Future Directions for Design Automation Research

Tim Cheng, UCSB

In my opinion, the following are three key challenges for future design automation research.

Silicon Debugging: The first silicon success rate has been dropping and this challenge is likely to persist without a significant research commitment to devising solutions for this issue. This trend is the result of several factors: increased complexity in system contexts; limited scalability of pre-silicon verification solutions; design team members that are working at great geographic distances from one another; greater time-to-market pressures; and the increasing discrepancy between design models to actual silicon. The ability to debug and diagnose various IP blocks in silicon and to quickly bring fully working silicon to market is crucial for the industry. A systematic debugging methodology, and tools to support these tasks, involving actual silicon samples must be developed and set in place to efficiently identify logic, circuit, and timing errors. This direction demands new thinking from researchers and the new solutions will likely need to combine testing, defect diagnosis, functional verification and timing verification to successfully meet these challenges. In addition, *design for debugging* techniques that are able to guarantee a high success rate for debugging would be needed.

Design for Reliability. Future systems must be designed to cope with failures. With increased variations, potential failure sources, and failure rates, new design and test solutions are needed in order to build reliable systems in the future. Such solutions must be cost-effective to be applicable for consumer applications. In principle, the system and its heterogeneous components should have some -- and preferably all -- of the following capabilities: embedded self-test for detecting manufacturing defects; on-line checking/monitoring used to detect soft errors, marginality failures, and other post-manufacturing failures; automatic diagnosis for locating critical failure sources; identifying sources for adaptation and/or recovery after failures; and cost-effective fault tolerance schemes, at both the component and system levels, for error resilience. Although partial solutions are available for some of these required features -- such as embedded self-test and limited on-line checking--, major research efforts are needed to create a comprehensive methodology for designing reliable systems.

Design and Test for Fabrics Beyond Silicon - There have been many recent materials- and device-level innovations -- nanowires, nanotubes, organic devices, spintronics, ink-jet printed devices, etc. --, some of which have the potential to become the building blocks of future implementation fabrics for various applications; however, their true potential for real applications cannot be properly assessed unless the architecture, integration, and design issues for these devices are thoroughly examined. The design automation research community must expand its focus beyond silicon CMOS and investigate design, analysis, modeling, and integration issues at the systems level for some or all of these candidate fabrics.