

# NRI: FND: Robust and Scalable Planning for Agile and Collaborative Robot Teammates in Complex Environments

Ye Zhao (PI, Georgia Tech), Sam Coogan (co-PI, Georgia Tech)



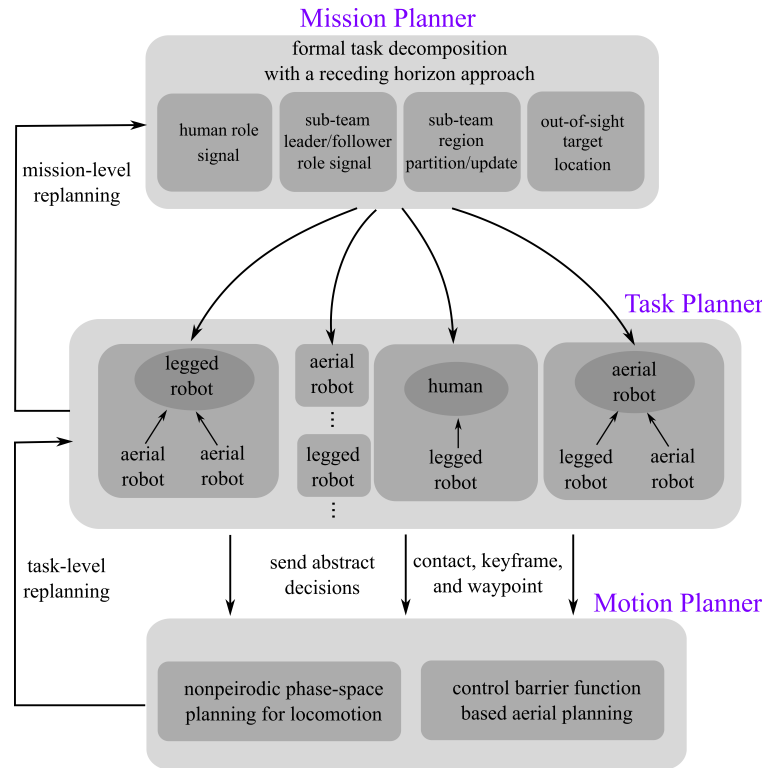
Project goal: “Whole-System Decision and Planning” of heterogeneous and ubiquitous co-robots with robustness and safety guarantees

## Challenge: Task and motion planning for unified aerial and terrestrial locomotion.



## Proposed Approach

- Robust phase-space planning and control barrier certificates for versatile terrestrial and aerial maneuvering.
- Sequential composition of template models via game-based reactive synthesis.
- A multi-agent decision-making approach with formal guarantees on achieving team goals.



## Scientific Impact

- Generalizable to other robotic systems, including wheeled robots, manipulator, and underwater vehicles.
- Extendable to incorporate learning-based formal methods and perception algorithms.

## Broader Impact

- Provide a fundamental understanding of scalable, dynamics-consistent motion and task design.
- Initiate a Vertically Integrated Project (VIP) team at Georgia Tech to encourage undergraduate involvement.



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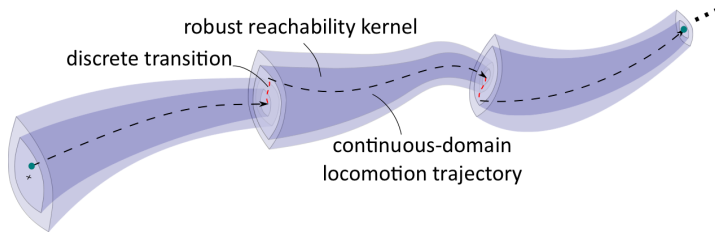


Long-term vision: Collaborative robots for complex tasks in the remote and constrained environment such as the DARPA Subterranean Challenge.

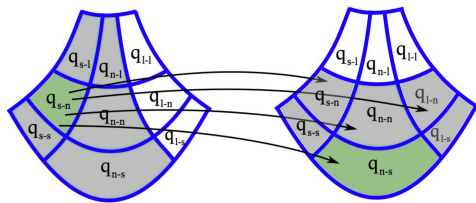


- Agile locomotion and manipulation over complex and unstructured environments
- Control barrier certificate for aerial motion planning with safety guarantees

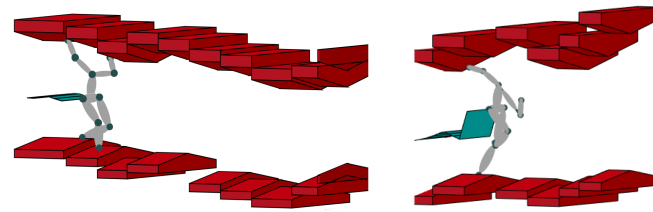
## Thrust 1: Robust motion planning for terrestrial and aerial maneuvering



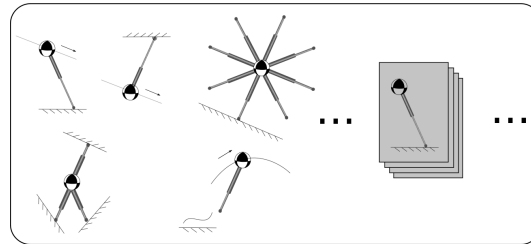
Design robust keyframe state transitions



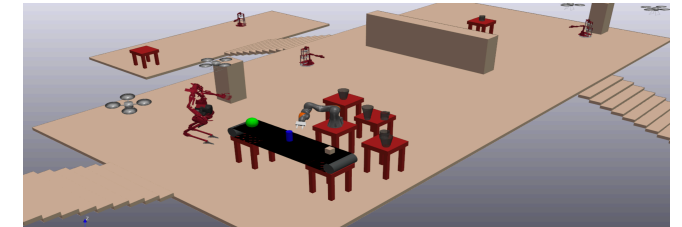
## Thrust 2: Game-theoretic, reactive task planning in dynamic environments



Sequential composition of unified template models



## Thrust 3: Multi-agent decision-making with formal global guarantees



Robot coordination with safety and liveness tasks

