Collaborative SLAM for Facilitating Radiological Search and Mapping with UWB Enabled Multi-Agent Platforms

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Abstract:

Our research aims to advance the state-of-the-art of radiological search, the task of deploying one or more autonomous agents to search a region for dangerous radioactive materials. These robots must carry delicate radiation sensors and be capable of quickly navigating a range of challenging environments with GPS being jammed or unreliable, and non-existent (or outdated) prior maps. To hasten the radiological search process, we parallelize the activity using intelligent multi-agent coordinated search. In other words, our robot swarm must autonomously divide the region into individual search tasks, intelligently assign them to specific agents, and then execute them in real-time – a process that requires concurrently navigating an unknown environment while constructing a shared inter-agent map. This algorithm, a form of distributed simultaneous localization and mapping (SLAM), must be robust to real-world working conditions; our algorithms must be resilient to loss of connectivity between agents, low communication bandwidth (i.e. cannot rely on sharing all data between agents), and potential permanent catastrophic loss of individual agents. To achieve these research goals, our recent work has focused on the use of multiple ultra-wideband (UWB) sensors to perform relative localization between agents, without need for external infrastructure. Our recent results extend our previous 2D work to 3D using only UWB relative ranging data. Additionally, we have run extensive tests with our collaborators at Lawrence Berkeley National Laboratory and are actively working to integrate our localization techniques into a larger distributed SLAM pipeline.

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