Réseau québécois sur l'énergie intelligente

Gabriel Renan Broday

RQEI

PhD Candidate at Concordia University

Power Electronics Interfaces for Energy Storage Systems (ESSs) in DC-Microgrids Applications

Thesis Supervisor: Dr. Luiz A. C. Lopes





Presentation Summary

- Introduction
 - Centralized vs Decentralized power generation
 - DC-Microgrids and their potential

• Problem statement

5-switch bidirectional DC-DC converter

• Simulation results – Case study





Introduction: Decentralizing power generation



Decentralized



- The existing/conventional power grid is of the centralized type.
- Environmental concerns are driving the deployment of renewable energy sources (RESs).
- Issues with power transmission and distribution upgrades are leading to a more "decentralized" system with smaller/modular sources placed close to the urban centers.



Introduction: DC-Microgrids



- The fluctuating and intermittency nature of RES requires its connection to strong buses.
- Alternatively, one can "support" the integration of larger amounts of RES with Energy Storage Systems (ESSs).
- The interface of the DC-sources and storage units to the DC-Microgrid should be done by means of fast acting and efficient power electronic converters.



Problem Statement



- Enhanced operation of the overall system is directly related to the actual choice of power converter (power electronics interface) and the control strategy employed.
- The operating point/conditions can be very volatile. This way, it is difficult to design a control strategy that presents the same performance for different conditions.
- Supercapacitors have shown to be a good option for supporting RES in DC-applications.



5-switch bidirectional DC-DC converter



- High voltage gain achieved by adjusting the turns ratio of the tapped inductor.
- Non-reversal of the currents iLM and iLT2 in the inductor branch as the power flows reverses: Faster dynamic response.
- Multi-State modulation schemes for control improvements and power losses balance due to the implementation of 5 power switches.



Case Study

• Connection of a 48V Supercapacitor to a 380V DC-bus.





Gabriel Renan Broday/ Concordia University







THANK YOU - MERCI!



15/02/2021