一种超大规模电源／地线网络快速压缩BiCGStab算法

苏浩航, 张义门, 张玉明, 满进财

(西安电子科技大学 宽禁带半导体材料与器件教育部重点实验室，陕西 西安 710071)

摘要　　提出一种新的快速分析方法对大规模电源／地线网络进行模拟. 首先以列索引的一维稀疏存储结构对大规模的系数矩阵进行压缩处理，避免了行索引数组，提高了计算的速度；其次采用BiCGStab算法对网络进行模拟，在保证计算速度的情况下避免了逆矩阵的计算，节省了计算内存. 实验数据表明，本算法的计算速度比HSPICE提高了两个数量级；计算所用的内存与HSPICE相比节省了约95％， 与预优共轭梯度法相比节省了约75％. 本算法求解效率高，并大幅度节省了计算内存，与常规的电路模拟软件相比，适用于分析规模日益增大的微处理器中的电源／地线网络.

关键词　　电源／地线网络　电路分析　BiCGStab算法

分类号　TP391.7

Fast method for the large-scale power and ground network analysis based on the compressed BiCGStab algorithm

SU Hao-hang,ZHANG Yi-men,ZHANG Yu-ming,MAN Jin-cai

(Ministry of Education Key Lab. of Wide Band-Gap Semiconductor Materials and Devices, School of Microelectronic, Xidian Univ., Xi′an 710071， China)

Abstract

<P>An effective method is proposed to perform static and transient simulations for the large-scale power and ground network circuits with a good result obtained. This method compresses the large coefficient matrix by only storing the non-zero elements with the column coordinate index which avoids the row coordinate index and eases the burden of memory usage. Then it uses the BiCGStab algorithm to analyze the large network which avoids the inverse matrix computing. Extensive experimental results on the large-scale power and ground network show that the presented method is over two orders of magnitude faster than HSPICE in transient simulations. Furthermore, our method reduces over 95％ memory usage than HSPICE and 75％ memory usage than Incomplete Cholesky Conjugate Gradient while the accuracy is not compromised. The presented method has more powerful capability to deal with the increasing size of power grids in modern microprocessors than general-purpose circuit simulators with significant memory and run-time advantages.
</P>

Key words　power and ground networks　circuit simulations　BiCGStab algorithm

DOI:

通讯作者　苏浩航 xiaosu0741@163.com