Non-Adaptive Sparse Recovery and Fault Evasion using Disjunct Design Configurations

Ahmad Alzahrani, *University of Central Florida*
Ronald F. DeMara, *University of Central Florida*

A run-time fault diagnosis and evasion scheme for reconfigurable devices is developed based on an explicit Non-adaptive Group Testing (NGT). NGT involves grouping disjunct subsets of reconfigurable resources into test pools, or samples. Each test pool realizes a Diagnostic Configuration (DC) performing functional testing during diagnosis procedure. The collective test outcomes after testing each diagnostic pool can be efficiently decoded to identify up to d defective logic resources. An algorithm for constructing NGT sampling procedure and resource placement during design time with optimal minimal number of test groups is derived through the well-known in statistical literature *d-disjunctness property*. The combinatorial properties of resultant DCs also guarantee that any possible set of defective resources less than or equal to d are not utilized by at least one DC, allowing a low-overhead fault resolution. It also provides the ability to assess the resources state of failure. The proposed testing scheme thus avoids time-intensive run-time diagnosis imposed by previously proposed adaptive group testing for reconfigurable hardware without compromising diagnostic coverage. In addition, proposed NGT scheme can be combined with other fault tolerance approaches to ameliorate their fault recovery strategies. Experimental results for a set of MCNC benchmarks using Xilinx ISE Design Suite on a Virtex-5 FPGA have demonstrated d-diagnosability at slice level with average accuracy of 99.15% and 97.76% for d=1 and d=2, respectively.

ACM Categories & Descriptors: B.8.1 Reliability, Testing, and Fault-Tolerance; G.2.3 Applications

Keywords: Reconfigurable Hardware; Non-Adaptive Group Testing; Reliability; Fault Tolerance; Fault Diagnosis; Fault Evasion; Sparse Recovery; d-Disjunct Matrix