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Improving Deep Reinforcement Learning Training Convergence using Fuzzy Logic for Autonomous Mobile Robot Navigation

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Abstract

Autonomous robotic navigation has become hotspot research, particularly in complex environments, where inefficient exploration can lead to inefficient navigation. Previous approaches often had a wide range of assumptions and prior knowledge. Adaptations of machine learning (ML) approaches, especially deep learning, play a vital role in the applications of navigation, detection, and prediction about robotic analysis. Further development is needed due to the fast growth of urban megacities. The main problem of training convergence time in deep reinforcement learning (DRL) for mobile robot navigation refers to the amount of time it takes for the agent to learn an optimal policy through trial and error and is caused by the need to collect a large amount of data and computational demands of training deep neural networks. Meanwhile, the assumption of reward in DRL for navigation is problematic as it can be difficult or impossible to define a clear reward function in real-world scenarios, making it challenging to train the agent to navigate effectively. This paper proposes a neuro-symbolic approach that combine the strengths of deep reinforcement learning and fuzzy logic to address the challenges of deep reinforcement learning for mobile robot navigation in terms of training time and the assumption of reward by incorporating symbolic representations to guide the learning process, and inferring the underlying objectives of the task which is expected to reduce the training convergence time. © (2023), (Science and Information Organization). All Rights Reserved.

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