member of IEEE, Past Associate Editor for IEEE Trans on Power Electronics and Past Chair of IEEE Danish joint IES/PELS/IAS chapter.He was the coordinator of Vestas Power Program (2007 - 2013, involving 10 PhD projects in the areas of power electronics, power systems and energy storage. His areas of interests are: MMC, HV SiC MosFet, design and control of power converters used in wind power systems, PV and HVDC/FACTS, energy storage systems based on Li batteries.

Laszlo Mathe received the B.Sc. degree in electrical engineering and the M.Sc. degree from the Technical University of Cluj-Napoca, Cluj-Napoca, Romania, in 2000 and 2002, respectively, and the Ph.D. degree in electrical engineering from the Department of Energy Technology, Aalborg University, Aalborg, Denmark, in 2010. Between 2002 and 2007, he worked for the industry as Control Development Engineer. Currently hi is an Associate Professor at Aalborg University. His current research interests include control and design of power converters, control of electrical drives, photovoltaic systems, modulation techniques vehicle electrification.

Cristian Lascu received the M.S. and Ph.D. degrees in electrical engineering from University "Politehnica" of Timisoara, Romania, in 1995 and 2002, respectively. From 2002 to 2004, he was with SIEI S.p.A., Italy, working on advanced power electronics and drives for electrical vehicles. From 2009 to 2011, he was with the Department of Electrical and Biomedical Engineering, University of Nevada. Currently he is with the Department of Energy Technology, Aalborg University, Denmark. His research interest are: modular power converters and advanced topologies and control for power electronic converters, AC motor drives and state observers for AC drives, power conversion for renewable energy systems.