A Memory-Efficient Parallelizable Method for Computation of Thévenin Equivalents used in Real-Time Stability Assessment

This paper introduces a factor-solve method, which efficiently computes Thévenin equivalents for all buses in the power system. A range of real-time stability assessment methods rely on Thévenin equivalents, and it is therefore essential that these can be determined fast and efficiently. The factor-solve method has runtime for computing Thévenin voltage that scales linearly with system size resulting in runtime of only a few milliseconds even for systems with several thousand buses. The computations only need the sparse admittance matrix for the power system and a sparse factorization resulting in low memory requirements, and furthermore Thévenin impedances can be determined in parallel. The factor-solve method is compared to a reference method, which uses coefficients for super-position to determine the Thévenin equivalents. The reference method is shown to have dissatisfying runtime and complexity. The factor-solve method is tested, parallelized and analysed, which shows a considerable speed-up in computations of Thévenin equivalents enabling them to be computed in real-time.

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