A DDS Based Real-Time Simulation Architecture for Space Robotic Tele-Operation Tasks

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Abstract

One of the main reasons for the development of space manipulators is to replace astronauts to perform tasks that involving long, repetitive operations and unhealthy, hazardous environment. Due to the particular harsh environment of space and the increasing demands of satellite maintenance, on-orbit refueling and assembly etc., the application of space robot has received significant attention. Some research has been done in the area of satellite capturing task, such as “Robot Technology Experiment (ROTEX)”, “Engineering Test Satellite VII (ETS-VII)” project, and “Orbital Express (OE)” program etc.

This paper presents a new distributed real-time simulation architecture based on Data Distribution Service (DDS) for space robotic tele-operation tasks. The objective is to make the simulation architecture open for collaborative tele-operation research and provide the operator an intuitive view of space robotic tele-operation in a wide set of scenarios. The main scope of this paper is the distributed real-time simulation system (RacconSim) design based on the real world model as part of Real Time Attitude Control and On-Orbit Navigation (RACOON) Lab.
The mission profile and background of space robotic tele-operation are firstly introduced (Figure 1). Within the context, a closer look into Racoon system design (Figure 2), simulation environment and DDS are described. Secondly, RacoonSim system, which includes multi-body dynamics, path & trajectory planning and control subsystems of space manipulator is introduced. Additionally, a user-friendly Virtually Reality (VR) user interface is developed, which is composed of 3D space mouse, joystick and Head-Up Display (HUD) as part of the Mission Control Center (MCC). Well-designed system architecture makes the Hardware-in-loop (HIL) simulation possible and can be extended easily in the future. The space tele-operation experiments show the effectiveness and feasibility of the proposed simulation system.

**References**

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**References**


