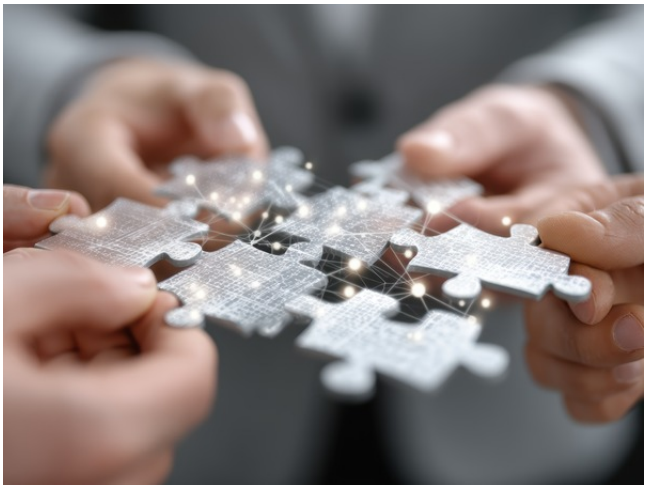
INNOVATION PARTNERSHIPS
UNIVERSITY OF MICHIGAN

PACTI

TECHNOLOGY NUMBER: 2026-115



Technology ID
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Category
Software
Software & Content
MOSS - Michigan Open Source Support

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View online

OVERVIEW

Pacti is a Python package that enables the formal design and analysis of interconnected systems by representing each component's requirements and behaviors as mathematical "contracts."

- Ensures system-level correctness and performance using only component-level specifications, reducing integration failures.
- Unlocks new market opportunities in highly regulated sectors (e.g., aerospace, defense, infrastructure) by enabling provably correct, secure, and cost-controlled design processes.

BACKGROUND

Modern engineering systems—from airplanes and vehicles to industrial automation and genetic circuits—consist of multiple interconnected hardware and software components. While individual components are often designed with rigorous techniques, failures and costly errors frequently arise from the complexity and unpredictability of their interactions. Industry-standard tools (like MBSE and SysML) help manage requirements but lack the ability to guarantee that combined systems behave as desired. This gap leads to expensive system failures, missed deadlines, and challenges in securing supply chains, even as demand for reliable and secure systems grows across markets such as autonomous vehicles, space missions, and critical infrastructure. There is a clear market need for tools that allow companies to: (1) guarantee system correctness and safety from design to integration, (2) improve interoperability among independently developed subsystems, and (3) control costs and timelines—especially in regulated or safety-critical industries.

INNOVATION

Pacti introduces an entirely new approach to system integration by representing each component's capabilities and needs as a "contract"—a precise statement of what a component guarantees, provided its surroundings meet certain assumptions. Unlike existing tools that manage requirements textually or manually, Pacti treats these contracts as computable objects; it can automatically analyze, combine, and verify the behavior of entire systems based only on component contracts—without needing the system to be physically built or simulated in detail. Key innovative benefits include:

- Automatic verification that system architectures will meet overall objectives (like safety, schedule, or performance) before integration.
- The ability to mix and match components from different suppliers using their contracts, reducing friction and risk in supply chains.
- Early detection of incompatibilities and root causes of system-level failures.
- Streamlined diagnostics, requirement allocation, and architecture tradeoffs, all based on mathematical rigor.

This contract-based approach is already supporting advanced design in areas from synthetic biology to NASA space missions, and promises to make development of safer, more efficient, and more competitive products possible across numerous industries.

ADDITIONAL INFORMATION

PROJECT LINKS: https://www.pacti.org/; GitHub

DEPARTMENT/LAB: Inigo Incer (Electrical and Computer Engineering)

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