Planetary Rover Developments Supporting Mars Science, Sample Return and Future Human-Robotic Colonization

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Abstract

We overview our recent research on planetary mobility. Products of this effort include the Field Integrated Design & Operations rover (FIDO), Sample Return Rover (SRR), reconfigurable rover unit/s that function as an All Terrain Explorer (ATE), and a multi-Robot Work Crew of closely cooperating rovers (RWC). FIDO rover is an advanced technology prototype; its design and field tests support NASA's development of long range, in situ Mars surface science missions. Complementing this, SRR demonstrates autonomous visual recognition, navigation, rendezvous, and manipulation functions for object pick-up, handling, and precision terminal docking/transfer to a Mars ascent vehicle for future Mars Sample Return. ATE demonstrates on-board reconfiguration of rover geometry and control, for adaptive response to adverse and changing terrain, e.g., traversal of steep, sandy slopes. RWC demonstrates coordinated control of two rovers under closed loop kinematics and force constraints, e.g., transport of large payloads, as would occur in robotic colonies at future Mars outposts. RWC is based in a new extensible architecture for decentralized control of, and collective state estimation by multiple heterogeneous robotic platforms—*CAMPOUT*. We overview the key architectural features. We have conducted experiments with all these rover system concepts over variable natural terrain. For each of the above developments, we summarize our approach, some of our key experimental results to date, and our future directions of planned development.

Keywords – mobile robots, cooperating robots, robotic colonies, robot architecture, reconfigurable robots

Author biography

Dr. Paul S. Schenker is Supervisor of the Mechanical and Robotics Technologies Group, Jet Propulsion Laboratory, California Institute of Technology, Pasadena, wherein he leads R&D in the areas of surface robotic mobility, sampling and advanced actuation. His current research focuses on development of autonomous rover-based science and sample return, including new concepts in multiple rover cooperation and reconfigurable mobile systems for all terrain exploration. Recent examples include NASA's FIDO rover, Sample Return Rover, MarsArm (Mars Polar Lander prototype), and Robot Assisted Microsurgery System (RAMS). His research specializations include machine perception, sensor fusion, advanced robotic control/architectures, and intelligent user interfaces, in which he has authored about 100 peer-reviewed publications. Dr. Schenker is a Fellow and the Immediate Past President of SPIE (1999).