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

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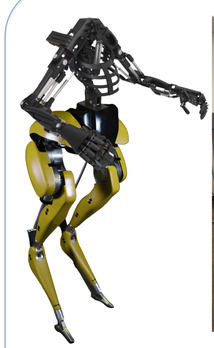
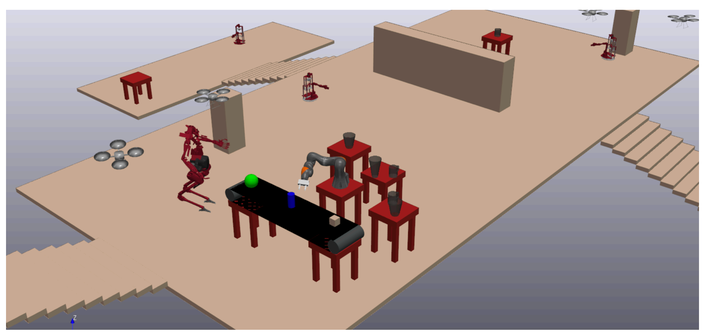
Project objective: Collaborative robots for complex tasks in the remote and constrained environment such as the DARPA Subterranean Challenge.



- Agile locomotion and manipulation over complex and unstructured environments
  - Control barrier certificate for aerial motion planning with safety guarantees
    - Multi-agent robotic system coordination and distributed planning

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

Challenge: Sequentially composing domain-specific aerial and legged locomotion models to achieve diverse, complex walking behaviors is challenging.

Proposed approach: (i) Devise composable phase-space planning for versatile legged locomotion; (ii) Design unified robust metrics and abstraction of diverse motion primitives.

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

Challenge: Formal methods for unified legged and aerial robots is under-explored but has the potential to expand achievable mobility tasks for the unified robot team.

Proposed approach: (i) Propose formal design of diverse, safe, and collaborative mobility task specifications; (ii) Design reactive game synthesis between robot sub-team and its local environment.

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

Challenge: Mission-level planning for complex team specifications should leverage low-level control capabilities and algorithm scalability.

Proposed approach: Devise scalable mission-level decomposition strategies that maintain global task specifications and reasons about mission-level robustness.

"Whole-System Decision and Planning" of heterogeneous and ubiquitous co-robots with robustness and safety guarantees

### Broader impact on society

The proposed framework has the potential to be leveraged to other robotic systems including wheeled robots, manipulator, and other research fields such as cyber-physical systems, smart building, and networked control systems.

### Broader impact on education and outreach

We have initiated a team within the Vertically Integrated Project (VIP) Program at Georgia Tech and recruit undergraduate students from multiple schools. The PIs will actively participate in the annual National Robotics Week at GaTech.

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