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Bayesian probabilistic power flow analysis using jacobian approximate bayesian computation

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Abstract-

A probabilistic power flow (PPF) study is an essential tool for the analysis and planning of a power system when specific variables are considered as random variables with particular probability distributions. The most widely used method for solving the PPF problem is Monte Carlo simulation (MCS). Although MCS is accurate for obtaining the uncertainty of the state variables, it is also computationally expensive, since it relies on repetitive deterministic power flow solutions. In this paper, we introduce a different perspective for the PPF problem. We frame the PPF as a probabilistic inference problem, and instead of repetitively solving optimization problems, we use Bayesian inference for computing posterior distributions over state variables. Additionally, we provide a likelihood-free method based on the approximate Bayesian computation philosophy, that incorporates the Jacobian computed from the power flow equations. Results in three different test systems show that the proposed methodologies are competitive alternatives for solving the PPF problem, and in some cases, they allow for reduction in computation time when compared to MCS.

Index Terms- Approximate Bayesian computation, Bayesian inference, power system, probabilistic power flow.

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