Adaptive Test Cost and Quality Optimization

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Abstract

The higher levels of integration and process scaling impose failure behaviors which are challenging to interpret, necessitating the continuous augmentation of fault models and test vectors in the hopes of taming the defect escape rate. The subsequent inflation in the number of test vectors coupled with the constant increase in the size of each test vector continuously boosts test cost. The economics of particularly the competitive consumer marketplace however require a constant vigilance at the test cost while ensuring a satisfactory test quality.

While the inclusion of new fault models helps boost test quality, the non-uniform distribution of various defect types and the defect coverage overlaps between fault models imply variable effectiveness of fault models and test vectors, resulting in the inclusion of a large number of ineffective vectors in test flow. A static derivation of test effectiveness however remains problematic in practice as it is well known that defect characteristics are prone to drifts throughout the product lifecycle. Furthermore, the increasing process variation and the integration of hundreds of domains within a chip result in increasingly distinct domains and individualized chip instances with diverse test resource requirements. The conventional test method of a static application of an identical test set to all chips consequently struggles to satisfy the demanding test cost and quality constraints in the face of the evolving defect behaviors and the increasing diversification in test resource requirements.

This talk addresses the simultaneous necessity for satisfactory test quality and low test cost through an adaptive test cost and quality optimization framework. The proposed methodologies not only adaptively assess the effectiveness of fault models and test vectors but also evaluate the variable test resource requirements of the chips and domains based on their distinct characteristics, enabling an effective yet efficient test through the selection of the most effective vectors and a carefully crafted allocation of test resources. The proposed methodologies are tailored for a broad set of application scenarios through the consideration of different defect classes and defect characteristic drift types while incorporating the test data gathering and delivery constraints and overcoming the associated algorithmic challenges.