

基于 Petri 网与 IFA 的 3D NoC 测试调度优化研究

胡 聪^{1,2}, 郑 岚^{1,2}, 覃斌毅³, 周 甜^{1,2}, 朱爱军^{1,2},
朱望纯^{1,2}

(1 桂林电子科技大学 电子工程与自动化学院, 广西 桂林 541004;

2 广西自动检测技术与仪器重点实验室, 广西 桂林 541004;

3 玉林师范学院 电子与通信工程学院, 广西 玉林 537000)

摘 要: 针对三维片上网络 (3D NoC) 测试调度困难、并行测试效率低的问题, 提出了一种层次着色赋时 Petri 网(HCTPN)与改进萤火虫算法 (IFA) 相结合的方法. 该方法通过 HCTPN 模型分层描述系统调度过程和局部测试细节, 并将测试调度方案与变迁发生序列相关联. 为了优化模型中的路由计算变迁, 针对 3D Torus 拓扑结构设计了一种改进路由算法. 在此基础上, 使变迁发生序列映射为萤火虫个体, 同时采用融合了反向学习机制与差分进化算法的 IFA 来寻找最优序列. 实验结果表明, HCTPN 模型能清晰刻画测试的调度过程、资源约束、优先级等特性; 改进路由算法能有效减少测试调度过程中的路由时间; IFA 能高效求得测试调度最优解, 测试时间较其他方法最大程度上降低了 18.9%, 有效提升了测试效率.

关键词: 三维片上网络; 测试调度; 层次着色赋时 Petri 网; 路由算法; 萤火虫算法

Research on test scheduling optimization of 3D NoC

based on Petri net and IFA

HU Cong^{1,2}, ZHENG Lan^{1,2}, QIN Bin-yi³, ZHOU Tian^{1,2},
ZHU Ai-jun^{1,2}, ZHU Wang-chun^{1,2}

(1 School of Electronic Engineering and Automation, Guilin University of Electronic Technology,
Guiling 541004, China;

2 Guangxi Key Laboratory of Automatic Detection Technology and Instruments, Guiling 541004,
China;

3 School of Electronics and Communication Engineering, Yulin Normal University, Yuling 537000,
China)

Abstract: To solve the problem of difficult test scheduling and low parallel test efficiency in three Dimensional Network-on-Chip(3D NoC), an Hierarchical Colored Timed Petri net(HCTPN) combined with improved firefly algorithm(IFA) is proposed. The system scheduling processes and testing details are hierarchically described by HCTPN model, and the test scheduling scheme is associated with the transition sequence. In order to optimize the routing calculations, an improved routing algorithm is designed for the 3D Torus topology. On this basis, the transition sequence is mapped to a firefly individual, and the IFA combined with reverse learning mechanism and differential evolution algorithm is used to find the optimal sequence. Simulation results show that the HCTPN model can clearly characterize the scheduling process, resource constraints, and priorities of the test. And the improved routing algorithm can effectively reduce routing time, meanwhile IFA can efficiently obtain the optimal solution of test scheduling. The test time was reduced by 18.9% to the greatest extent, which effectively improved the test efficiency.

Key words: three dimensional network-on-chip; test scheduling; hierarchical colored timed petri net; routing algorithm; firefly algorithm

作者简介:

胡 聪 男, (1981-), 博士, 副教授, 硕士生导师.研究方向为集成电路测试.

郑 岚 女, (1993-), 硕士研究生.研究方向为集成电路测试.

覃斌毅 男, (1985-), 博士, 讲师.研究方向为太赫兹光谱检测.

周 甜 (通讯作者) 女, (1982-), 硕士研究生.研究方向为集成电路测试.

E-mail:35742022@qq.com.

朱爱军 男, (1978-), 博士, 副教授, 硕士生导师.研究方向为集成电路测试.

朱望纯 男, (1976-), 硕士, 研究员, 硕士生导师.研究方向为可测性设计、自动测试系统.