A comprehensive review on multi robot task assignment and path planning: Operational constraints, challenges, and potentials of deep reinforcement learning

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Abstract

Task allocation and path planning are two highly focused areas in the arena of Multi Robot Systems (MRS) due to their versatile applications. Whether they are treated separately or in conjunction, the operational constraints play a critical role on their performance. This paper presents a comprehensive review on task assignment and path planning of MRS by dedicating a specific focus on operational constraints, and explores the potentials of Deep Reinforcement Learning (DRL) to address them. A detailed insight into formulation and scheme characterization of Multi Robot Task Allocation (MRTA) problems is presented with an extensive review on the solution techniques of task allocation and path planning, among which the learning-based approaches (particularly DRL) were found to be providing notable advantages over traditional ones. The operational constraints are systematically categorized and challenges appearing alongside them are identified. Furthermore, the

paper pinpoints existing research gaps in this regard, and ventures into discovering ways to bridge them using state-of-the-art DRL training algorithms, techniques, frameworks, and concepts, which also expose significant potential and research avenues for MRS. Additionally, the computational resources and accelerators for DRL are discussed to appreciate the real-world deployment of DRL-based MRS. Thus, the paper establishes a benchmark for advancing the swift autonomy of MRS. © 2025 Elsevier B.V.

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Challenges; Constraints; Deep Reinforcement Learning; Multi Robot Systems; Path Planning; Task Assignment

Indexed keywords

Engineering controlled terms

Deep learning; Deep reinforcement learning; Motion planning; Multi-task learning; Multipurpose robots; Robot learning; Robot programming

Engineering uncontrolled terms

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Abstract

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