

IAF SPACE EXPLORATION SYMPOSIUM (A3)
Space Exploration Overview (1)

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SWARM ROBOTICS: A NEW PARADIGM IN ROBOTIC SPACE EXPLORATION

Abstract

The future of space exploration is increasingly supported by robotic platforms as a tool to study and understand the universe, as well as to prepare the conditions for future missions and human settlements. However, the development of these robotic missions is essentially a risky and difficult activity that often coexists with the uncertainty and adverse conditions of remote operations where there is no possibility of help or rescue. Consequently, to increase the chances of survival and mission success, swarm robotic systems are proposed as a new paradigm for space exploration. Swarm robotics is a field of research in artificial intelligence, responsible for the development of new mechanisms of organization and coordination, decentralized and distributed, of robotic entities with relatively simple structures, which, through their interaction with other entities and their environment, develop intelligent collective behavior to solve complex tasks. Characterized by self-organization, scalability, and resilience, it provides a fault-tolerant system that offers robust and reliable platforms for planning, coordinating, and executing space missions to explore the solar system on a new scale and scope, from the surface of planets to moons, asteroids, and other celestial bodies. Nevertheless, it also poses new challenges for the management of high levels of complexity in communications and networks, control and navigation systems, and data management. In this sense, a conceptual autonomous and heterogeneous robotic swarm platform is proposed, composed of specialized mission modular entities such as explorers, orbiters, collectors, and transporters, among others, to ensure a permanent and sustainable exploration of the solar system.