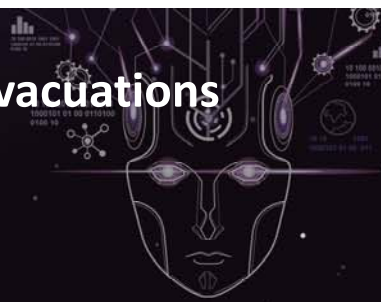


# NRI: INT: COLLAB: Interactive and collaborative robot-assisted emergency evacuations



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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.
- Communicating with and directing evacuees to safety, while also maintaining their attention is difficult.

## Scientific impact and potential generalizations

- A scalable distributed algorithm which integrates decoupled optimal feedback planning and distributed conflict resolution (fig. 2).
- An anytime algorithm which identifies the Pareto optimal solutions of multi-robot motion planning.
- Pattern planning for reference densities, density feedback control based on PDEs to make velocity fields for individual robots (fig.3).

## Technical Approach and New Contributions



- Robots constructed (x3) (fig. 1)
- Physical HRI experiments beginning mid-March
- Simulation experiments on indicate that explanations may cause overtrust.

Fig. 1 Evac. Robots

## Impact on Society

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

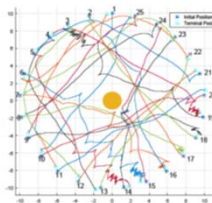
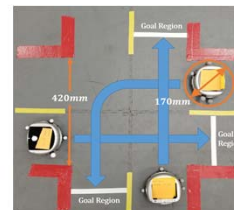


Fig. 2 Multi-robot optimal motion planning in simulation and real-world experiment.



## Impact on Education and Outreach

- Course module development related to robots and emergency evacuation
- Upcoming demo of evacuation robots to children at Discover Space

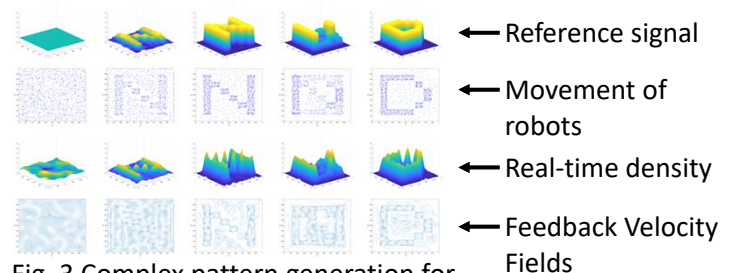


Fig. 3 Complex pattern generation for swarm robotics systems.

## Impact Quantification

- Upcoming experiments will determine how amenable groups of people are to emergency evacuation robots.