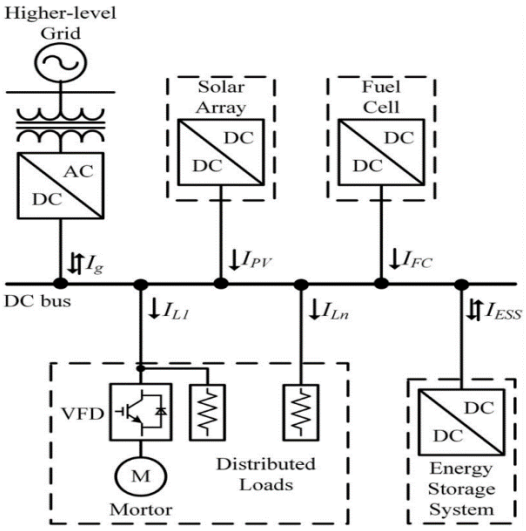
Energy Management System Design for Cyber-Physical DC Microgrid Systems

Background Introduction: As the penetration level of RES-DGs continues rising, the fluctuation of power generated from RES-DGs makes optimal energy management within DC microgrids really challenging. To address this challenge, in this project, neural network based machine learning technologies will be used to predict generations from renewables, electricity consumptions from residential houses and optimally control the charging/discharging of energy storage systems in DC microgrids. A typical DC microgrid is shown in Fig. 1 [1].



A typical DC Microgrid Structure [1]

Project Objectives:

- Build the following physical DC microgrids system, being familiar with Matlab/Simpower Programming is required.
- Design neural network based renewable generations and electricity usage prediction modules;
- Design neural network based energy management scheme for energy storage systems;
- Design Thermo-Controllable Load Model (like HVAC or Building Centralized heating and cooling plant) in Matlab/Simpower.
- Interfacing physical DC microgrids in Matlab/Simpower and communication network modules in OPNET Modeler (Riverbed Tech)--C++ programming skills are required for Co-simulation

Number of Students: 5-6

References:

[1] Y. Zhang and Y. W. Li, "Energy Management Strategy for Supercapacitor in Droop-Controlled DC Microgrid Using Virtual Impedance," in *IEEE Transactions on Power Electronics*, vol. 32, no. 4, pp. 2704-2716, April 2017

[2] S. K. Sahoo, A. K. Sinha and N. K. Kishore, "Control Techniques in AC, DC, and Hybrid AC–DC Microgrid: A Review," in *IEEE Journal of Emerging and Selected Topics in Power Electronics*, vol. 6, no. 2, pp. 738-759, June 2018

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