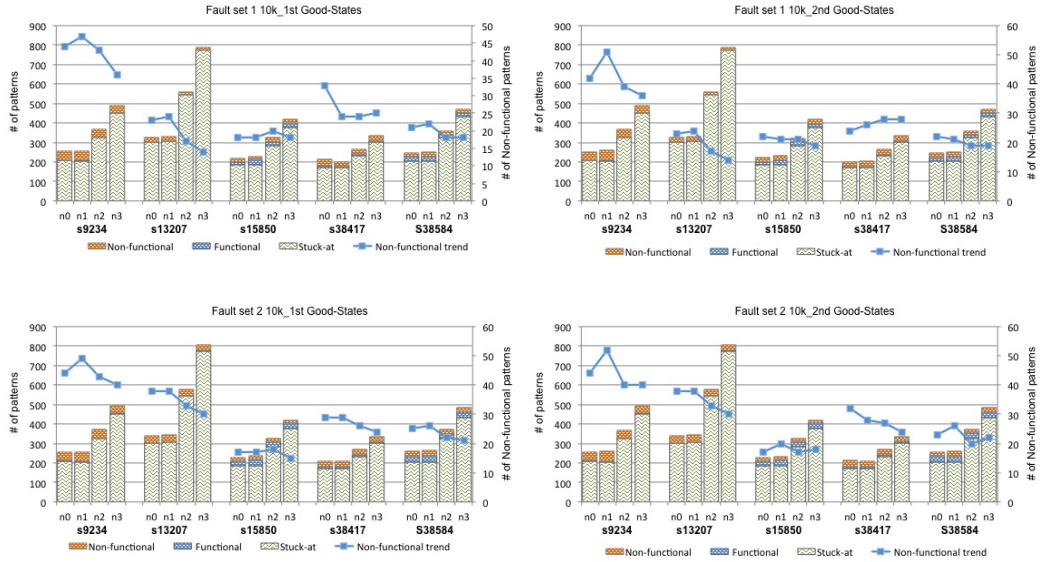
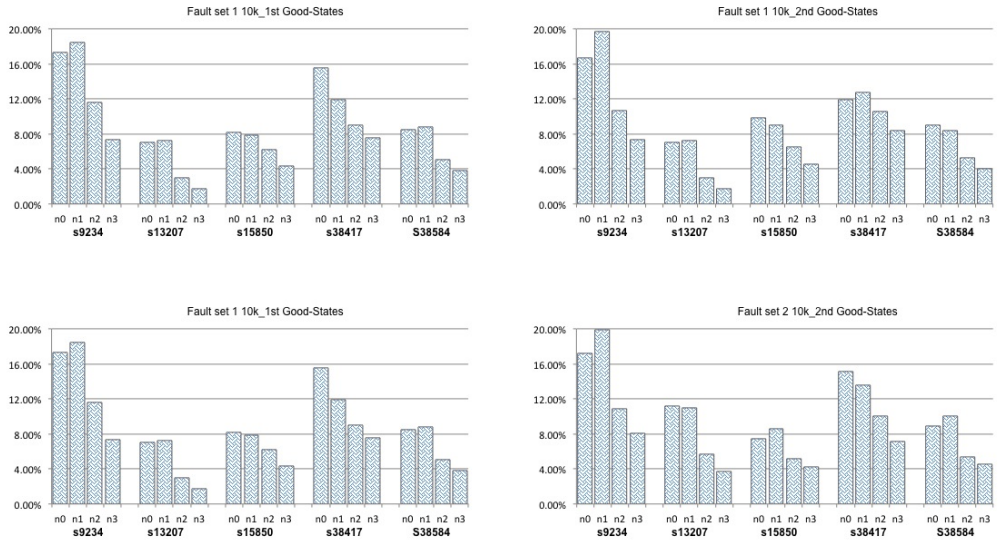
Stuck-At Patterns V.S. Cell-Aware Top-Off Patterns



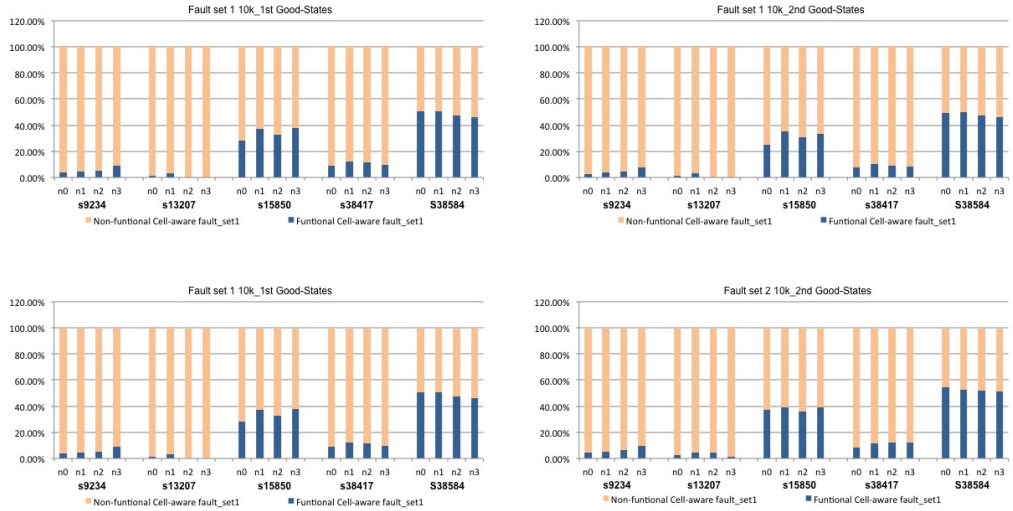
In the above figures we can see that two different generations of 10 000 good-states used on two different permutations of Cell-aware fault set yielded similar results. Another observation is that in each of the four cases there are more patterns that test for non-functional defects than those that tests for functional defects that are generated by cell aware ATPG, even in comparison with the large number of patterns generated by stuck-at ATPG, the number of non-functional patterns is significant. The number of functional test patterns is negligible compared to the large amount of patterns generated by the stuck-at ATPG. Because adding all of the non-functional tests to the test set adds significant costs, these figures suggest that using n-detect with a higher degree of n can decrease the number of non-functional tests which will decrease the added costs associated with testing all of the non-functional defects.

% Increase in Test Length When Non-Functional Cell-Aware Faults are Included in the Fault Set



These graphs represent the total percentage of patterns that test for non-functional defaults generated by Cell-aware ATPG out of all Stuck-at ATPG plus functional Cell-aware ATPG patterns for each of the five circuits that were tested. Here again we see that two different sets of 10 000 good-states, as well as two different Cell-aware fault set's achieved similar results. As the n-detect redundancy increases we see a sharp decrease in the percentage of patterns that check for non-functional defects. Although even when we use n3 there remains 3 4% of patterns testing non-functional defects this is still a dramatic decrease from the normal percentage which is around 17 18% of all test patterns. This percentage decrease is not due to a decrease in the actual number of non-functional test patterns (as seen in figure 1), but an overall increase in the number of stuck-at ATPG patterns generated in response to the desired redundancy of the n-detect pattern generation.

Distribution of Cell-Aware Faults Between Functional Non-Functional for those not Detected by Stuck-At ATPG



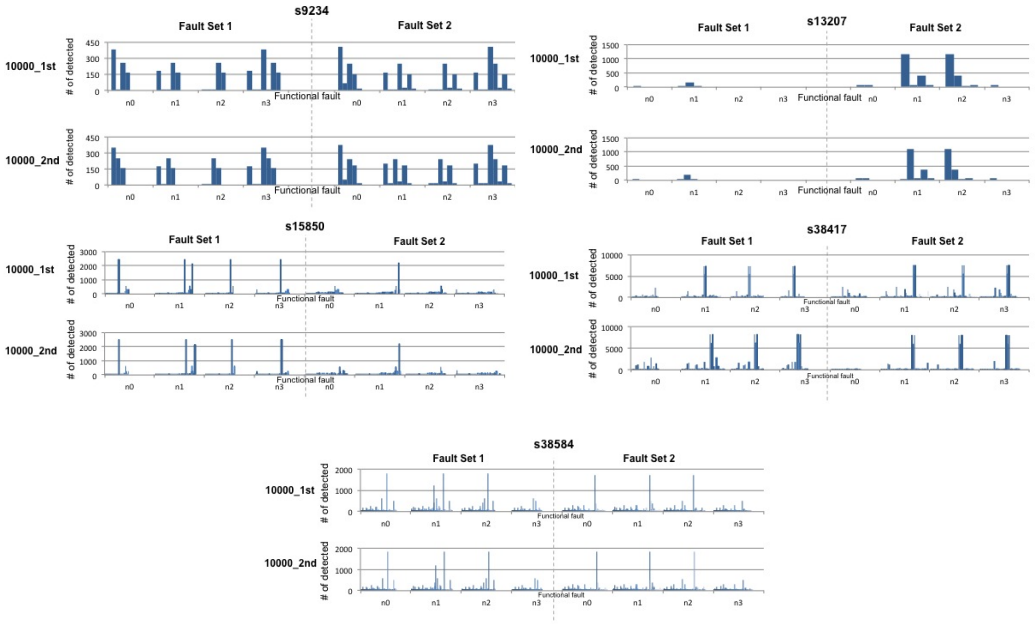
The above figures show the distribution of percentages of functional, and non-functional Cell-aware faults not detected by stuck-at ATPG. Once again the results were similar for all of the tested patterns and Cell-aware fault sets. Different circuits obtained different distributions based on circuits characters. However we can see that the non-functional Cell-aware faults that were detected accounted for a large percentage of the total Cell-aware faults for those not detected by Stack-at ATPG . In s13207 the non-functional Cell-aware faults accounted for 97-100% of all non-detected Cell-aware faults by Stuck-at ATPG, even in s38584 non-functional Cell-aware faults accounted for 50-54% of the total non-detected Cell-aware faults by Stuck-at ATPG.

of Functional Faults Table

Benchmark		**s9234**				**s13207**				**s15850**				**s38417**				**s38584**			
n **number**		**n0**	**n1**	**n2**	**n3**	**n0**	**n1**	**n2**	**n3**	**n0**	**n1**	**n2**	**n3**	**n0**	**n1**	**n2**	**n3**	**n0**	**n1**	**n2**	**n3**
Fault Set 1	10k 1st	4	5	5	7	1	3	0	0	26	41	31	37	26	38	31	23	153	177	142	128
	10k 2nd	3	4	4	6	1	3	0	0	23	39	29	33	21	33	24	20	149	175	141	128
Fault Set 2	10k 1st	5	7	7	8	2	4	4	1	41	53	45	47	35	46	45	36	183	216	178	160
	10k 2nd	5	6	6	8	2	5	4	1	41	47	39	44	23	36	33	30	190	212	177	163

This table shows the number of functional Cell-aware faults in each circuit, because Cell-aware faults are inserted in each of the gates we can see that the larger the circuit, the more functional Cell-aware faults are inserted.

Number of Detections for each Fault Detected by Good-State Patterns



Here are charts for each of the five circuits that were tested. They show the number of functional faults that were detected based on Cell-aware fault sets used and the iteration of the test. The bars above each of the n-detect numbers represent the faults detected in each set of gates: AND, NAND, NOR, and OR respectively, with 2,3, and 4 input pins each. We noticed that some faults were detected only 2 or 3 times, whereas others were detected as many as 8 000 times. The faults that were detected many times are likely the most crucial faults. N-detect does not detect many important functional faults, even as n increases. This suggests that increasing the redundancy of the test set with n-detect is ineffective for examining these crucial functional faults.