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Julia-Based Computational Tool for Composite System Reliability Assessment

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Abstract : The reliability evaluation of composite generation and bulk transmission systems is crucial for ensuring a reliable supply of electrical energy to significant system load points. However, evaluating adequacy indices using probabilistic methods like sequential Monte Carlo Simulation can be computationally expensive. Despite this, it is necessary when time-varying and interdependent resources, such as renewables and energy storage systems, are involved. Recent advances in solving power network optimization problems and parallel computing have improved runtime performance while maintaining solution accuracy. This work introduces CompositeSystems, an open-source Composite System Reliability Evaluation tool developed in Julia™, to address the current deficiencies of commercial and non-commercial tools. This work introduces its design, validation, and effectiveness, which includes analyzing two different formulations of the Optimal Power Flow problem. The simulations demonstrate excellent agreement with existing published studies while improving replicability and reproducibility. Overall, the proposed tool can provide valuable insights into the performance of transmission systems, making it an important addition to the existing toolbox for power system planning.

Keywords : open-source software, composite system reliability, optimization methods, Monte Carlo methods, optimal power flow

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