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Operations-Based Planning for Placement and Sizing of Energy Storage in a Grid With a High Penetration of Renewables

Krishnamurthy Dvijotham, Scott Backhaus, Misha Chertkov

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As the penetration level of transmission-scale time-intermittent renewable generation resources increases, control of flexible resources will become important to mitigating the fluctuations due to these new renewable resources. Flexible resources may include new or existing synchronous generators as well as new energy storage devices. The addition of energy storage, if needed, should be done optimally to minimize the integration cost of renewable resources, however, optimal placement and sizing of energy storage is a difficult optimization problem. The fidelity of such results may be questionable because optimal planning procedures typically do not consider the effect of the time dynamics of operations and controls. Here, we use an optimal energy storage control algorithm to develop a heuristic procedure for energy storage placement and sizing. We generate many instances of intermittent generation time profiles and allow the control algorithm access to unlimited amounts of storage, both energy and power, at all nodes. Based on the activity of the storage at each node, we restrict the number of storage node in a staged procedure seeking the minimum number of storage nodes and total network storage that can still mitigate the effects of renewable fluctuations on network constraints. The quality of the heuristic is explored by comparing our results to seemingly "intuitive" placements of storage.

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