Paper ID: 44292
student

25th IAA SYMPOSIUM ON SMALL SATELLITE MISSIONS (B4)
Highly Integrated Distributed Systems (7)

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ONTOLOGY BASED SELF-SYNTHESIS METHOD OF TASK CONFIGURATION FOR SATELLITE CLUSTER

Abstract

Highly autonomous satellite cluster has a good prospect because it is capable of low cost, high performance and high additivity. However, the process of efficiently generating run-time task configuration for multi-mission satellites is a bottleneck of supporting the self-adaptation of a satellite cluster. To this end, this paper presents an architecture and a self-synthesis method based on the ontology for the task configuration. As foundation of the method, the satellite cluster ontology is demonstrated, which includes both the semantical and factual knowledge about the satellite cluster and its working environment. Then the four-step work flow illustrates how the task configuration generating mechanism generates the solution space tree and finds the optimal solution. Key features of the self-synthesis method include deploying an ontological knowledge base as well as providing an inferencing mechanism. The mechanism is based on a Description Logic(DL) Reasoner in Web Ontology Language(OWL) and automates the process to generate the solution space tree. The process of reducing the solution space tree could even be knowledge base assisted. In the last step, the optimal task configuration is calculated from the constrained optimal problem with both functional constraints and non-functional constraints. The case study highlights the capacity of the proposed approach to obtain a task configuration and simplify the reconfiguration in run-time with a three-satellite cluster for exploring asteroid missions. The paper is completed with discussion about the significance of the method on implementing future self-adaptive, distributed and intelligent space system.