Partial Refactorization Techniques for Electromagnetic Transient Simulations

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This paper explores partial refactorization techniques to accelerate the simulation of Electromagnetic Transients (EMTs) in power systems. Direct sparse left-looking LU factorization from the KLU solver is used to solve network equations. The refactorization step can be time-consuming if the factorized matrix varies often as the simulation involves power electronics switching or nonlinear devices. A path-based partial refactorization technique is proposed to accelerate the re-computation of LU factors. In the left-looking algorithm, only a subset of columns that belong to the computed factorization path are refactorized. In addition, Block Triangular Factorization (BTF) is enhanced through partial refactorization, which further accelerates computation through smaller, evolving submatrices. The new techniques are tested on large power grids. Substantial performance gains are achieved.

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