A Path Optimization Strategy for USV-UAV Collaborative Exploration of Maritime Target with Energy Constraints

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Abstract

For this study, we focus on the exploration of maritime areas that contain accident-prone points, such as illegal riding, unauthorized boarding, illegal fishing, and smuggling. This exploration is carried out using a cooperative system consisting of an Unmanned Aerial Vehicle (UAV) and an Unmanned Surface Vehicle (USV). The goal is to allow the USV-UAV system to efficiently explore all of the accident-prone points while minimizing the UAV's energy usage. Specifically, we aim to achieve this objective while keeping travel time as short as possible. The collaborative exploration system leverages the strengths of both the UAV and the USV. The UAV is deployed to explore hazardous areas that are inaccessible by the USV, while the USV doubles as a mobile charging station, resolving the UAV's energy limitation issue. The proposed algorithm for this subject paper, called the Collaborative Accident Searching Routing Optimization (CASRO) algorithm, utilizes the benefits of both the Lazy Theta* algorithm and the Improved Ant Colony algorithm to optimize the path of a cooperative system between USV and UAV. With CASRO, we aim to address the two key limitations of the USV, namely poor flexibility, and the UAV's limited energy simultaneously. Finally, the effectiveness and superiority of the proposed planning strategy in target exploration is verified by numerical simulations of randomly distributed maritime areas with accident-prone points.

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