Paper ID: 82504

22nd IAA SYMPOSIUM ON BUILDING BLOCKS FOR FUTURE SPACE EXPLORATION AND DEVELOPMENT (D3)
Interactive Presentations - 22nd IAA SYMPOSIUM ON BUILDING BLOCKS FOR FUTURE SPACE EXPLORATION AND DEVELOPMENT (IP)

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ENABLING SUSTAINABLE SPACE EXPLORATION: THE ROLE OF AI, ROBOTICS, AND EXOSKELETON WEARABLES IN INFRASTRUCTURE DEVELOPMENT

Abstract

The harsh environment, limited resources, and the need for self-sufficiency pose significant challenges to sustainable space exploration and settlement. Emerging technologies, such as artificial intelligence (AI), robotics, and exoskeleton wearables, are crucial for addressing these challenges and enabling the development of new, reusable infrastructures that facilitate affordable access to space, reliable transportation, and effective operations on celestial bodies. This study investigates the synergistic integration of these technologies to achieve sustainable space exploration and habitation.

The methodology focuses on developing AI algorithms for optimizing resource management, environmental controls, and life support systems within space habitats. AI-powered systems can efficiently allocate limited supplies and maintain optimal living conditions. Robotics are explored for their potential in autonomous construction using in-situ resources, reducing the need for Earth-bound materials. Robotic systems can also perform maintenance tasks, ensuring the longevity and reliability of space infrastructure. Exoskeleton wearables are evaluated for their ability to enhance human performance in construction, maintenance, and exploration tasks, mitigating the risk of injury and fatigue in extraterrestrial environments.

The findings demonstrate the transformative impact of integrating AI, robotics, and exoskeleton wearables in establishing sustainable space habitats. These technologies collectively contribute to reducing dependence on Earth-bound supplies, improving safety and quality of life for space inhabitants, and promoting the sustainability of extraterrestrial colonies through efficient resource management and environmental conservation. The study highlights the critical role of these technologies in addressing the logistical and operational challenges of space settlement, particularly in creating infrastructures that support affordable and reliable transportation and sustained operations on the Moon, Mars, and beyond.

The conclusion underscores the significance of this research in laying the foundational infrastructure for future space exploration and habitation. The integration of AI, robotics, and exoskeleton wearables emerges as a comprehensive solution to the challenges of space settlement, offering a pathway toward achieving reusable and efficient space infrastructures. However, further research is needed to address the limitations of current technologies and explore new avenues for innovation. The study's implications extend beyond space exploration, potentially driving technological advancements that could benefit Earth-based applications and foster international collaboration in the pursuit of expanding human knowledge and presence in the universe.

Keywords: Space Settlement, Artificial Intelligence, Robotics, Exoskeleton Wearables, Sustainable Development, Space Habitats, Resource Utilization, Infrastructure Management, Space Exploration, Lunar and Planetary Operations, In-Situ Resource Utilization, Autonomous Construction, Human Performance Enhancement.