Future of Design Automation Research

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I would like to highlight the following three challenges for future design automation research. Broadly, these challenges reflect trends toward the growing importance of software over hardware in system-level design, the importance of mixed-technology systems as new applications for existing CMOS technology are explored, and the importance of statistical techniques in hardware design in nanometer CMOS.

Design of software. Design automation research has traditionally focused on hardware, but the real challenge in the future lies in software. Lower software productivity improvements and increases in software content are driving demand for software developers and making software the main bottleneck in system-level design. Software rather than hardware defects will dominate reliability concerns and software costs will be the dominant component of total system cost. Techniques to automate the design and verification of software are urgently needed. Furthermore, the increasing reliance of parallelism to achieve performance improvements in future computing systems is requiring more assistance in developing software applications that can exploit parallelism.

Design of mixed-technology systems. Increasingly, integrated CMOS will find places in increasingly diverse mixed-technology application domains. This will happen as CMOS technology scaling saturates and new opportunities are sought that exploit the existing investment in CMOS. Examples include optical and electrical biosensors, nano-electrical-mechanical systems, optical communications links, and mm-wave antennas and passives. This will require the ability to abstract, model, and simulate increasingly heterogeneous systems. Flexible modeling environments such as Verilog-A are becoming increasingly popular. Underlying tools and modeling frameworks must be developed to simulate these systems, including the integration of finite-element modeling and electromagnetic modeling.

Managing variability. Increasingly both simulation and optimization tools must be statistical to account for variability in underlying process technology. This involves fundamental changes in technology characterization, compact modeling, simulation, parasitic extraction, and optimization tools. Systematic local layout effects may be increasingly predicted by RET modeling as part of parasitic extraction. These approaches will complement design techniques to incorporate redundancy and improve robustness.