Guest Editor’s Introduction: Getting More Out of Test

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The 2006 IEEE International Test Conference (ITC) focused on the theme “Getting More Out of Test.” This means ensuring product quality and reliability as cost efficiently as possible. In today’s market environment, it also means taking test beyond its traditional role of separating good products from bad. Specifically, as both semiconductor manufacturing processes and electronic products—ICs, boards, and systems—become more complex, it is becoming increasingly more important for test to provide diagnostic feedback to manufacturing and product design teams.

Every level of the product delivery process relies on models—from manufacturing-process models for IC design to IC performance models for system design. A design goes to production when our models predict it will meet the power, performance, and cost specifications that the market demands. We make the best choices we can on the basis of such predictions, but imperfect models mean we don’t really know the effects of those choices. Models inevitably require simplifications of reality. Only at test, on the other hand, does the rubber truly meet the road. Test responds to the accumulated effects of choices made throughout the product delivery process. Its response includes answering questions regarding whether the product is good or bad. Moreover, test increasingly strives to provide an explanation for any test result that doesn’t meet requirements or expectations.

Today, test plays a key role in providing feedback to the manufacturing process in terms of defects and process parametrics, including both nominal values and variability. In addition, test provides the inputs upon which product debugging relies. Test is called upon to find both design errors and problematic design-process interactions. Test’s diagnostic function makes it invaluable as an aid to ramping and sustaining yields, and to delivering products that meet challenging market-driven power, performance, and cost specifications.

The three articles in this special section, all written by well-received ITC 2006 authors, address ways we can get more out of test. The first two articles provide specific examples of techniques for addressing the newly important diagnosis and debugging functions of test. The third addresses test decision making more generally, and specifically suggests that exploring the psychology that underlies our decisions could help us eventually get more out of test.

First, in “X-Tolerant Compactor with On-Chip Registration and Signature-Based Diagnosis,” Jerzy Tyszer et al. describe a novel compactor architecture and a strategy for performing diagnosis on the basis of its results. Test data volume and test time pressures have made compression essential for many of today’s ICs, but issues such as handling unknown (X) states have presented formidable challenges. Moreover, distilling output results into compact signatures may seem antithetical to the observability needed for diagnosis. This article addresses these challenges head on with its X-tolerant compactor and a specific diagnostic procedure that uses the collected responses. Experimental results on two industrial designs demonstrate the usefulness of this approach.

Next, “Cell Broadband Engine Debugging for Unknown Events,” by Mack Riley and Mike Genden, describes design-for-debugging (DFD) features of the state-of-the-art, widely used Cell Broadband Engine processor. The design challenges of this high-speed, multicore, multithread-capable processor made it vital to include debugging capability. At the same time, the high-volume target market imposed strict area-overhead constraints; multigigahertz operating frequencies presented clock-control challenges; and high I/O bandwidth imposed strict limits on debugging-specific inputs and outputs. This article describes how the debugging features were implemented in the face of these challenges, and provides examples of their use.
Finally, “The Psychology of Electronic Test,” by Scott Davidson and Helen Davidson, addresses several intriguing questions regarding the decisions we make in test. One such question is how to decide how much coverage is enough and why test engineers are often more likely to exert effort to achieve 1% additional stuck-at fault coverage than 10% additional coverage of another type. Another is why the low-cost tester has not seen the available market expected based on the test community’s enthusiastic support of the low-cost test approach in forums such as conference panels and industry meetings. The authors suggest that factors such as group dynamics and concern for status play a role. Moreover, such factors may have an unintended impact on the quality of our decisions. The authors invite readers to consider how such factors affect them and their decisions.

**Taken together, the** articles in this special section highlight the importance of the decisions we make in test. Compaction schemes that are efficient and enable high-quality diagnosis can help test play its increasingly important yield-learning role. Careful design for debugging can help get products to market quickly and reliably. Rational thinking about test issues can help us make good trade-offs in design and test. Test-related decisions impact the efficiency and effectiveness of our ability to deliver high-quality, cost-efficient, reliable products. They also influence our ability to add value to IC, board, and system production through process and product debugging, diagnosis, and yield enhancement. In short, when we make such decisions wisely, they have great potential to help us get more out of test!

Anne Gattiker is a research staff member at the IBM Austin Research Lab. Her research interests include defect-oriented test, test-based yield learning, and design for manufacturing. Gattiker has an AB in engineering science from Dartmouth College, and an MS and a PhD in electrical and computer engineering from Carnegie Mellon University. She serves on the International Test Conference program and steering committees, and she was the ITC 2006 program chair. She is a member of the IEEE.

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