

Building and validating a large-scale combined transmission & distribution synthetic electricity system of Texas

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Abstract-

Distributed energy resources, such as rooftop solar, have rapidly expanded in recent years, given declining costs and the desire to reduce carbon emissions. With more energy resources located in the lower-voltage distribution system, it is increasingly helpful to utilize combined transmission and distribution (T&D) system models to analyze interactions between these normally-distinct subsystems. This paper proposes a methodology for creating very large-scale, highly detailed, combined T&D systems that are synthetic—that is, free from non-public data—yet still realistic. The methodology creates very large-scale combined T&D systems by merging the most up-to-date techniques for creating synthetic distribution feeder networks with the latest methods for building synthetic, meshed bulk-power transmission networks. This methodology is demonstrated on a T&D system geolocated in Texas, and benchmarked with co-simulation results. Validation demonstrates that the resulting syn-texas-TDgrid synthetic test system realistically represents characteristics found in actual networks, addressing the lack of available T&D test systems. With over 15,000 feeders and 46 million electrical nodes, this T&D dataset has applications for research in optimal power flow algorithms, voltage control, reconfiguration, and T&D coordination schemes under high adoption of distributed energy resources.

Index Terms- Power system; Test system; Distribution; Transmission; Networks; Planning; Co-simulation; Power flow

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