Structured Test, Then and Now
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There are two broad approaches to device testing: Functional test – “Does the device do what it is supposed to do?” – and structural test – “Has the device been built correctly?” Historically, electronic devices were tested functionally. If a device met its specifications, then by definition it worked and test was complete. As the complexity of electronic systems increased, however, verifying that a device met its specifications became increasingly difficult. A syllogism was constructed to solve the testing problem: If the device’s design is correct, and if each part of the manufactured structure operates correctly, then the device works. With this, structured test was born. Staples of structured test have been in existence since the 1960s, including fault models (stuck-at faults date from the 1940s [1], although the first published reference is [2]), automated diagnostics [3], fault simulation [4], and automatic test pattern generation [5]. At present, some form of structured test is the norm for virtually all integrated circuits.

By the 1970s, structured test generation for combinational circuits was well understood, but then as now most practical circuits were sequential. The introduction of level-sensitive scan design [6], and other scan techniques [7], provided a means of changing a sequential circuit into a combinational one for test purposes. Suddenly, structured test was available for all circuits, but at a cost: additional area (usually estimated at 10%) and delay associated with scan made structured test uneconomical for some designs. Experimental results continued to show that functional tests identified circuits that structural tests did not [8]. The argument continued for years, with Intel arguing as recently as 1997 that scan for microprocessors was not viable [9]. While functional tests are effective at finding some types of defects, and while a structured approach costs silicon area, functional tests are not without their drawbacks. First among these is the cost of generating them, an effort that is increasing dramatically with each process generation [10]. The search to replace functional tests has led to another structural test approach: defect-based test (DBT). DBT extends structural testing by arguing that if a circuit is designed correctly, and is shown to contain no defects, then it must work.

The two panelists represent organizations that span the change from functional to structural test. Ed Eichelberger was one of the pioneers of scan testing at IBM during the 1970s, and Navid Shahriari is helping to introduce a structured approach to Intel now. The panel discussion will look at what factors drive the technical and business decisions to adopt a structural approach to test, and look at both what has changed over the course of the structured test revolution, and what has stayed the same.

Moderator: Robert C. Aitken, Agilent Technologies

Panelists:
Edward B. Eichelberger
Navid Shahriari, Intel

References and further reading