Formally Specifying Families of Space Exploration Missions

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ABSTRACT

NASA plans innovative and novel approaches to future (unmanned) space exploration missions. Future missions involve sending spacecraft and robots to harsh environments, where resilience is necessary for the survival of the mission. In addition, distances and communication lead times between the spacecraft and Earth necessitate much of the mission operation being autonomous.

We have been conducting research on the development of autonomous space exploration missions based on principles from Autonomic Computing, whereby the mission is imbued with self-management capabilities. Potential future missions involve the use of swarm technologies to achieve complex goals and survivability in space. One such concept mission, ANTS (Autonomous Nano-Technology Swarm), involves a number of sub-missions that are self-similar. We describe our use of techniques from software product lines, and in particular a multi-agent system (MAS) product line approach. The need for assurance that decisions, etc., taken by the mission are within the remit of the mission and will ensure its survivability is of growing importance and is addressed using formal methods.

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