Paper ID: 80146
oral
student

IAF SPACE SYSTEMS SYMPOSIUM (D1)
Space Systems Architectures (2)

Author: Mr. Federico Mustich
Politecnico di Torino, Italy, federico.mustich@studenti.polito.it

Mr. Leonardo Maria Festa
Politecnico di Torino, Italy, leonardomaria.festa@studenti.polito.it
Dr. Fabrizio Stesina
Politecnico di Torino, Italy, fabrizio.stesina@polito.it
Dr. Raffello Camoriano
Politecnico di Torino, Italy, raffaello.camoriano@polito.it

POINT CLOUD-BASED REINFORCEMENT LEARNING FOR AUTONOMOUS NAVIGATION OF A ROBOTIC ROVER ON PLANETARY SURFACES

Abstract

This work proposes an autonomous navigation software stack to allow robotic rovers in open-field environments to reach given target coordinates in a safe, reliable, and efficient manner.
The primary objective of this project is to train a Reinforcement Learning (RL) agent to acquire the most effective tactics for safely traversing through the surroundings until the desired destination is reached, all while adhering to safety limitations. The emphasis is on successfully training the agent given the available computational resources.
The rover receives target coordinates from the user and point cloud data from dedicated sensors such as stereocameras or LIDARs, providing information about the surrounding environment morphology.
Assuming the robotic rover has a reliable method to locate its position and orientation in the field and track its movements during operations, as well as a robust controller to reach a target point in its immediate proximity within a few meters from its current position, the first step is to develop a simulation environment to train the agent on a virtual rover. Next, a state-of-the-art point cloud processor is selected to train and test an RL agent on the virtual environment. The trained model is then tested on an actual physical rover in a mars-like reconstructed environment.
Although designed for planetary navigation and exploration purposes, we believe that the proposed model could be adapted with minimal modifications to other similar open-field navigation tasks. By combining Reinforcement Learning with point cloud data, our proposed autonomous navigation software stack provides an efficient, reliable, and safe solution for autonomous exploration and navigation in challenging environments.
The entire project is developed within DIANA from Politecnico di Torino, a student team competing in the Rover Challenge Series, which challenges students from all the engineering areas to design and develop a prototype for an astronaut assistance rover platform.