American Solar Energy Society

Women in Solar Energy (WISE) Forum
June 25, 2020

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High Dimension Droop Control for Wind Resources in DC Microgrids

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Introduction & Motivation
This research bridges two important concepts and develops an improved method for implementing them.

Wind resources:
- Sustainable, renewable source of energy
- Can be distributed geographically and located near feeds

Microgrids:
- Robust, larger utility grid
- Can operate independently of the utility grid

Droop Control:
- Method for sharing load between multiple sources in a power system
- Does not require communication - high system reliability

While droop control has been implemented with wind resources connected to microgrids, traditional droop control does not allow the wind speed to be taken into account. Therefore, during times of high wind, available wind power is not utilized.

This research takes the traditional droop control method and expands it to multiple dimensions to allow more of the available power from the wind to be utilized in a microgrid.

Approach
In order to study the proposed high dimension droop control method, a sample microgrid was modeled using MATLAB/Simulink. A noisy, turbulent wind profile and corresponding load profile were modeled. A 24-hour wind speed was used, to ensure that the available wind was modeled.

Control Design

Source modeling:
- Step-down source voltage to bus voltage

State equations:
- Power equations

Controller implementation:
- Proportional-integral

Simulation Results

Conclusions and Future Work

Future work:
- Optimizing droop surface shape
- Examples for other high dimension droop control methods

Acknowledgment
This research was funded in part by the US National Science Foundation under Grant No. 0961710.