Efficient Exploration Strategies for Source Localization using an Intelligent Radiation Awareness Drone (iRAD)

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Introduction and Motivation

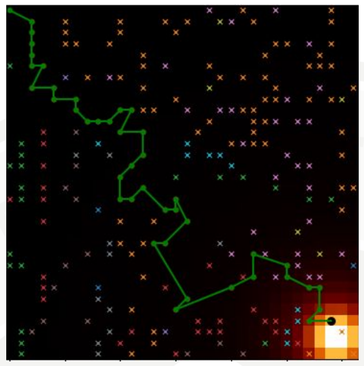
- ❏ Manual location of radiation sources is inefficient and dangerous
- ❏ Unmanned aerial vehicles (UAVS) improve both these areas
- ❏ Algorithms enable optimal exploration of environments and efficient localization of sources
- ❏ Works for any mobile platform, including manual searches, but works best within holonomic platforms
- ❏ Need to account for other objectives such as Search & Rescue, damage surveying, and battery life or radio range

Mission Relevance

- ❏ This project provides efficient means of accurately and quickly exploring environments to detect sources
- ❏ Verification and monitoring of radiological sources is critical for material security and non-proliferation
- ❏ This work seeks to create an optimal means of widespread monitoring to address those concerns

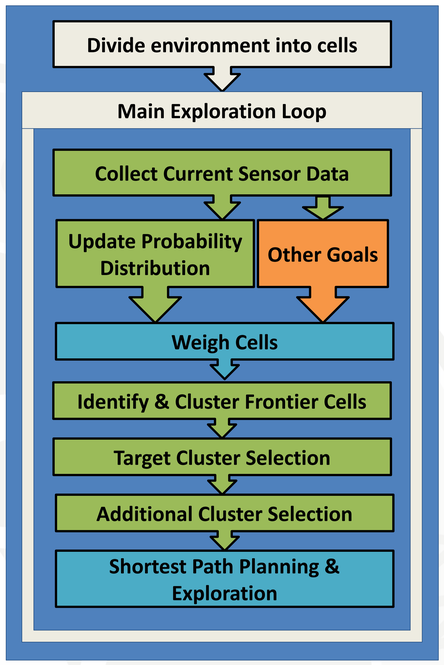
Technical Approach

- ❏ Algorithms like Recursive Bayesian Estimation and Least Squares greedily localize sources, making “beelines”
- ❏ Can result in redundant backtracking
- ❏ Utilize probabilistic frontier-based strategy for more holistic exploration strategy



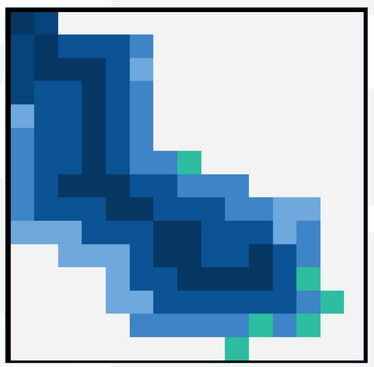
▲ Recursive Bayesian Estimation

▲ iRAD-Lite Prototype Design

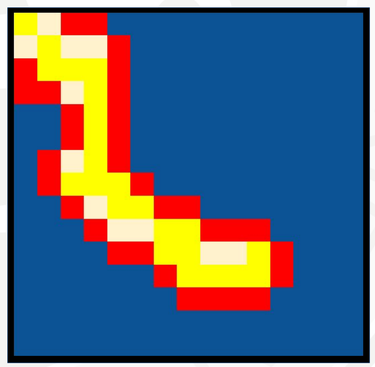


▲ Frontier Exploration State Machine

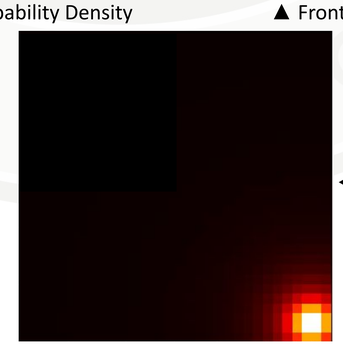
Results



▲ Cell Probability Density



▲ Frontier and Interior Cells



◂ Radiation Intensity Map

Expected Impact

- ❏ If successful, this project offers a more efficient approach to both traditional technniques and greedy approaches
- ❏ Provides a safe and efficient method of detecting radiological sources across a wide area as fast as possible, taking into account other objectives into its pathing
- ❏ Ideal for routine and incident-response surveying with many possible sources and secondary monitoring objectives

MTV Impact

- ❏ Prepared for future presentations and have material to construct a manuscript or paper
- ❏ Early practical introduction to advanced topics in robotics and statistics beyond current level

Conclusion

- ❏ With a single source and only localization in mind, greedy options are simpler and faster
- ❏ Much easier to adapt to multiple sources and higher noise than regression based options

Next Steps

- ❏ Add additional simulated objectives to the weighing function
- ❏ Run trials on simulated test data and compare distance travelled and simulated runtime
- ❏ Physical tests on UAV with non-ionizing sources
- ❏ Examine multi-agent coordination

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