

Fast-Spanning Ant Colony Optimisation for Mobile Robot Coverage Path Planning

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Abstract— Coverage path planning acts as a key component for applications such as mobile robot vacuum cleaners and hospital disinfecting robots. However, the coverage path planning problem remains a challenge due to its NP-hard nature. Bio-inspired algorithms such as Ant Colony Optimisation (ACO) have been exploited to solve the problem because they can utilise heuristic information to mitigate the path planning complexity. This paper proposes a new variant of ACO - the Fast-Spanning Ant Colony Optimisation (FaSACO), where ants can explore the environment with various velocities. By doing so, ants with higher velocities can find targets or obstacles faster and keep lower velocity ants informed by communicating such information via trail pheromones. This mechanism ensures the optimal path is found while reducing the overall path planning time. Experimental results show that FaSACO is 19.3 – 32.3% more efficient than ACO, and re-covers 6.9 – 12.5% fewer cells than ACO. This makes FaSACO more appealing in real-time and energy-limited applications.

Keywords— *Mobile Robot, Ant Colony Optimisation, ACO, Coverage Path Planning, Fast Spanning ACO*