A Control Framework for Autonomous Physical Systems: Observation, Modeling, Prediction, and Planning

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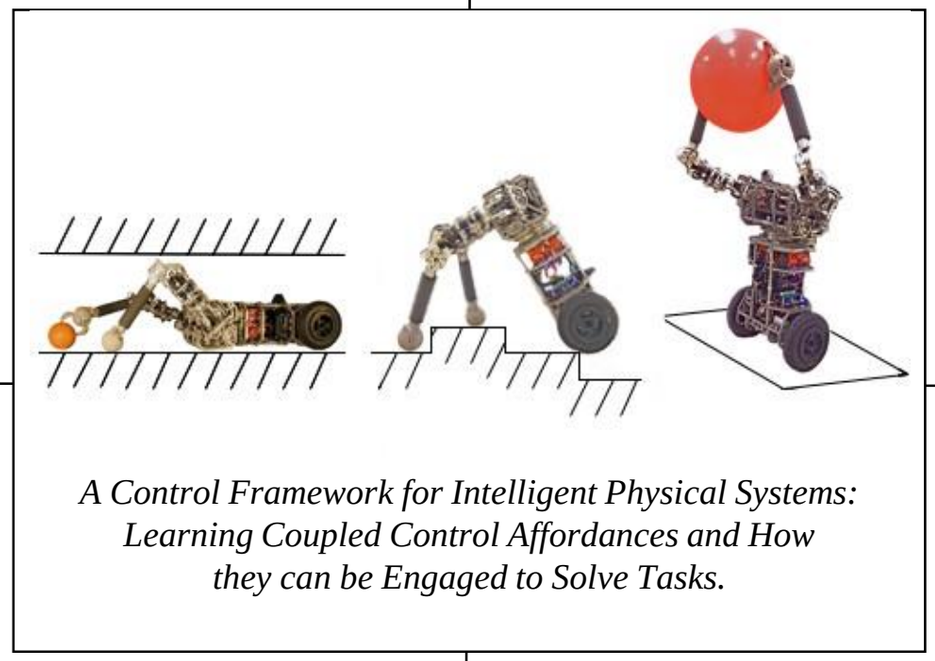
Research Objectives

goal: to learn background knowledge that supports continuous monitoring and long-term autonomy

innovation: new representation for multi-modal control knowledge—the *Aspect Transition Graph*

relation to SOA: predict better reliability, propose to demonstrate 1,000 autonomous control decisions per reset in mobile manipulation tasks and unstructured environments.



A Control Framework for Intelligent Physical Systems: Learning Coupled Control Affordances and How they can be Engaged to Solve Tasks.

start TRL: 1 with theoretical foundations and pilot data

end TRL: 2-3 with statistically significant laboratory performance data with uBot mobile manipulator

Approach

Def: *aspect* - a reliable/stable configuration of a multi-sensory **landscape of attractors**

BUILD: object models called *Aspect Transition Graphs* representing control transitions between a pair of *aspects*

- Learn from Demonstration
- Intrinsically Motivated Structure Learning

REPRESENT: a belief-space MDP, where state is a probability distribution over a population of these models (ATGs) supported by the history $z_{0:t}$ of multi-sensor observations;

EXPERIMENT/EVALUATE: plan sequences of actions that optimize measures of information and performance in mobile manipulation tasks.

Potential Impact

a general method for situation assessment and support for safety, flexibility, and long-term autonomy in important applications, including:

supply chain support, **personal robotics**, **search and rescue**, **health- & elder-care robotics, deep ocean science**, **and**

space exploration:

habitats (robots that people live inside),

remote maintenance and repair (Deep Space Gateway)