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Genetic Algorithm for In-Theatre Military Logistics Search-and-Delivery Path Planning

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Abstract : Discrete search path planning in time-constrained uncertain environment relying upon imperfect sensors is known to be hard, and current problem-solving techniques proposed so far to compute near real-time efficient path plans are mainly bounded to provide a few move solutions. A new information-theoretic –based open-loop decision model explicitly incorporating false alarm sensor readings, to solve a single agent military logistics search-and-delivery path planning problem with anticipated feedback is presented. The decision model consists in minimizing expected entropy considering anticipated possible observation outcomes over a given time horizon. The model captures uncertainty associated with observation events for all possible scenarios. Entropy represents a measure of uncertainty about the searched target location. Feedback information resulting from possible sensor observations outcomes along the projected path plan is exploited to update anticipated unit target occupancy beliefs. For the first time, a compact belief update formulation is generalized to explicitly include false positive observation events that may occur during plan execution. A novel genetic algorithm is then proposed to efficiently solve search path planning, providing near-optimal solutions for practical realistic problem instances. Given the run-time performance of the algorithm, natural extension to a closed-loop environment to progressively integrate real visit outcomes on a rolling time horizon can be easily envisioned. Computational results show the value of the approach in comparison to alternate heuristics.

Keywords : search path planning, false alarm, search-and-delivery, entropy, genetic algorithm
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