

Multiagent Physical Cognition and Control Synthesis Against Cyber Attacks

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Main challenge

Industrial production automation is leading to an ever-increasing adoption of autonomous mobile robots and cloud robotics

Large-scale hacking events are becoming increasingly more common, and have resulted in serious data breaches

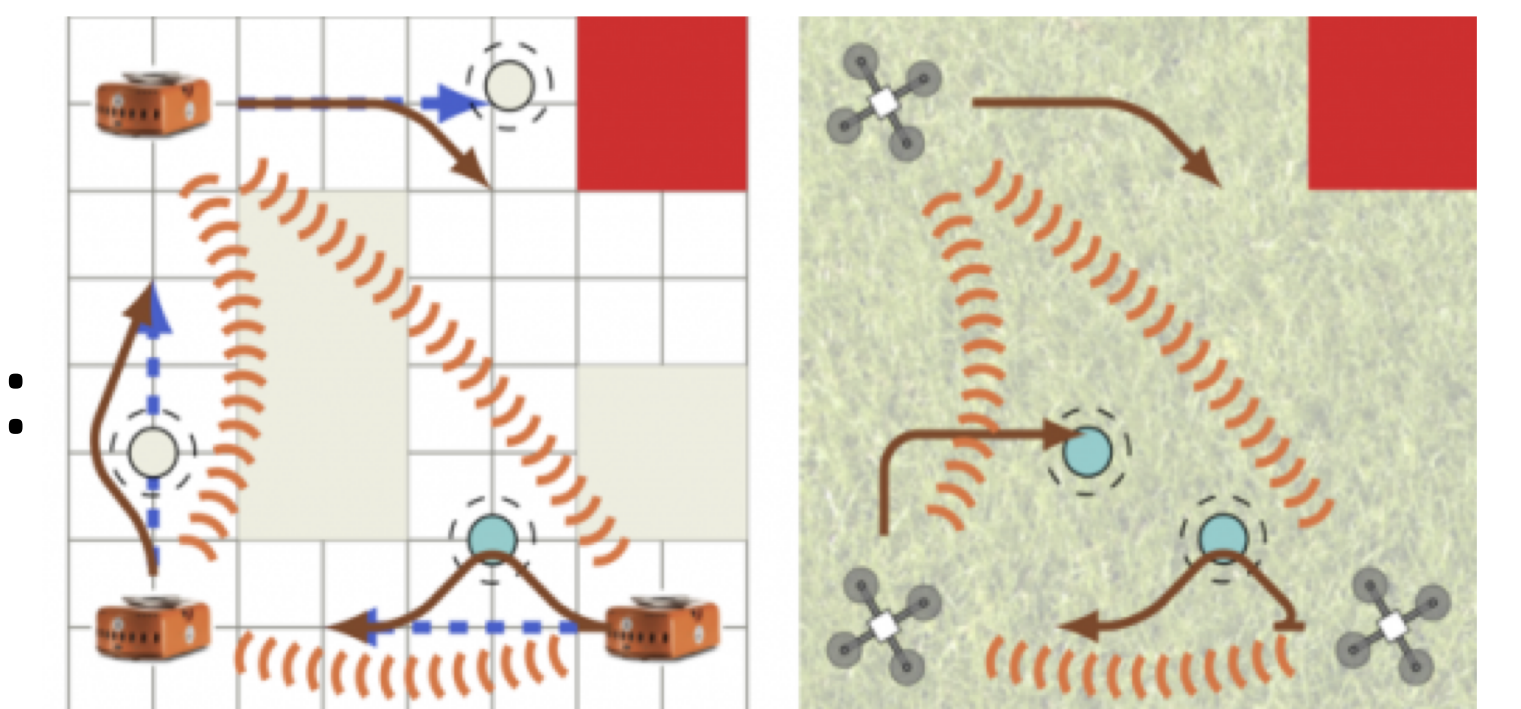
Risk: new cyber-physical attack surfaces, with potential losses in production and increases in human injuries

Opportunity: Manipulate central planning to enforce that via observation mechanisms and limited information announcements

Scientific impact

A new security layer that is tailored to the characteristics of CPS systems:

- Security as a first-class objective for both planning and control
- Use of physical cognition and measurements (in our case, co-observations), as an introspection mechanism
- Control where information is, how, and when it is shared as a very effective way to make attacks less attractive



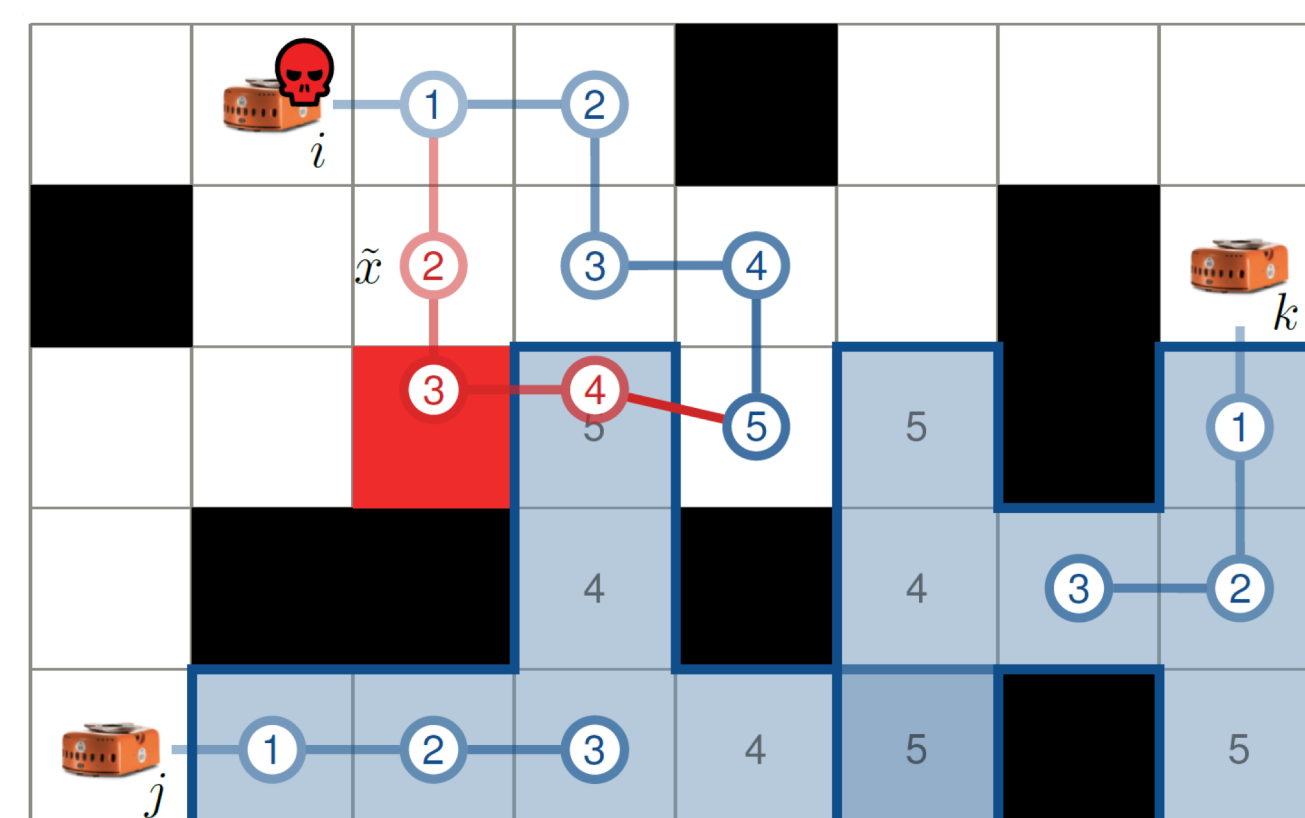
Thrust 1

Planning for large-scale robotic systems on discrete spaces

Co-observation schedules: Robots report co-observations, which we use to detect plan deviations (no observation = attack).

Horizon-limiting announcements: Motion plans are disseminated incrementally,

so that the attacker cannot find plans with deviations guaranteed to avoid spurious detections

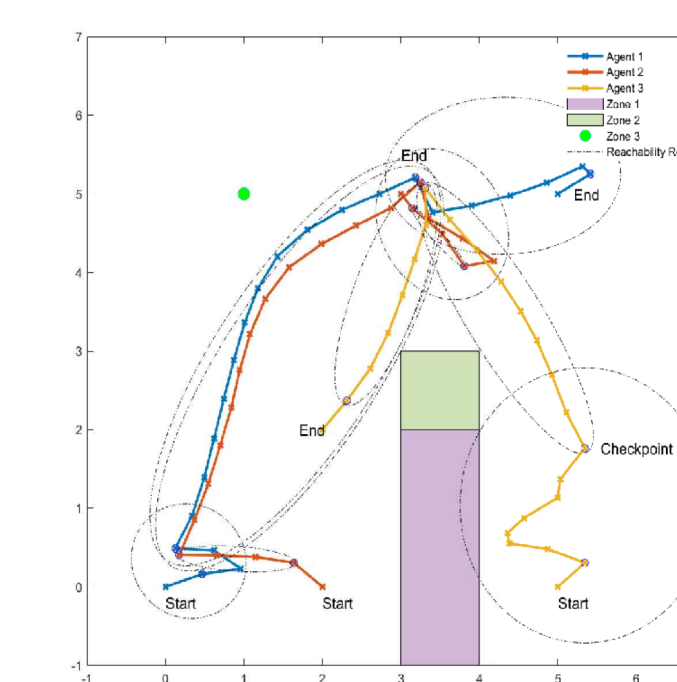
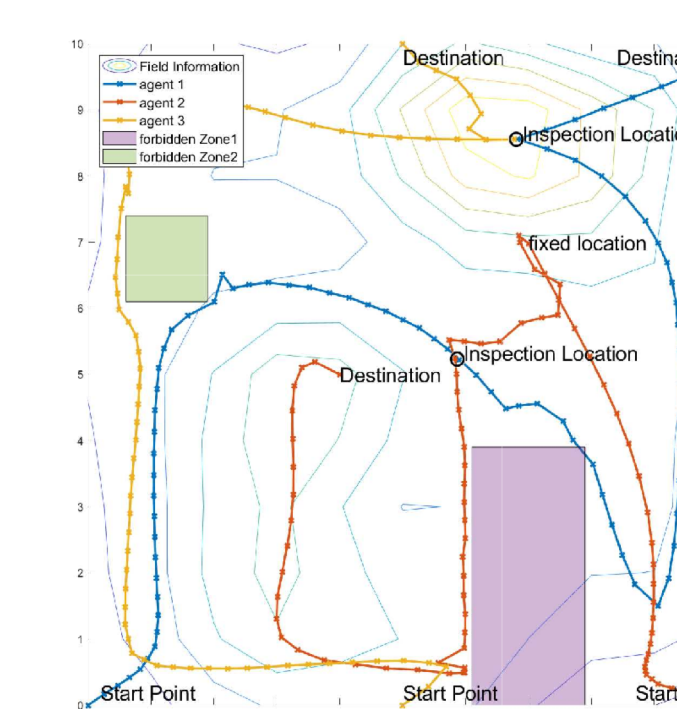


Thrust 2

ADMM based multi-agent path planning under safety constraints:

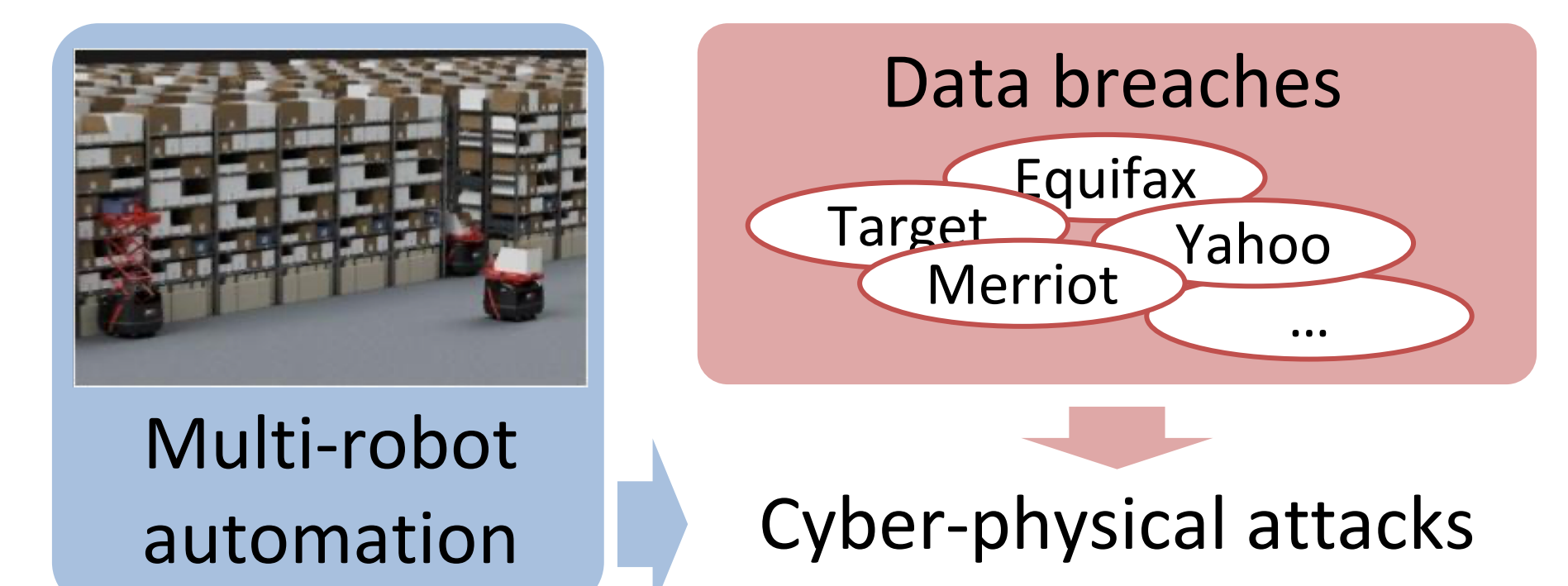
Co-Observations schedules at specific locations from Thrust 1

Reachability limits to guarantee that a compromised robot cannot safety zone between observations with any plan. Uses ellipsoidal bounds



Broader impact

Make automated warehouses safer humans, avoid loss of productivity



Edge computing and automation material included in curriculum (distributed systems Fall 2020)

BU U-Design K-12 “Innovation-in-a-box” with remotely controlled drones