

NRI: INT: COLLAB: Interactive and collaborative robot-assisted emergency evacuations

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<https://sites.psu.edu/real/projects/interactive-and-collaborative-robot-assisted-emergency-evacuation/>

During an emergency, evacuees must make quick decisions, so they tend to rely on default decision-making that may put them at risk, such as exiting the way they entered, following a crowd, or sheltering in place. Mobile robots have been increasingly deployed as assistants on city streets and in hotels, shopping centers and hospitals. The future ubiquity of these systems offers an unprecedented opportunity to revolutionize how people are evacuated from dangerous situations. This project develops embodied multi-robot robots to serve as emergency evacuation first responders leading people to safety.

Keys Challenges of Robot-Assisted Emergency Evacuation

- Emergencies change dynamically and coordination of a multi-robot team to optimize evacuation is not trivial.
- The operational environment is unstructured and crowded, making motion planning difficult.
- Multilateral interactions among humans, robots, and the environment.

Technical Approach and New Contributions

- Collecting human subject data regarding evacuation (fig. 1).
- Data will aid with deployment models and develop controllers for large scale evacuations
- Multiscale modeling and closed-loop control

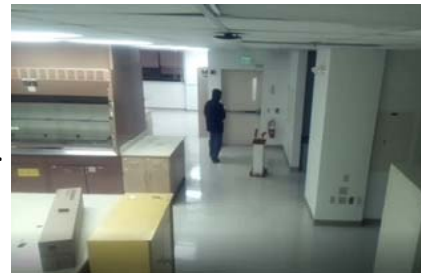


Fig. 1 A human subject is led to an exit by a guidance robot.

- Density planning and control based on mean-field models (fig 2) for large-scale robotic systems such as traffic networks, UAVs.

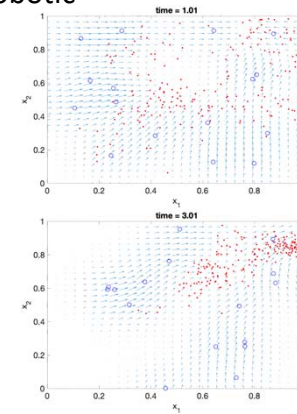


Fig 2. Multi-robots dynamically generating navigation fields to guide the crowd

- Scalable near-optimal motion planning for many robots (fig. 3)

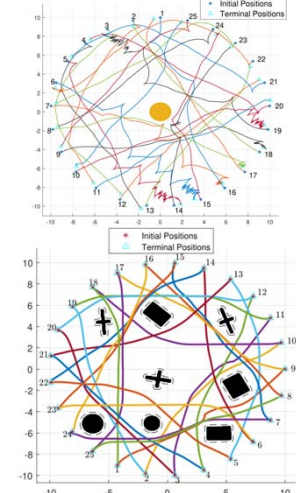


Fig. 3 Multi-robot motion planning.

Impact on Society

- Safe evacuation of people during an emergency.
- Application to schools, concerts, public events.

Impact on Education and Outreach

- Have developed course module related to robots and emergency evacuation
- Will demo evacuation robots to children at Discover Space in State College

Impact Quantification

- Experiments are evaluating how amenable groups of people are to emergency evacuation robots.
- Underlying concepts are generating new ideas related to HRI/Controls.