

Maintenance Issues for Very Long-Lived Robotic Space Systems

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With the robotic exploration of the Solar System well underway, a logical next step is the development of spacecraft capable of exploring the regions beyond the orbit of Pluto (e.g., the Kuiper Belt and the Oort Cloud), or capable of exploring in situ the nearer extra-solar planetary systems. Barring unforeseen advances in propulsion and communications technologies, the mission times for such voyages will be measured in decades or centuries, and the spacecraft will be required to achieve a much higher degree of autonomous operation than has been the case for previous and current planetary missions. These characteristics pose significant maintenance challenges that must be overcome if such systems are to be successfully fielded.

Recent work at the Jet Propulsion Laboratory (JPL) has identified technologies that will be required to develop these types of spacecraft [Chao00]. The list below, taken from [Chao00], summarizes some of the advances that will be required.

- 1) Avionics System
 - a) Polymorphic architecture with generic logic blocks
 - b) Self-repair/self-healing techniques
- 2) On-Board Autonomy
 - a) Goal-oriented software, autonomous planning and execution
 - b) Autonomous fault-handling
 - c) Self-learning/self-discovery

The panel presentation explores the maintenance issues that will be presented by spacecraft implemented with these technologies, as well as the challenges presented by long mission durations and lengthy communication delays.

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References

- [Chao00] S. Chao, J. Blosiu, "Ultra Long Life System Concept (Draft)", JPL Internal Report, November 6, 2000