Combined Generation and Optimization of a Wind-Solar-Battery Power System

Dan Shen, Afshin Izadian
Energy Systems and Power Electronics Laboratory, Purdue School of Engineering, IUPUI.

Compared with other renewables, wind and solar have been established as proven future sources of energy, because of their environment-friendly, safe and cost-effective characteristics. However, there are some difficulties associated with combined utilization of solar and wind, e.g. intermittency of wind and of the solar radiation, and their variation do not match the time distribution of the demand. For this purpose, advanced network of multiple renewable energy systems with storage units have been proposed. Small-scale standalone combination of solar, wind and battery has been found effective in some independent power supply system.
Proposed in this research on a standalone distributed hybrid power system which consists of solar power, wind power and battery storage. A control strategy is introduced to maximize the simultaneous energy harvesting from both renewable sources. The supervisory controller results in five contingencies considering the level of power generation available at each renewable energy source and the state of charge in the battery. Power converters interface the source with a common DC bus. The interfacing converter is controlled either as a current or a voltage source. A supervisory controller is proposed to accomplish the source type allocations and balance of energy in the operating contingencies. Simulation results demonstrate accurate operation of the controllers and functionality of the maximum power point tracking algorithm in each operating condition both for solar and for wind power.

Advisor: Dr. Afshin Izadian, Energy Systems and Power Electronics Lab, Purdue School of Engineering, IUPUI