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ENHANCING RESCUE ROVER AUTONOMY THROUGH DEEP Q-LEARNING OPTIMIZATION FOR LUNAR MISSION

Abstract

Integrating advanced AI algorithms in rescue rover systems can vastly improve autonomous navigation and decision-making in disaster response scenarios. This study aims to revolutionize autonomous systems for search and rescue missions by combining cutting-edge rover technology with Deep Q-network (DQN) reinforcement learning. Our primary objective is to enhance the rover's capacity to navigate complex rescue terrains independently, detect and overcome obstacles, and reach designated locations efficiently. We leverage a comprehensive simulation environment built upon Gazebo and Robot Operating System (ROS) to achieve this goal. This environment enables us to develop an intelligent navigation system that uses LiDAR and Real-Sense depth sensor data to perceive the surroundings and make informed decisions. Our study employs rigorous experimentation to modify the hyperparameters of the DQN algorithm, showcasing the rover's enhanced trajectory planning and real-time obstacle avoidance capabilities. By incorporating DQN into the rover's control system, we signify a significant advancement compared to conventional navigation techniques, presenting a fresh perspective on autonomous exploration and prospective rescue missions in challenging topography. The results highlight the efficacy of reinforcement learning in improving the performance of autonomous vehicle systems in uncertain conditions, thereby facilitating future rescue operations. Our approach will allow autonomous systems to navigate Lunar terrain more efficiently and reliably.