

From Natural Language to Safe Actions

--- Crafting an Automatic **Control Design Architecture** for
AI-Physical Systems towards Society 5.0
through the **Japan–Canada–USA** Network

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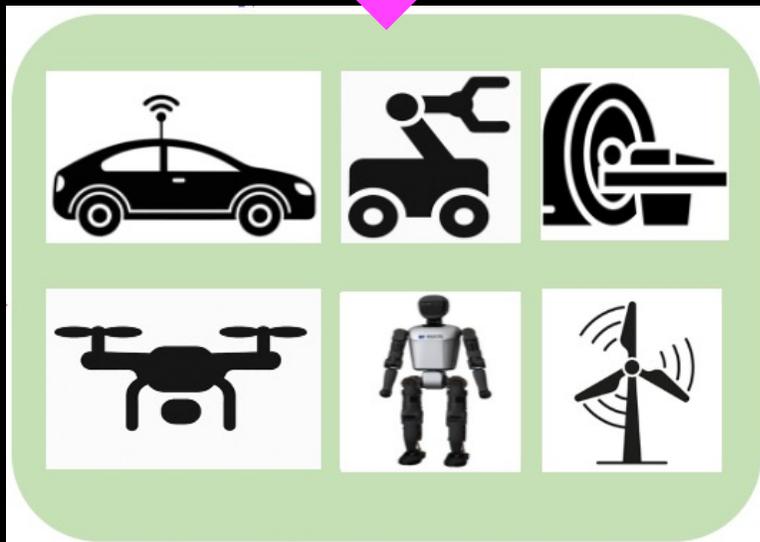
JST ASPIRE

Advent of AI-Physical Systems (APS)

LLMs



Physical agents



Natural language

APS

Actions in real world

(embodied AI, physical AI)

figure 01



unitree go2

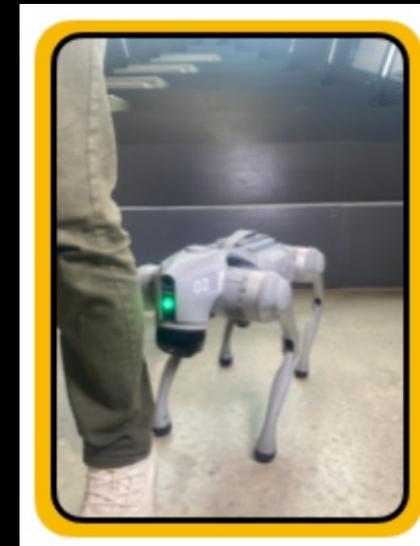


APS Pose New Safety Risks

- LLM **hallucination** can cause **unintended** unsafe behavior
- LLM **jailbreak** can cause **intended** physical harm



Dangerous
zone
intrusion



Human
collision

[RoBoPair,
arXiv:2410.1
3691

Safe Control Architecture for APS

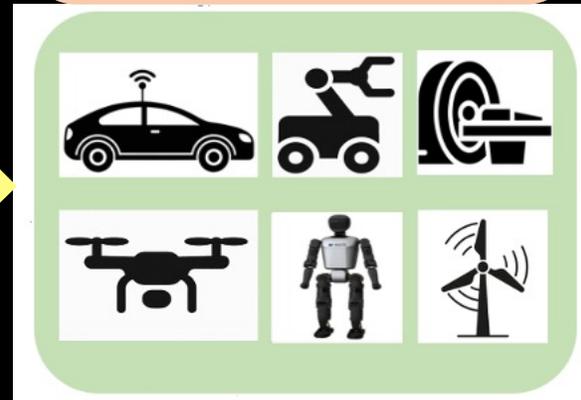
LLMs



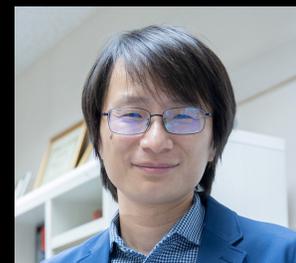
Safety Guarantees



Multi-Agent Systems



Kai Cai



Supervisory Control

Networked Control

Game Theory

Formal Methods for LLMs



Laca Pavel



Chuchu Fan

Research Thrusts

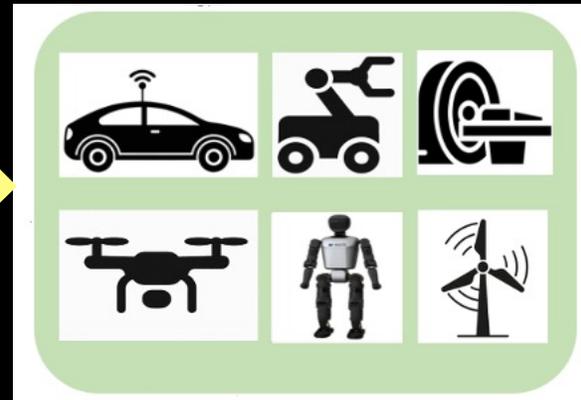
LLMs



NL to Formal Spec

Supervisory Control

Game Theory



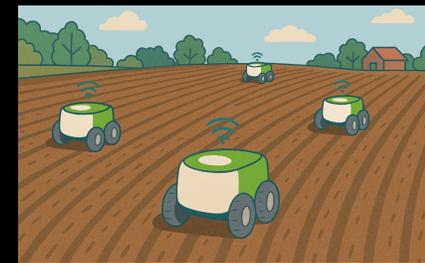
 
Thrust 1:
Feedback
Reprompting

Thrust 2:
Distributed
Control &
Feedback
Replanning




Thrust 3:
Integration and
Use Cases

Marine traffic control Smart agriculture



Hirotsada
Hashimoto

Shuji Yokoi

JST ASPIRE Project

- **Period:** 2025.12 ~ 2029.03
- **Budget:** 70M JPY (~450K USD)
 - Main: **students/researcher exchange (short/long stays)**
 - Conference travels: **limited to co-authored papers**
- **Partners:**
 - Japan: OMU, U of Tokyo (other institutions welcome)
 - Canada: U of T (other researchers in U of T welcome)
 - USA: MIT (other researchers in MIT welcome)

Activity plans

- 2026.03: Kickoff meeting
- 2026.08: Osaka meeting + IFAC WC
- 2026.09~: One researcher to U of T,
one researcher + one student to MIT
- Other ideas:
 - More researcher/student exchanges
 - Meetings at U of T or MIT
 - Workshops / summer schools

March 3 program

- Research introduction from Chuchu Fan's group
- **Coffee break**
- Invited talk: Takeshi Hatanaka
- **Lunch break**
- Research introduction from Hirotada Hashimoto and Hitoshi Yoshioka
- Research introduction from Yingying Liu
- **Coffee break**
- Open discussions

March 4 program

- Research introduction from Lacra Pavel
- Coffee break
- Research introduction from Sasinee Pruekprasert
- Lunch break
- Invited talk: Kohei Suenaga
- Research introduction from Shoya Ishimaru
- Coffee break
- Students' poster session