CRII: CPS: FAICYS: Model-Based Verification for AI-Enabled Cyber-Physical Systems Through Guided Falsification of Temporal Logic Properties

Khouloud Gaaloul, University of Michigan-Dearborn

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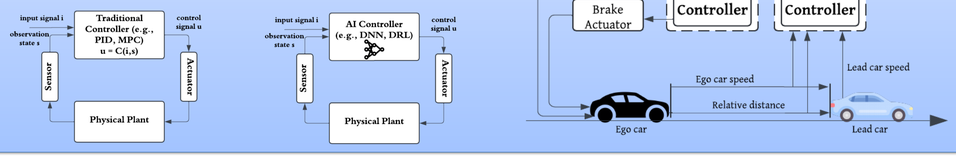
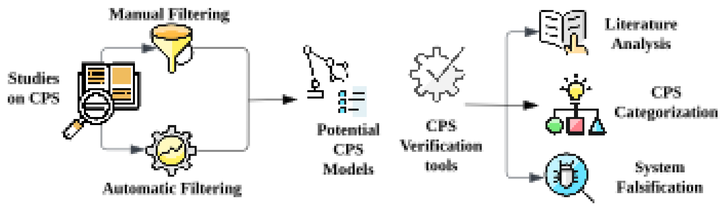
Challenge:

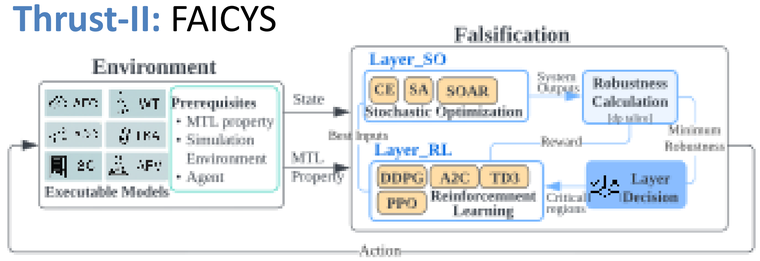
- Verification bias and lack of Benchmarks in AI-Enabled CPS
- Limitations of temporal Logic falsification for AI-enabled CPS
- Exploration challenges and curse of dimensionality in AI-Driven CPS verification



Solution: Thrust-I: Empirical analysis and benchmarking for AI-enabled CPS verification



Thrust-II: FAICYS



* Fully Automated
* Accurate Detection
* Efficient & Scalable

Scientific Impact:

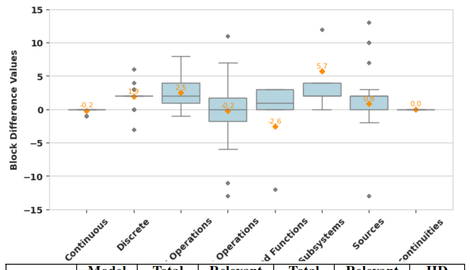
- Deep understanding of neural network interactions in AI-Enabled CPS through empirical analysis
- Optimized falsification through stochastic optimization and reinforcement learning in a novel framework that improves the efficiency and accuracy in detecting property violations in AI-enabled CPS

Broader Impact:

- Enhance the reliability of AI systems by reducing safety-critical failure rates by 20-30% across broad CPS applications
- Increase female representation in AI and CPS research by 10-20% through targeted mentorship and outreach

Accomplishments:

- Category-Wise Atomic Block Differences between AI-Driven and Traditional CPS models
- Flow Dynamics Metrics for Traditional (T) and AI-Driven (AI) CPS Models
- Fault Detection Results



	Model	Total BC	Relevant BC	Total CC	Relevant CC	HD
System Average	T	288.75	116.5	306	274.25	6.38
	AI	349.13	141.5	350.13	312	7.75
% Diff	-	+29.2	+25.7	+21.1	+20.5	+21.0

Model/Policy	#Violated Exec.	# Fals. Requirements	Avg. time
Traditional	30	8/8	0.2
AI Avg	26	6/8	73.9

AISE-CPS Lab

My page: Linkedin

WICS page: WICS

CPS Explorer :

H. Yusuf, "Model-Based Verification for AI-Enabled Cyber-Physical Systems through Guided Falsification of Temporal Logic Properties," Doctoral Symposium, 4th International Conference on AI Engineering – Software Engineering for AI (CAIN 2025)
H. Yusuf and K. Gaaloul, "Navigating the Shift: Architectural Transformations and Emerging Verification Demands in AI-Enabled Cyber-Physical Systems," Poster, 4th International Conference on AI Engineering – Software Engineering for AI (CAIN 2025)

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