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

Technical Approach and New Contributions

- Simulation experiments (fig. 1).
- Simulation experiments focused on decreasing evacuation time.
- Physical HRI experiments on hold

Fig. 1 Identify movable objects

Scientific impact and potential generalizations

- A scalable distributed safe reinforcement learning algorithm for multi-robot motion planning (fig. 2).
- Pattern planning for reference densities, density feedback control based on PDEs to make velocity fields for individual robots (fig.3).

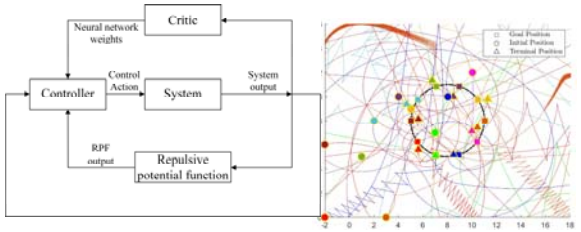

Fig. 2 Distributed safe reinforcement learning for multi-robot motion planning.

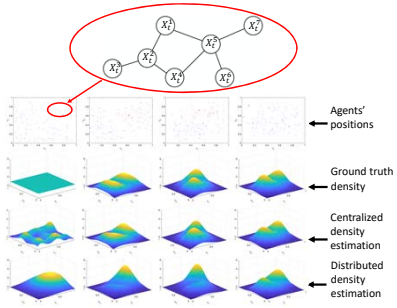

Fig. 3 Each robot to estimates the global density using its own position and information exchange with nearby robots

Impact on Education and Outreach

- Course module development related to robots and emergency evacuation
- Demo of evacuation robots to children at Discover Space on hold

Impact on Society

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

Impact Quantification

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

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