

Self-Transforming Robotic Planetary Explorers

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While the 1997 Sojourner mission was an outstanding technical feat, future robotic exploration systems will need to be far more capable. They will need to explore challenging planetary terrain, such as on Mars, with very limited human direction. To achieve this capability, major revolutionary breakthroughs in planetary robotic technology will be required. Here a new and potentially very important concept for robotic explorers is proposed. These are self-transforming planetary explorers – systems that are able to autonomously change their physical and software structure to meet the challenges of its environment and task. Such systems could dramatically enhance the ability of planetary explorers to survive and to successfully complete their mission objectives.

In the concept, the robotic systems would be constructed with reconfigurable elements, or modules. Based on sensor information and onboard models and analysis, the system would autonomously transform itself into the “best” configuration to meet the local challenges.

System configurations that could be self-constructed from the original basic system are called cognates. Realizing effective and practical self-transforming systems is difficult for a number of reasons. During this Phase I program, the feasibility of the concept will be studied. While the challenges associated with this study are substantial, so are the potential benefits. If the self-transformation concept can be practically applied, it could significantly impact future planetary exploration missions in the year 2010 and beyond.

