

电工理论与新技术

基于Krylov子空间中Lanczos算法的金属导体部分元等效电路模型缩减

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摘要: 针对金属导体部分元等效电路模型的渐近波形估算(waveform evaluation, AWE)方法缩减的数值病态问题, 提出使用基于Krylov子空间的Lanczos算法对系统模型进行缩减, 将直接矩量显式计算转化为间接矩量隐式计算, 将主导极点的抽取转化为主导特征值的抽取, 并对系统近似误差限和程序自动终止准则进行了分析计算。在此基础上, 给出了独立于频率之外的简化等效电路模型, 得到了解耦电阻电感参数, 并通过计算实例验证了该方法的正确性。该文的研究成果克服了AWE等直接矩量显式计算只能提取有限几条缩减支路的不足, 极大提高了模型缩减方法的有效性和普适性。

关键词: 部分元等效电路模型 数值病态 间接矩量匹配 Lanczos算法 模型缩减

PEEC Model Reduction of a Conductor Based on Lanczos Algorithm in Krylov Subspace

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Abstract: A problem of intrinsic numerical ill-conditioning of asymptotic waveform evaluation (AWE) model reduction method is pointed out of partial element equivalent circuit (PEEC) model of a conductor associated with the direct moment matching. The paper proposes that the Lanczos algorithm in Krylov subspace is applied to reduce the high-order original system. The new algorithm transfers the moment direct explicit computation to indirect implicit calculation, and transfers extracting the dominant poles to picking up corresponding dominant eigenvalues, and analyzes the error bound and the automation termination criterion of the system. Then, the resistances and inductances of the reduced decoupled branches are obtained independent of frequency, which is validated by examples. The achievements above avoid the defect only drawing several reduced branches by AWE and settle the base of the widespread application of model reduction methodology.

Keywords: partial element equivalent circuit model numerical ill-conditioning indirect moment matching Lanczos algorithm model reduction

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