

2026
DESIGN AND VERIFICATION™
DVCON
CONFERENCE AND EXHIBITION
UNITED STATES

SANTA CLARA, CA, USA
MARCH 2 - 5, 2026

A Novel Fast Regression: An AI/ML Driven Automated Sanity Regression Flow

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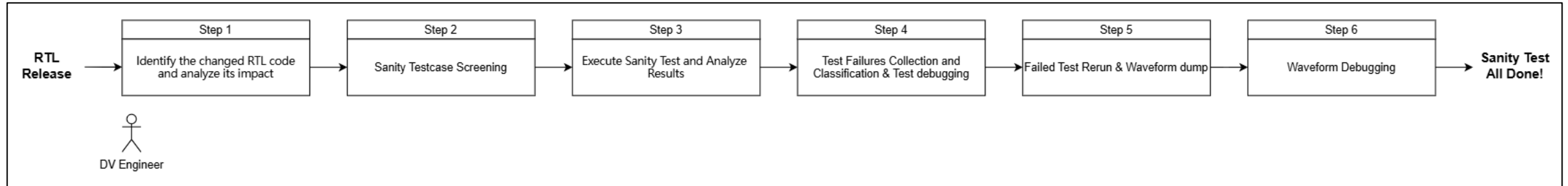
*Samsung Electronics Co.

&Cadence Design Systems



01. Background

Current Sanity Regression Flow

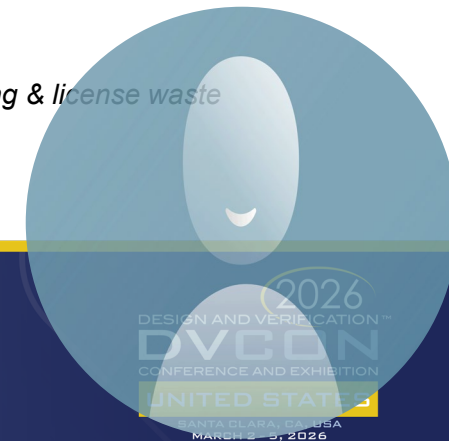


▪ Pain Points of Verification Engineer

- **Difficult to assess impact of RTL changes**
→ Leads to full test execution and time-consuming test selection
- **Log analysis depends heavily on individual experience**
→ Delays root cause analysis and increases human error risk
- **Waveform debugging is time-consuming and complex**
→ Manual RTL diff and signal comparison required

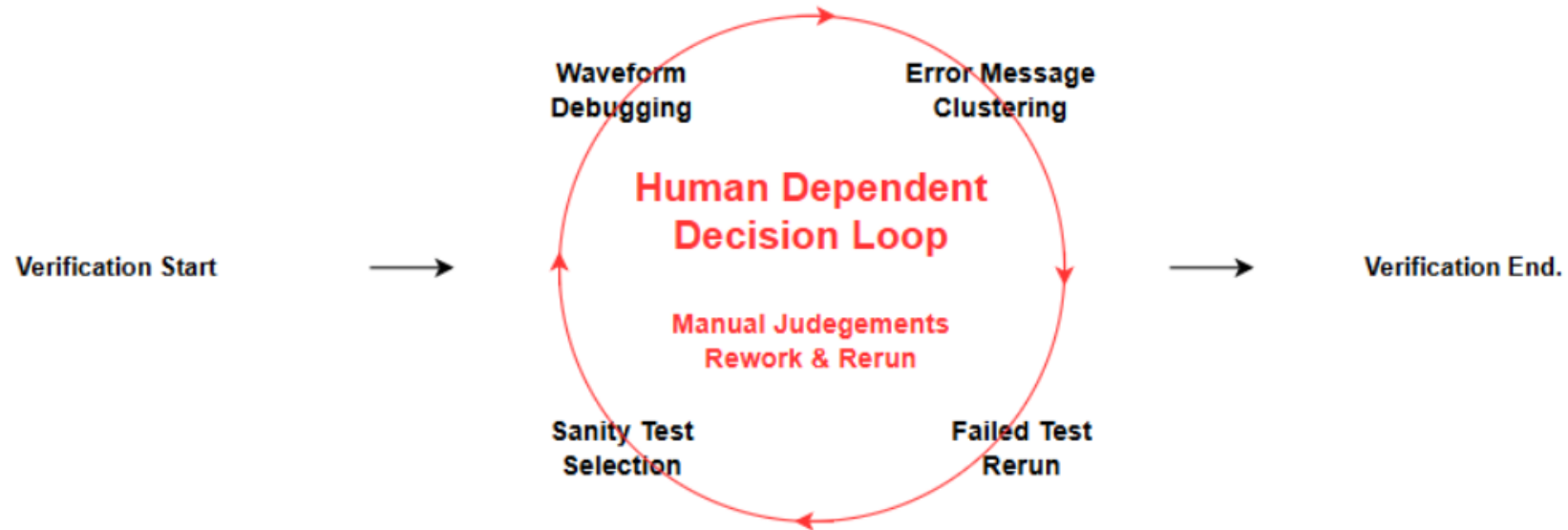
▪ Potential problems of Sanity Regression

- **Problem 1 : Decline in Sanity Test Quality**
→ Irrelevant tests are included and this leads to low test quality
- **Problem 2 : Manual Centric Verification Flow**
→ High chance of human error and repetitive, inefficient work
- **Problem 3 : Resource Waste & Increased TAT**
→ Unnecessary process leads to higher computing & license waste



01. Background

Current Sanity Regression Flow : Perfect storm of Human Error



* **Consistency** and **automation flow** are no longer optional — they're essential to overcome the limits of manual Verification !

01. Background

Four Major Pain Points in the Current Process

Test Selection

Needs Automatic Test Targeting

Fail Log Analysis

Needs Automatic Fail Log Clustering

Rerun Process

Needs Rerun Optimization & Wavedump

WaveForm Debug

Needs Waveform Debug Enhancement

01. Background

A Solution to Address Four Key Pain Points

**Automatic
Test Selection**

Stage 1.

Automatic Test Targeting

AF

**Failure
Clustering**

Stage 2.

Automatic Fail Log Clustering

AT

**Automatic
Rerun**

Stage 2.

Rerun Optimization & Wavedump

AR

WM

Waveform diff

Stage 3.

Waveform Debug Enhancement

01. Background

A Solution to Address Four Key Pain Points

**Automatic
Test Selection**

Stage 1.

Automatic Test Targeting

**Failure
Clustering**

Stage 2.

Automatic Fail Log Clustering

**Smart Sanity
Regression**

**Automatic
Rerun**

Stage 2.

Rerun Optimization & Wavedump

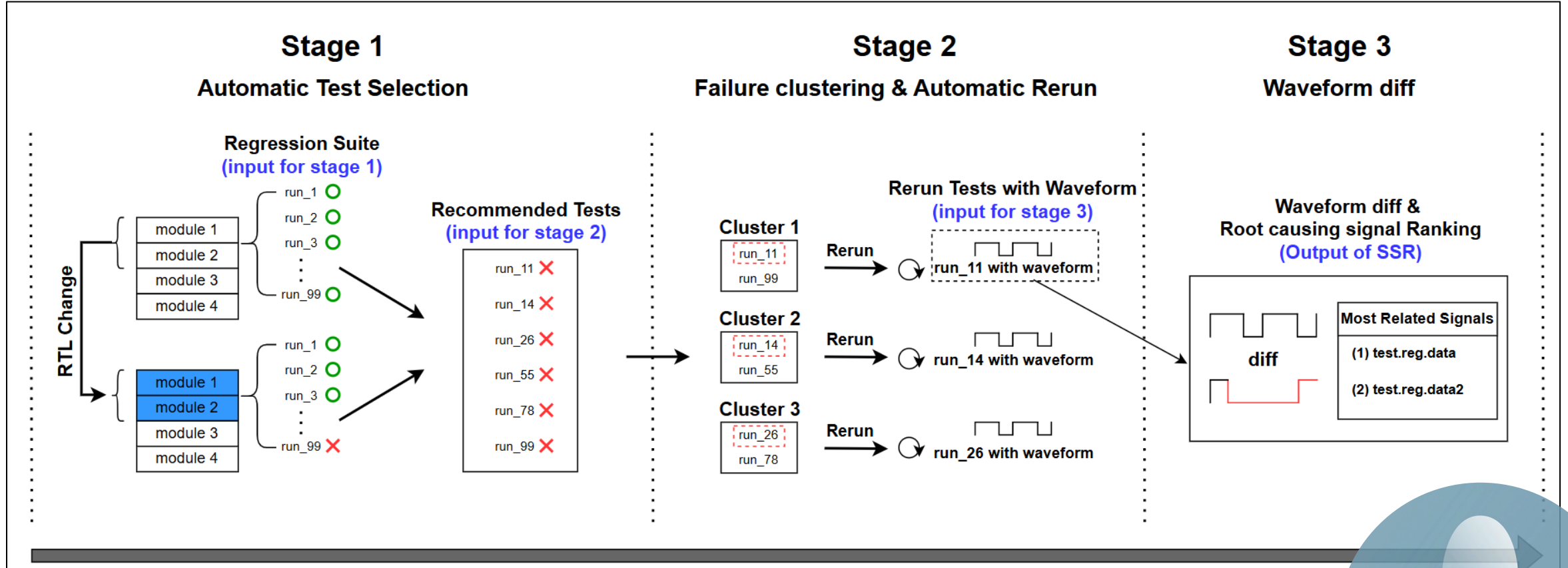
Waveform diff

Stage 3.

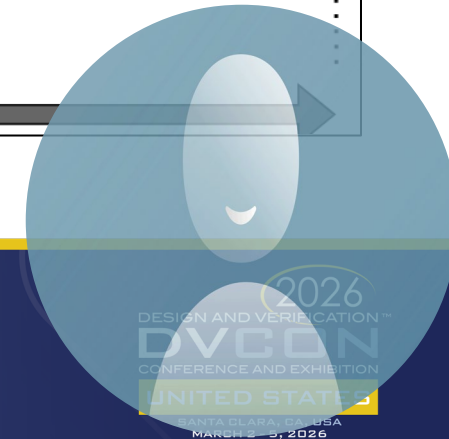
Waveform Debug Enhancement

02. Smart Sanity Regression (SSR)

SSR : An Integrated Full Automation Verification Methodology



** Automated Verification Flow!*



02. Smart Sanity Regression (SSR)

Stage 1. – Automatic Test Targeting

Automatic Test Selection

Stage 1.

Automatic Test Targeting

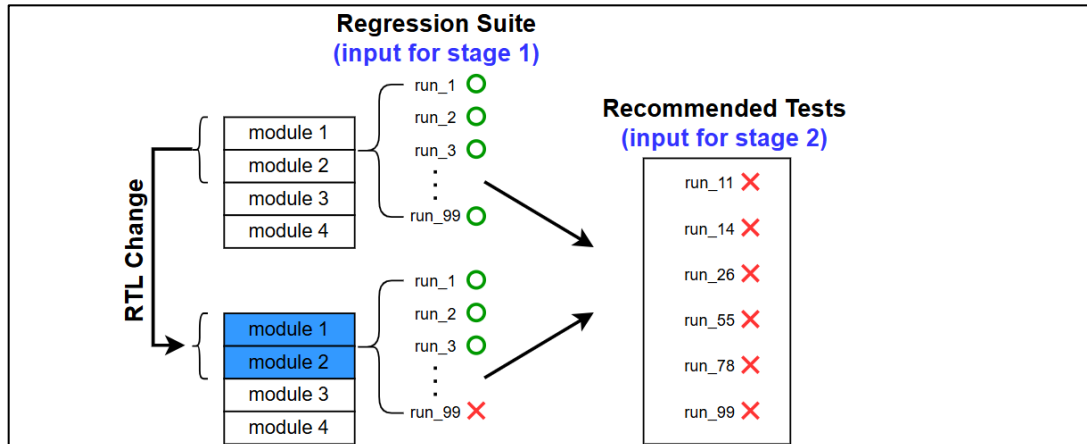
AF

Main Function & Expected Outcomes

- **Understands code changes** → **suggests the right tests**
 - Prevents test overrun by avoiding irrelevant regressions
 - Quickly selects the right tests based on RTL changes

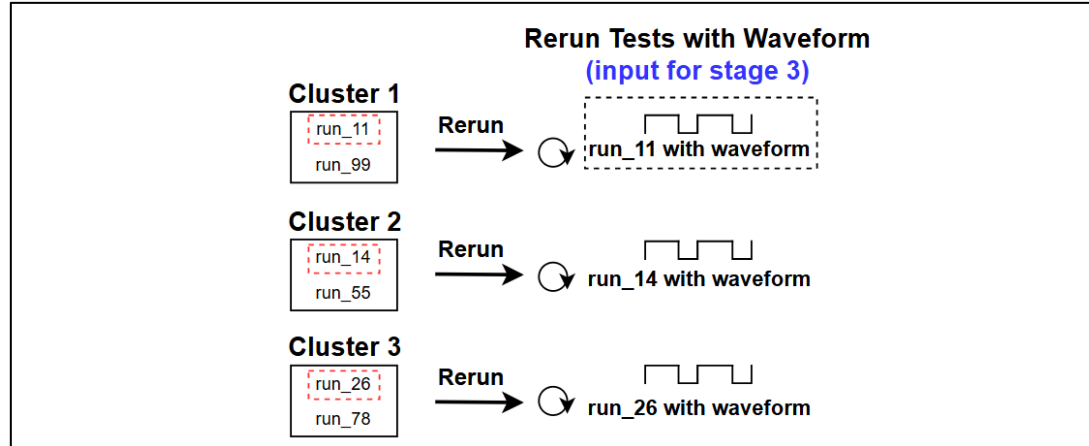
Inputs / Output

- **(Input) Golden Session Name**
- (Input) Golden RTL Snapshot directory
- (Input) Golden vsif file directory
- (Input) New RTL Snapshot directory
- (Output) Recommended Testset vsif file



02. Smart Sanity Regression (SSR)

Stage 2.- Failure Clustering & Automatic Rerun



AT

Failure Clustering

Stage 2.

Automatic Fail Log Clustering

AR

Automatic Rerun

Stage 2.

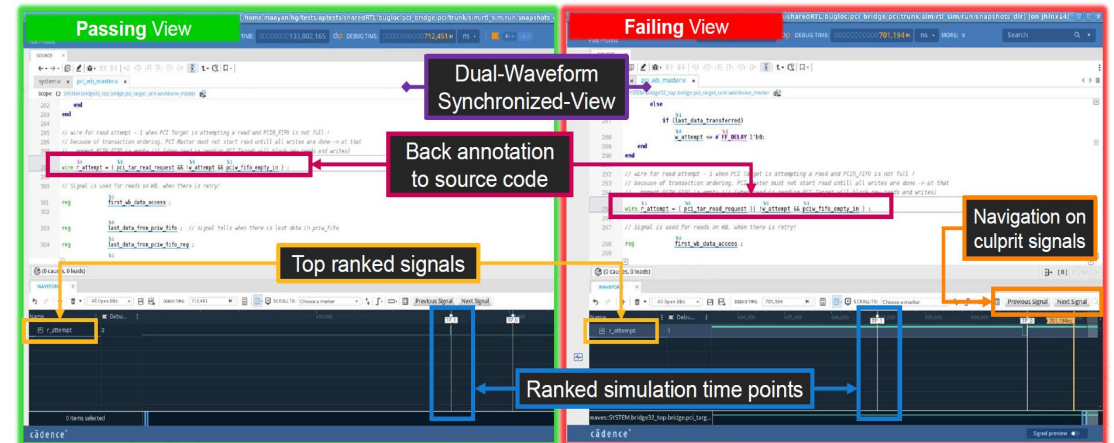
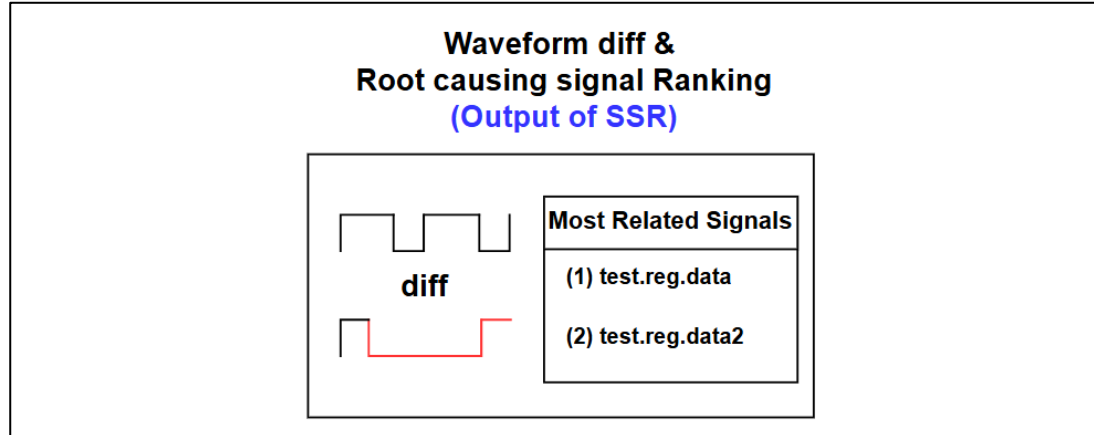
Rerun Optimization & Wavedump

Main Function & Expected Outcomes

- **(AT) Auto-Clusters failed tests by error message type**
 - Fewer clustering errors, faster analysis
 - Consistent debugging, even for **juniors**
- **(AR) Optimized Rerun process (save resource)**
 - Minimize retry cost from missed or misedited tests
 - Dump only what's needed → faster debugging prep

02. Smart Sanity Regression (SSR)

Stage 3. – Waveform-based smart comparison



Main Function & Expected Outputs

- **Signal diff view • Waveform focus • RTL traceability**
 - Faster and more accurate debugging
 - Even **junior** engineers can easily spot waveform issues
 - Standardized, high-quality debug across the team

WMM

Waveform diff

Stage 3.

Waveform Debug Enhancement

02. Smart Sanity Regression (SSR)

Core Goal of Smart Sanity Regression

- **Not Just Faster – but Smarter**

- SSR Bridges the gap between Junior and Senior engineers
- Raises the **entire team's verification quality.**

- **From experience-based to process-driven**

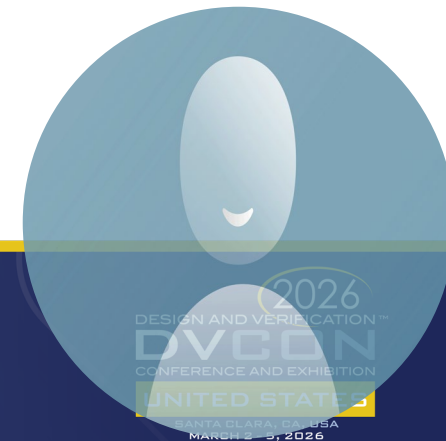
- Test selection, log analysis, waveform debugging... Previously depended on individual skill.
- Now fully **automated and standardized.**

- **Consistent results. Every time**

- No matter who runs it —**SSR ensures the same quality output.**

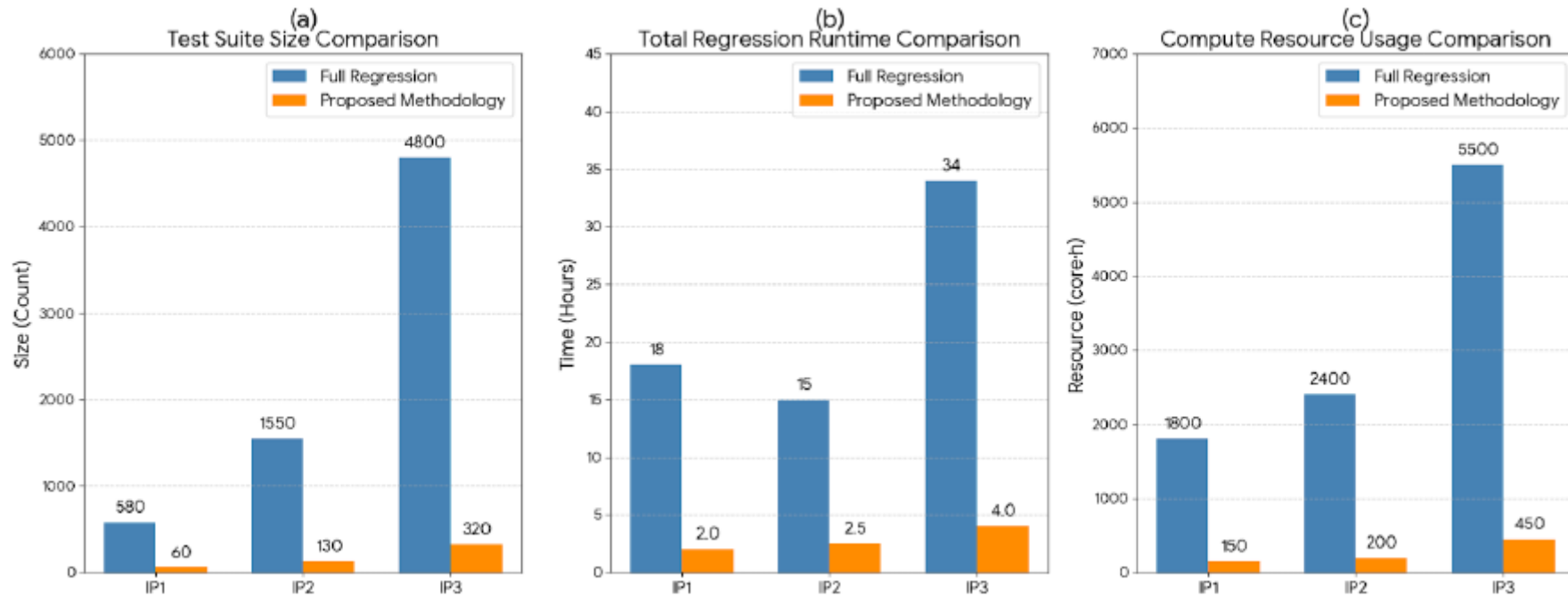
“Skill no longer defines quality”

— Process does.

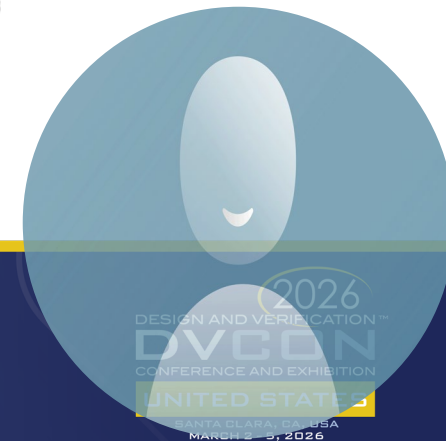


03. Experimental Results

SSR in Comparison with Full Regression



* With Functional Coverage 100% on modified module.



03. Experimental Results

SSR in Comparison with Conventional Sanity Regression

COMPARISON OF TEST SUITE SELECTION BETWEEN CONVENTIONAL SANITY REGRESSION AND SSR .

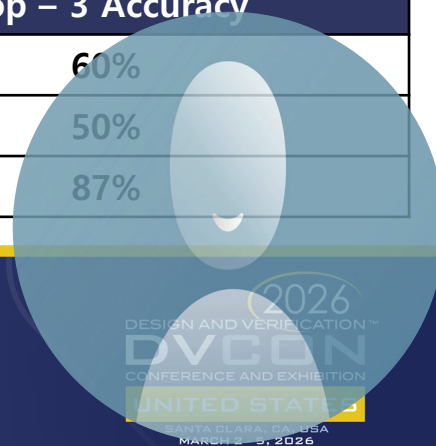
| IP | Predefined Tests | Tests Related to Modification | SSR Tests | Relation to modification |
|-----|------------------|-------------------------------|-----------|--------------------------|
| IP1 | 50 | 10 (20%) | 60 | 100% |
| IP2 | 150 | 15 (10%) | 130 | 100% |
| IP3 | 200 | 10 (5%) | 320 | 100% |

ANALYSIS OF FAILURE CLUSTERING RESULTS GENERATED BY SSR

| IP | Failed Tests/Total (%) | Clusters Generated | Reduction in Reruns |
|-----|------------------------|--------------------|---------------------|
| IP1 | 40/60 (67%) | 5 | 88% |
| IP2 | 90/130 (69%) | 8 | 91% |
| IP3 | 200/320 (63%) | 15 | 92% |

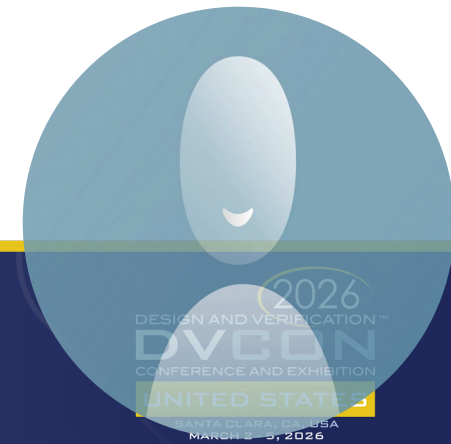
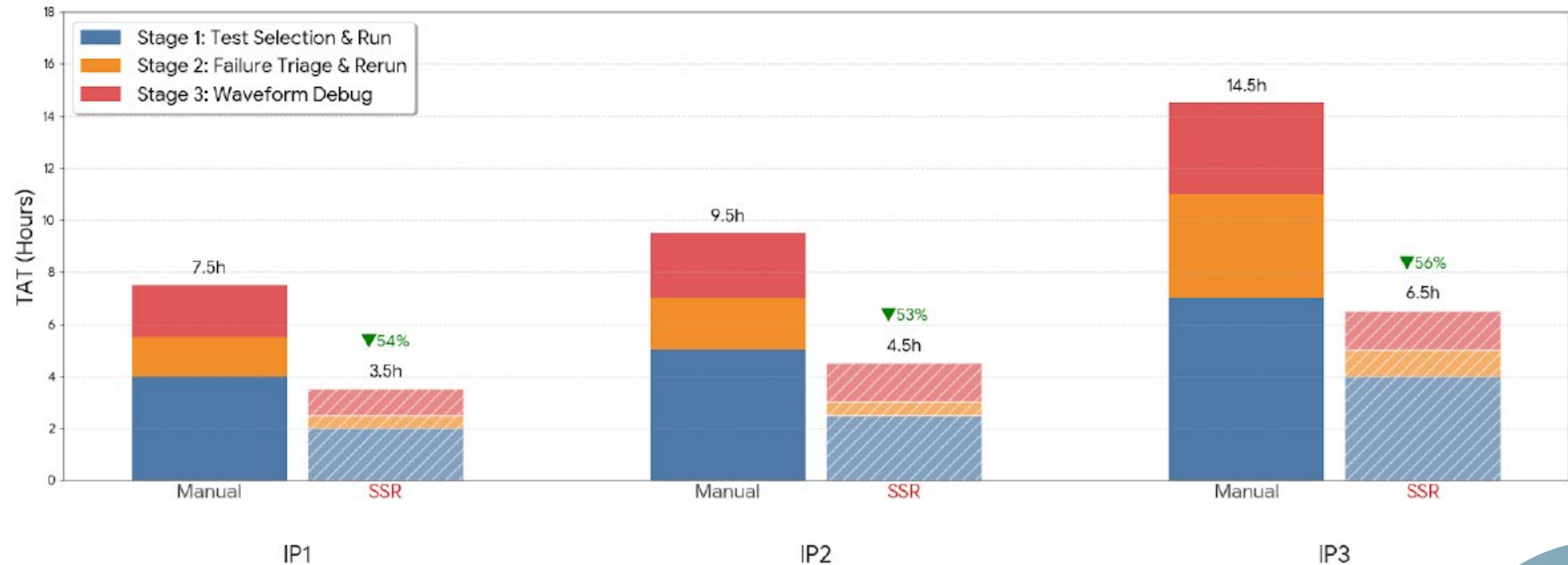
COMPARISON OF SIGNAL RANKING ACCURACY BETWEEN CONVENTIONAL SANITY REGRESSION AND SSR

| IP | Clusters Analyzed | Average Rank of True Root Signal | Top – 3 Accuracy |
|-----|-------------------|----------------------------------|------------------|
| IP1 | 5 | 3.5 | 60% |
| IP2 | 8 | 4.7 | 50% |
| IP3 | 15 | 2.4 | 87% |



03. Experimental Results

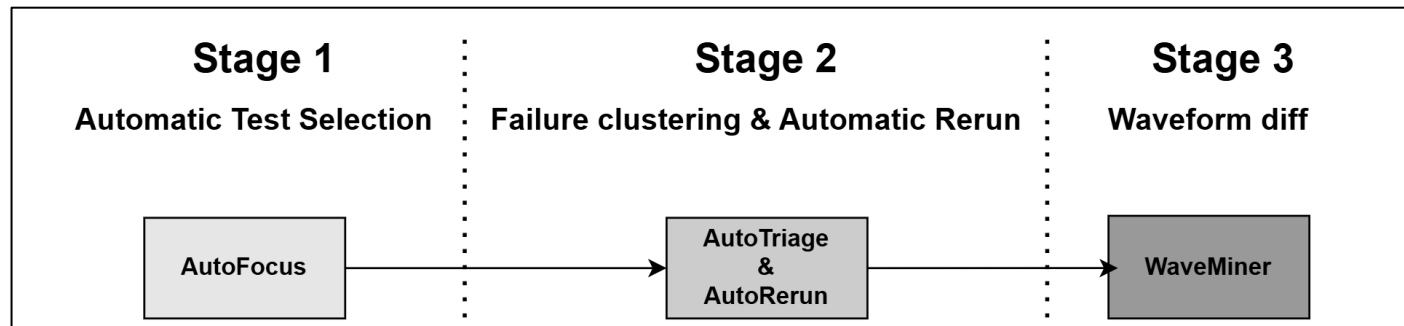
SSR in Comparison with Conventional Sanity Regression



04. Summary

Traditional Flow vs Smart Sanity Regression (SSR)

| Category | Traditional Flow | Smart Sanity Regression | Key Point |
|--------------------------|---|---|--|
| Test Selection | Manual test selection → unnecessary regressions | AutoFocus auto-selects critical tests based on RTL changes | - Faster verification, - Reduced compute & license usage |
| Fail Log Analysis | Manual log review → redundant root cause analysis | AutoTriage clusters logs by common failure cause. | - Faster triage, - Reduced engineer workload |
| Rerun Process | Manual setup for rerun (test, wave, seed) | AutoRerun handles rerun per cluster automatically | - Faster reruns, - Reduced wavedump overhead |
| Waveform Debug | Manual signal inspection in waveforms | Waveminer shows diffs and highlights changes | - Faster, waveform debugging - More targeted waveform debugging |
| Step to Step Link | Manual handoffs between steps → reformatting needed | Auto-links stages by passing outputs as inputs | - End-to-end automation; fewer errors, better efficiency |



Smarter!

Speedy!

Reliable! Fully Automated Methodology!



End of Document

