

**Title:** Exploring the application of ant colony optimization in path planning for Unmanned Surface Vehicles

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**Abstract:** USVs have emerged as effective instruments in a wide range of maritime applications, including environmental monitoring and search-and-rescue missions. The surge in their application is attributed to their operational flexibility and cost efficiency, making them a focal point of research interest in recent years. One of the research angles related to the USV is the path planning algorithm, which is the core technology in USV deployment. Among various path planning algorithms, Ant Colony Optimization (ACO) has garnered considerable attention for its capability to discover near-optimal solutions in complex search spaces inspired by the foraging behavior of ants. Therefore, this paper discusses the application of ACO in the path planning of USVs, including the development of the ACO algorithms and the challenges faced in designing the path planning algorithm. This work also proposes research priorities and future works for USV path planning based on existing research works. Specifically, future research works aim to address the existing challenges and enhance the practical deployment of ACO-based path planning techniques for USVs. In summary, this paper is a valuable resource for researchers and engineers interested in optimizing the navigation of USVs through effective path planning strategies using ACO algorithms.

**Keywords:** Unmanned Surface Vehicles (USVs), Path planning, Ant Colony Optimization (ACO), Maritime applications, Environmental monitoring, Search and rescue, Operational flexibility

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