Accelerating Functional Verification Through Stabilization of Testbench Using AI/ML

Srikanth Vadanaparthi[1], Pooja Ganesh[1], Dharmesh Mahay[2], Malay Ganai[2]
[1] Qualcomm, 5775 Morehouse Dr, San Diego, CA 92121
[2] Synopsys, 690 East Middlefield Rd, Mountain View, CA 94043

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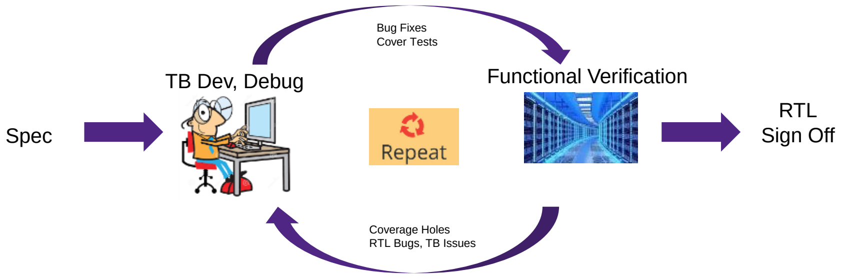
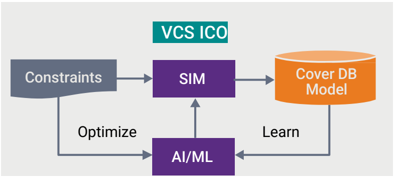
INTRODUCTION (or REQUIREMENTS)

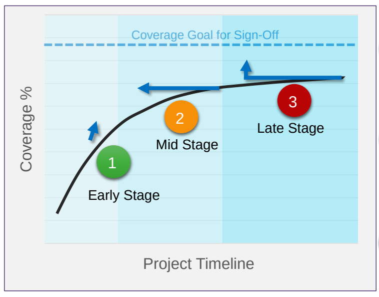


Leapfrog Spec to Sign-off using AI/ML with ICO



OBJECTIVES

Accelerate Functional Coverage Curve



Typical Coverage Convergence Profile

1 TB Development
Ask – Stabilize and Mature TB faster

2 Optimize Regression, Faster Goals
Ask – Accelerate Coverage and Bug rate

3 Coverage Convergence & Closure
Ask – Faster closure, Reduce directed tests

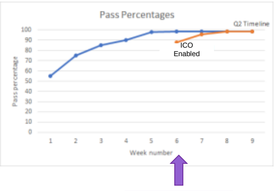
Expose faster and hard-to-hit bugs, occurring in

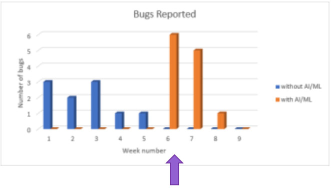
- Complex logic with independent inputs
- The logic which requires a long loop of action to trigger
- Rare occurrence scenarios that may show up and disappear.

RESULTS

Shift-left Bug & Functional Coverage Rate

Week #	Pass %	ICO Enabled?	# TB bugs	# RTL bugs
Week 1	55%	no	13	3
Week 2	75%	no	10	2
Week 3	85%	no	11	3
Week 4	90%	no	11	1
Week 5	98%	no	7	1
Week 6	88%	Yes	18	6
Week 7	96%	Yes	7	5
Week 8	98.50%	Yes	5	1
Week 9	98.50%	Yes	5	0





ICO Enabled

ICO Enabled

- ICO was enabled on Week 6th when pass rate was ~98%
- A big surge in both TB and DUT was observed even when TB/DUT was deemed stable
- In subsequent fewer iterations all DUT bugs were exposed

Exposed scenarios not in func spec:

- *TB failure #1: Constraint inconsistency failures*
- *TB failure #2: Design SVA failures due to issues in the UVM driver*
- *TB failure #3: Scoreboard issues related to the checker*
- *RTL failure: Design deadlock scenarios*

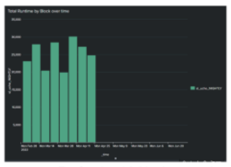
Faster coverage closure

- *Achieved 95% functional coverage in 6 vs.10 regressions.*

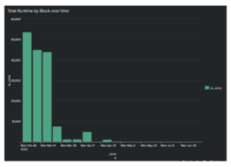
RESULTS

Save Writing Directed Tests, Grid Usage

Coverage	Metric	Default	ICO Enabled	Improvement with ICO
Code	Line	88064	89231	1167
	FSM	855	885	30
	Condition	356836	359019	2183
	Branch	66888	69931	3043
Functional	Cover Points	1757	1804	47
	Coverpoint bins	39628	39969	341
	Cross Coverage bins	305445	306859	1414
	Total Bins	347984	349661	1677



Default: 198k time units

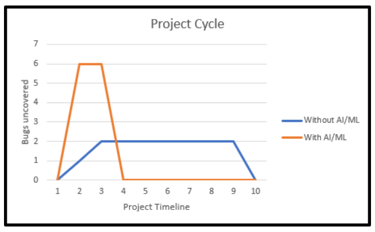


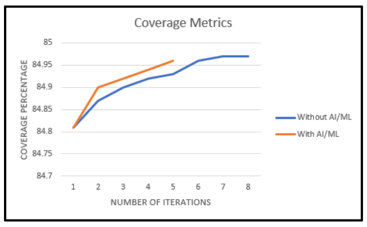
ICO: 162k time units

10-15% reduction in grid usage per block

"After enabling ICO in random regression for this block, we witnessed dramatic improvement or left shift in functional coverage closure by 1.5 weeks. We observed that most of complex bins which needs tweaking of constraints or delay profile automatically are now getting hit quickly. Consequently, we now need to spend very minimal effort (maybe for less than 100 bins instead of 200 to 500 bins) on directed /constraint tweaking or delay profile tweaking.

CONCLUSIONS





- ❑ Shift-left bug finding in RTL, testbench, constraints
- ❑ Accelerate functional, code coverage automatically
- ❑ Help reduce the manual effort to write test cases of direct tests for hard-to-hit scenarios ~ 2 weeks per block
- ❑ No manual effort to rewrite or change functional coverage models
- ❑ ICO fits seamlessly in VCS regression Environment and easily deployed at all stages.

REFERENCES

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