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Author: Mr. Divye Singh
ThoughtWorks Technologies India Private Limited, India, divye.singh@thoughtworks.com

Mr. Amit Patel
ThoughtWorks Technologies India Private Limited, India, pamit@thoughtworks.com
Mr. Justin Jose
India, justinj@thoughtworks.com
Mr. Harshal Hayatnagarkar
ThoughtWorks Technologies India Private Limited, India, harshalh@thoughtworks.com

LARGE-SCALE SIMULATION OF HETEROGENEOUS MULTIPLE ROVERS: AN EXPERIENCE REPORT

Abstract

In this experience report, we will discuss computational challenges in large scale simulations of heterogeneous multiple rovers that should work together in exploration missions.

Rovers are now more commonly used in planetary and interplanetary space exploration. All known missions have employed a single rover for the task. These rovers are built for harsh and hostile environments of specific planets, and are controlled by teams on the Earth. The monitoring and control of such missions is complex due to various factors such as complexity of the rover hardware and software, delay in telemetry, environment around the rover, and the nature of experiments to be performed. It is thus imperative that a lot of engineering thought and toil is required for such rovers' research design and development. For these reasons, engineers rely upon multi-disciplinary model-based simulations and development, for designing, analyzing, building, and testing the integration of hardware and control systems together. This integrated approach is the foundational principle of 'cyber-physical systems'.

Now this all about a single rover system, and complexity grows multifold in a multi-rover system. We are interested in designing such a system where not only multiple rovers collaborate to achieve various goals but also each rover can have specific capabilities. Given the complexity of this system, we chose to simulate it using Gazebo, an Open-Source 3D robotic simulation platform and ROS, a system control and inter-process communications framework. We learned that it did not scale up for our needs. However, we found that Gazebo and ROS can be extended for communication and coordination. In our talk, we will share our learning on executing large-scale simulations for a multi-rover exploration mission with Gazebo and ROS.