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# INTELLIGENCE FOR SPACE ROBOTICS

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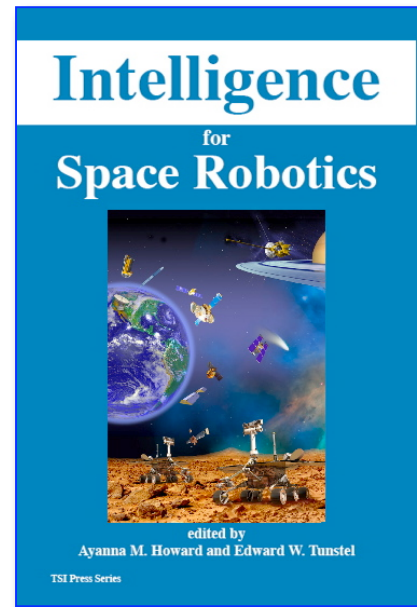
## FOR SPACE CONNOISSEURS AND RESEARCHERS ALIKE

Space exploration missions employ robots, instrumented with a variety of sensors and tools, on remote planetary surfaces, on orbit, or as assistants to astronauts. The utility of space robots is a function of their ability to move about, perform work, and explore intelligently without frequent contact with, or strong reliance on, human operators. This requires capabilities for sensing and perception of surrounding unstructured or uncharted environments. It also requires intelligent reasoning about perceptions to perform tasks in a purposeful and reliable manner in such environments. As such, robotic intelligence or autonomy is closely related to success of space missions involving robots and automated space systems. With the increasing successes of robotic missions by space agencies worldwide, robot autonomy technology has boldly confronted the challenging proving grounds of space and its planetary surfaces, further demonstrating its utility and practicality with each mission. The need for intelligent space robots has increased as well, and will continue to increase with the ever-challenging pursuits of the international space agencies requiring teams of humans and smart robots.

Space missions present unique robotics challenges. Advanced autonomy must function reliably and within strict limitations on data processing and computational hardware resources while also dealing with effects of challenging space environments. *Intelligence for Space Robotics* addresses a broad range of relevant topics, focusing on the use of intelligent sensing and computing techniques for addressing space robotics problems. The authors, who are experts in their respective application domains, present cutting-edge and emerging technologies, space mission scenarios, and results of recent applications of robotic intelligence in space and in laboratories worldwide.

## FEATURES

- Provides an in-depth overview of practical sensor-based and computer-based intelligence techniques for addressing space robotics problems.
- Offers an international perspective with contributions from roboticists at Space Agencies and affiliated Universities located around the world.
- Conveys the state of the art and future directions in a manner equally suited for space robotics experts as well as engineering and science students.
- Presents a cross-section of robotic intelligence applied in practice and under development for future space missions.



## CHAPTERS

### PART 1: CHALLENGES OF SPACE ROBOTICS

- Robotics Challenges for Space and Planetary Robot Systems
- Space Computing Challenges and Future Directions

### PART 2: PLANETARY SURFACE ROBOTICS

- Surface Navigation and Mobility Intelligence on the Mars Exploration Rovers
- Vision-Based Localization and Terrain Modeling for Planetary Rovers
- Design Methodologies for a Colony of Autonomous Space Robot Explorers
- Intelligent Rover with Advanced Mobility for Minor Body Surface Exploration
- Autonomy of Planetary Rovers

### PART 3: ON-ORBIT ROBOTIC OPERATIONS

- Modeling Human Intelligence for Robotic Capture of Space Objects
- Toward Intelligent System Health Monitoring for NASA's Robonaut
- Guidance, Navigation and Control for Space Inspection Robots
- A Framework for Autonomous Space Robotic Operations

### PART 4: ASTRONAUTS AND ROBOT ASSISTANTS

- Applying Intelligence Techniques for Task Allocation in Human-Robot Mission Scenarios
- Intelligence for Human-Assistant Planetary Surface Robots
- Characteristics Common to the Utility of Robotic Astronaut Assistants
- Humanoids for Lunar and Planetary Surface Operations

### PART 5: MODELING, SENSING AND INTELLIGENT CONTROL

- Dynamic Characteristics of Space Robots for Smart Motion Control: From on-orbit manipulators to surface mobile robot
- Terrain Estimation for Enhanced Autonomous Rover Mobility
- Robot Fault Diagnosis Methods
- Intelligent Control for Agile Biomorph Robotics



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