

INTRODUCTION

Problem Context

Overnight RTL regression runs generate thousands of verification errors

Engineers must gather information from logs, configurations, databases, specifications, and HDL sources before analysis

Current Practice

Information gathering is systematic and repetitive across verification workflows

A significant portion of engineering time is spent on manual data collection

Our Direction

We present a domain-aware, **multi-agent system** for RTL verification error triage

The system automates systematic information gathering across multiple sources

Human experts remain responsible for decision-making, enabling safe and practical deployment in production environments

OBJECTIVES

Primary Goal

Enable **efficient and safe automation of information gathering** in RTL verification workflows

Design Objectives

Develop a **domain-aware, multi-agent** architecture tailored to RTL verification error triage

Encode verification expertise using a pattern-based knowledge base derived from real workflows

Support systematic data collection across logs, databases, configurations, and HDL sources

Operational Objectives

Preserve human decision-making for error analysis and resolution

Ensure safe operation suitable for production verification environments

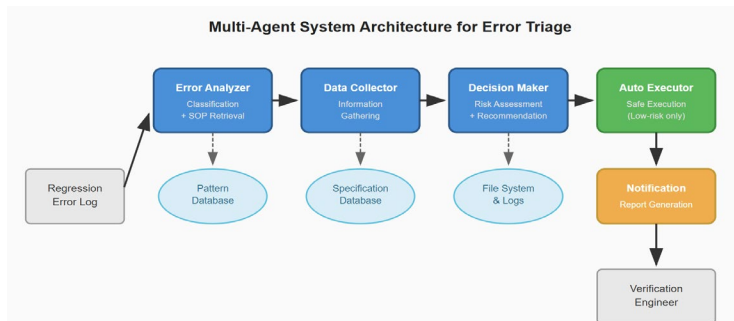
Reduce per-error triage time and improve verification turnaround efficiency

ARCHITECTURE

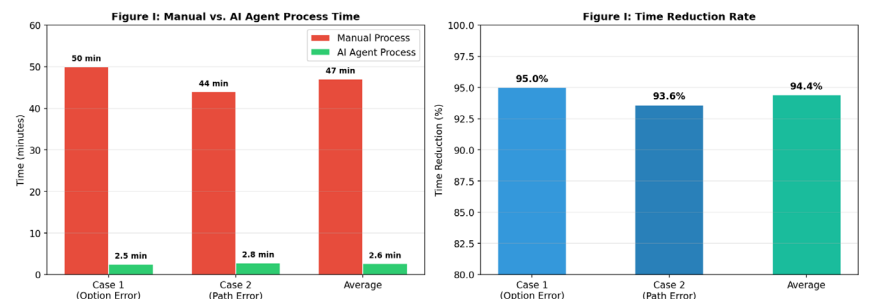
A sequential multi-agent pipeline triages regression errors by combining **pattern-based analysis** with **multi-source data collection**.

The system synthesizes context through a **Decision Maker**, enabling safe execution of **low-risk actions only** via the Auto Executor.

A structured report is generated by the **Notification agent** for rapid review and final decision by the verification engineer.

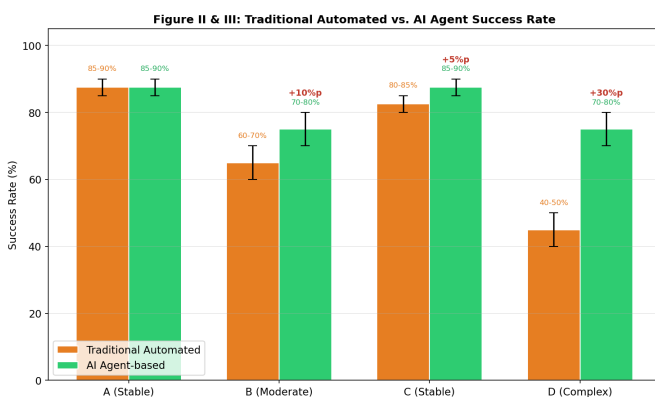


RESULTS (TIME)



The proposed **AI agent-based system** significantly reduces per-error triage time compared to manual workflows. Across representative error cases, triage time decreases from **44–50 minutes** to **2.5–2.8 minutes**, with an average reduction from **47 minutes** to **2.6 minutes**. This corresponds to a **94.4% reduction** in systematic information-gathering time.

RESULTS (SUCCESS RATE)



The proposed **AI agent-based system** achieves higher solution success rates than traditional script-based automation across domains with different complexity levels. Performance is comparable in stable domains (A and C), while clear gains are observed in moderate and complex domains: **60–70% → 70–80%** (B, **+10%p**) and **40–50% → 70–80%** (D, **+30%p**). These results demonstrate improved generalization in complex verification scenarios.

CONCLUSIONS

Key Findings

Systematic information gathering in RTL verification can be **effectively automated**

A **domain-aware, multi-agent** approach integrates naturally with existing **verification workflows**

Quantitative Impact

Achieved a **94.4% reduction** in per-error triage time

Reduced information-gathering effort from tens of minutes to a few minutes per error

Practical Significance

Human experts remain responsible for **decision-making** and resolution

The system operates **safely** in **production verification environments**

Demonstrates a **practical** and **scalable** approach for **deploying AI** in RTL verification workflows

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