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USING REINFORCEMENT LEARNING FOR SATELLITE FORMATION

Abstract

Satellite formation flying, which involves controlling the relative positions and orientations of multiple satellites flying in close proximity to each other, is a complex and challenging task that has numerous applications in space exploration and commercial ventures. One promising approach to addressing the challenges of satellite formation flying is reinforcement learning, a subfield of machine learning that involves training an agent to make decisions in a dynamic environment by maximizing a reward signal. Reinforcement learning for satellite formation flying advantage is its ability to adapt to changing conditions and unexpected events. For example, if one of the satellites in the formation fails or experiences a malfunction, the agent can reconfigure the formation to compensate for the loss and maintain the desired configuration. Additionally, reinforcement learning can enable the satellites to learn from each other and collaborate to achieve a common goal. To apply reinforcement learning to satellite formation flying, it is typical to simulate the environment and the agent's behaviour in a computer program. The program provides the agent with information about the current state of the formation, such as the positions and orientations of the satellites, and the agent makes decisions about how to adjust the formation to achieve the desired configuration. The program then evaluates the agent's decisions based on a reward signal, which can be designed to encourage behaviours that conserve fuel, maintain stability, or achieve other objectives. One key challenge in applying reinforcement learning to satellite formation flying is the high dimensionality of the problem. We are developing techniques for reducing the dimensionality of the problem, such as using neural networks to represent the agent's decision-making process or using hierarchical reinforcement learning to break the problem down into smaller subproblems. Another challenge in applying reinforcement learning to satellite formation flying is ensuring the safety and reliability of the system. Because satellite formation flying involves multiple spacecraft flying near each other, a malfunction or error in the agent's behaviour could have catastrophic consequences. Despite these challenges, reinforcement learning offers a promising approach to addressing the challenges of satellite formation flying. By enabling the satellites to learn and adapt to changing conditions, reinforcement learning can improve the efficiency and reliability of formation flying systems. This paper shall discuss about the challenges and the Reinforcement Learning algorithm to reduce the errors and a better understanding of satellite formation flying.