

Temporal aggregation for large-scale multi-area power system models

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Abstract-

The study of integrated electricity systems that consist of several interconnected areas in the long term often results in large-scale complex models, that are difficult to solve. The already large spatial size of these systems, combined with a fine-grained time representation, necessary to capture the short-term variability arising from the high penetration of renewable generation, increases the complexity of the problem, and thus, its computational cost. To overcome this issue, temporal reduction techniques are generally applied. However, the application of time aggregation in interconnected systems represents a challenge. The goal is to select the best possible time aggregation that considers at the same time the particularities of each of the areas that make up the whole system. To do so, the authors propose a new methodology for temporal aggregation in multi-area energy system models. By implementing a multi-dimensional clustering algorithm, the original hourly data is transformed into system states, or group of hours that share similar characteristics, reducing significantly the computational burden required to solve it. Together, an accurate representation of the variability of the system is achieved. The main conclusions are derived from a real-size case study based on the electricity markets of three European countries. The sensitivity analysis performed shows the degree of accuracy of the results obtained, as well as the computing cost incurred for different temporal configurations. Ultimately, the results show the benefits of using this methodology over a more conventional approach.

Index Terms- power system planning, optimization, pattern clustering, power system computation

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