Constraint Aware Planning and Control for Cyber-Physical Systems

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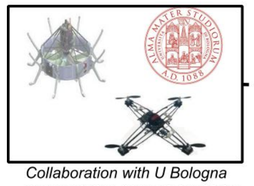
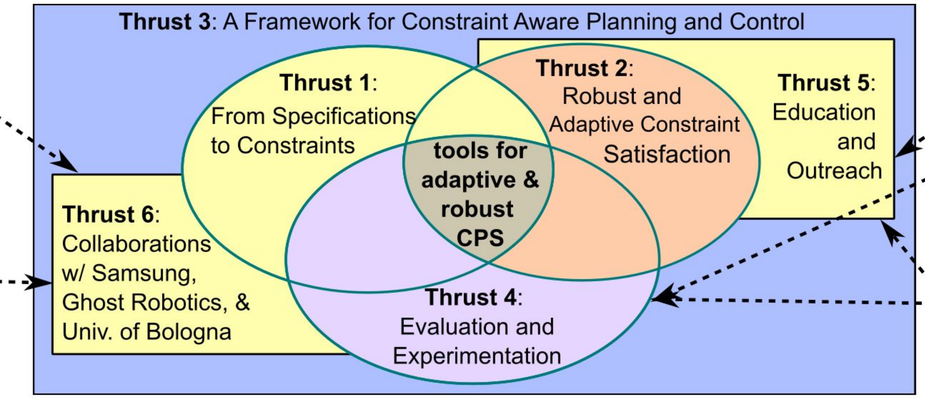
https://hybrid.soe.ucsc.edu/nsf-cps-constraintaware

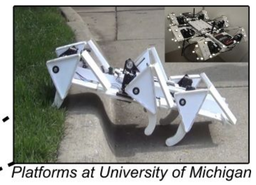
Challenge: Enable robust, adaptive planning & control for nonlinear, nonsmooth, & constrained systems, while respecting their physical constraints and meeting specifications.

Significance: The need for this project arises from the difficulty of combining planning, safety, and robustness in the control of physical systems in general and hybrid cyber-physical systems in particular.

Industry Collaborators


Collaboration with U Bologna on regulation for aerial vehicles




Platforms at University of Michigan


Platforms at UC Santa Cruz

Solutions:

- Generate a framework for the design of algorithms that self-adapt to jointly plan the motion and control the CPS, with robustness.
- Design algorithms that self-learn and self-adapt in real time to cope with unexpected changes in the physics and in the specification to enable autonomous systems to perform tasks robustly and safely.
- Formulate tools that reason about specifications and physics as vertically-integrated modular and reconfigurable constraints.

Scientific impact:

- Mathematical framework to rigorously formulate learning-based planning and control for CPS with awareness of its constraints.
- Novel architectures that lead to robust adaptive constraint satisfaction.
- Deep understanding of roles and priorities of system constraints in CPS.
- Tools and design techniques that permit engineers to deploy constraint aware algorithms.

Broader Impact on Society:

- Broad application of the results to CPS that require planning and control, especially autonomous systems in air and ground transportation.
- Benefit to industry developing multi-legged robotic systems and solutions for real-time planning & control under dynamic obstacles.

Broader Educational and Outreach Impacts:

- Collaboration with colleagues at the University of Bologna.
- Outreach to high school students through Summer outreach and STEM mentoring.
- Publishing of teacher resources online and offering of teacher training.

Quantifying Broader Impact:

Impact is quantified by successful collaborative activities, adoption of results by industry and academic, and by student enrollment in outreach activities.

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