FIRST DVCON IN TAIWAN!

WELCOME TO DVCON TAIWAN

2023-09-07 – NYCU, HSINCHU

新竹陽明交通大學電資大樓

Congratulations & Thank You to the Organizers & Participants
Autonomous Verification: Are We There Yet?

Ajay Singh
SVP of Engineering, Design Creation & Verification
What is Autonomous Verification?

“Autonomous Verification refers to the process of automatically verifying and validating systems, software or components without significant human intervention. It involves utilizing automated tools, algorithms, or systems to assess the correctness, performance, safety, or compliance of a particular entity or process…”
Autonomous Taxis Are Here Today

Robotaxi expansion gets green light in San Francisco

© 11 August
LEVELS OF DRIVING AUTOMATION

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No Automation</td>
</tr>
<tr>
<td></td>
<td>The Human performs all the driving tasks</td>
</tr>
<tr>
<td>1</td>
<td>Driver Assistance</td>
</tr>
<tr>
<td></td>
<td>The Vehicle features a single automated task (e.g. cruise control)</td>
</tr>
<tr>
<td>2</td>
<td>Partial Automation</td>
</tr>
<tr>
<td></td>
<td>The Vehicle features multiple automated tasks, but Human involvement is needed for other tasks</td>
</tr>
<tr>
<td>3</td>
<td>Conditional Automation</td>
</tr>
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<td></td>
<td>The Vehicle can perform most driving tasks, but Human override is still required</td>
</tr>
<tr>
<td>4</td>
<td>High Automation</td>
</tr>
<tr>
<td></td>
<td>The Vehicle performs all driving tasks under specific circumstances. Human override is an option</td>
</tr>
<tr>
<td>5</td>
<td>Full Automation</td>
</tr>
<tr>
<td></td>
<td>The Vehicle performs all driving tasks without any Human intervention or attention</td>
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</table>

The Human monitors the driving environment

The Vehicle monitors the driving environment
# LEVELS OF VERIFICATION AUTOMATION

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- The Human controls the scope of Verification
- The Tool controls the scope of Verification
Do We Need Autonomous Verification?

More than 50% of SoCs <10nm Need a Respin

#1 cause of Respuns: Logic / Functional Issues

Yes! Autonomous Verification is Needed to Address Complexity

Demand for workers is expected to rise by ~50% … … While supply will grow by less than 1% annually … … Meaning that demand for design workers will exceed supply by nearly 35% in 2030
Where can we do automation in Verification?

- Architectural Spec
- Design Spec
- Test Plan
- DUT RTL
- Tests
- Debug Failures
- Regression System
- Results
- Coverage Closure

Debug Cycle
Coverage Cycle
Debug Closure

Verification Time Spent
- Manual Process
- Debug 35%
- Other 30%
- Coverage Closure 35%

Verification Time Spent

Drive Coverage Closure

Regression System
Results

Debug Cycle

Debug Failures

TEST FAIL

TEST PASS
Typical Coverage Flow

- Test Generation
- Stimulus Generation
- Run Regressions
- Coverage Database
- Find Coverage Holes
- Manually Bias Tests
AI Assisted Coverage Flow

- AI-Inferred Coverage
- Prescriptive Insights
- Data Continuum
- AI-Targeted Stimulus
- Automated Analytics
- Automated Test Biasing
- Automated Regression
- Prescriptive Insights
VSO.ai: Autonomous Coverage Closure

Accelerating coverage closure upto 3x-5x

With VSO.ai
Without VSO.ai
VSO.ai: Customer Results
Faster Closure and Higher Coverage

- **10-15% Higher Coverage**
  - Automotive

- **26% Higher Coverage**
  - IP Provider

- **3X Reduction In Tests**
  - Memory

- **2X Reduction in Tests**
  - Processor

- **68% Reduction in Tests**
  - Mobile SoC

- **5-10X Reduction In Tests**
  - AP Mobile
How is Debug Automated Today?

Debug Failures

Architectural Spec

Design Spec

DUT RTL

Test Plan

Tests

Regression System

Results

Drive Coverage Closure

Debug Cycle

Coverage Cycle

Verification Time Spent

Manual Process

Coverage Closure 35%

Debug 35%

Other 30%

Verification Time Spent
Typical Debug Flow

1. RTL/TB Code Check-In
2. Regression
3. RCA
4. Triage
5. Fix Bug

Flow: RTL/TB Code Check-In -> Regression -> RCA -> Triage -> Fix Bug
AI Assisted Debug Flow

Next-Generation Verdi: Improves debug productivity up to 10X
Next-Gen Verdi: Accelerate Debug Automation

Customer Examples

- **Gate-level with Many Xs**
  - XRCA Engine: 60x

- **DUT Code Change**
  - DUTRCA Engine: 20x

- **Multiple Failing Assertions**
  - DUTRCA Engine: 10x

- **DFT with X Monitors**
  - XRCA Engine: 10x

- **Massive Log Files**
  - ML-Binning: 5x

- **DUT Hang**
  - DUTRCA Engine: 48x
Introducing Next-Generation Verdi Platform

See the demo in the Synopsys booth!
What About Specification Automation?

- Architectural Spec
- Design Spec
- Test Plan
- DUT RTL
- Tests
- Debug Failures
- Regression System
- Drive Coverage Closure
- Coverage Cycle
- Results
- Debug Cycle
- TEST FAIL

Verification Time Spent:
- Debug 35%
- Other 30%
- Coverage Closure 35%

Manual Process

Drive Coverage

Verification Time Spent
Generative AI Can Help to Remove Ambiguity & Provide Automation.
Introduction to Generative AI

• Generative AI: a branch of AI used to create new content, including audio, code, images, text, simulations, and videos.

• Recent advances in GPT (Generative Pre-trained Transformer) technology have enabled applications like ChatGPT.

• ChatGPT is an LLM interface that can converse with a human, write essays, create websites automatically etc.

If Generative AI can create “intelligent” responses, can it write Verilog, automate chip design flow, and create layouts?

How about EDA?
RTL Copilot
Natural Language Text → SystemVerilog Code

DV Assistants with Engineer in the Loop

Provide Spec in Natural Language
Use LLM interface to Generate RTL code
Review Code
Accept / Reject
Generative AI Vision TechTalk
Presented by Microsoft (Eric Berg) at DAC 2023

**HW Vision**
- Generate RTL modules (adder, mux, fifo)
- Generate Formal Verification Testbench (FV TB) for design exercise
- Generate connection logic
- Generate UVM TB for connected block
- Optimize random test stimulus using ML/AI tools
Generative AI Promises

Transform English Specification to Machine Readable Specification

Multi-Step Reasoning Assistant

Code Advisor

Test Collateral Generation
Generative AI: Key Challenges

- Lack of Public Design Data
- Private LLM Costs
- LLM Hallucinations

Reinforcement Learning with Human Feedback & EDA Tools as Agents in the Loop can help
# Levels of Verification Automation

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**WE ARE HERE**

![Image of a person with a steering wheel, indicating control over the verification process.](image-url)
Question to DALL-E

Show the Level 5 vision of Autonomous Verification

Robots Doing Verification

We Focusing on What's Important
Thank You