Paper ID: 78628
oral

30th IAA SYMPOSIUM ON SMALL SATELLITE MISSIONS (B4)
Constellations and Distributed Systems (7)

Author: Dr. mahya ramezani
University of Luxembourg, Luxembourg , mahya.ramezani@ext.uni.lu

Dr. Mohammad ali Amiri Atashgah
University of Tehran, Iran, Atashgah@ut.ac.ir
Dr. Mohammadamin Alandihallaj
University of Luxembourg, Luxembourg , amin.hallaj@uni.lu
Prof. Andreas Hein
University of Luxembourg, Luxembourg , andreas.hein@uni.lu

REINFORCEMENT LEARNING FOR PLANNING AND TASK COORDINATION IN A SWARM OF CUBESATS: OVERCOMING PROCESSOR LIMITATION CHALLENGES

Abstract

CubeSats have emerged as an innovative and cost-effective solution for space exploration and scientific research. However, a major limitation of CubeSats is their limited computing power and memory. This processor limitation can restrict the complexity of computations that can be performed on-board, limiting their ability to perform complex tasks such as data analysis and image processing. One potential solution to this challenge is to use a swarm of CubeSats and share their processors to perform complex computations. In this paper, we propose a novel approach for planning and task coordination in a swarm of CubeSats using reinforcement learning. Reinforcement learning is a type of machine learning that has been successfully used in a variety of decision-making problems. In our approach, we employ a multi-agent reinforcement learning algorithm to coordinate the actions of multiple CubeSats. The algorithm is designed to learn an optimal policy for each CubeSat based on the state of the system and the actions of other CubeSats. Our approach enables the swarm of CubeSats to share their processors and perform complex computations that would not be possible with a single CubeSat. To evaluate our approach, we conducted a set of experiments in a simulated environment. Furthermore, we investigated the robustness of our algorithm to changes in the environment and showed that it remains effective in the presence of environmental disturbances. Our results suggest that using reinforcement learning for planning and task coordination in a swarm of CubeSats is a promising approach to overcome the processor limitation challenge. This approach has the potential to enable new capabilities for CubeSats and expand their range of scientific and commercial applications.