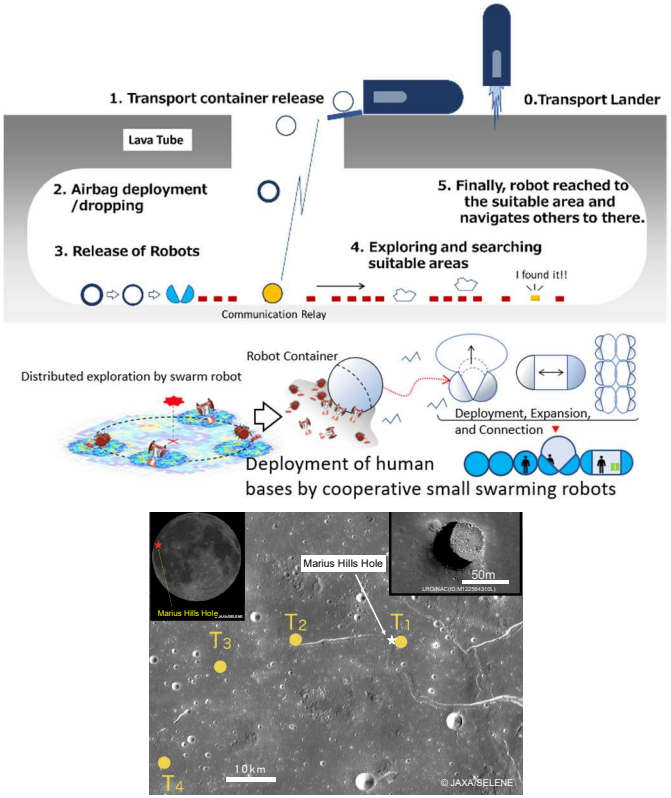
Intelligent Multi Agents for Exploration and Settlement in Unknown and Unexplored Areas

1. Position in the program

This project aims to develop decentralized and self-organizing AI robot technology in challenging environments, toward the realization of long-term human habitation. By utilizing swarm robotics and shared AI, small robots exceed the capabilities of larger ones, presenting an exciting challenge with significant potential. It contributes to Moonshot Goal 3, which aims to develop autonomous AI robots capable of independent decision-making and activity in challenging environments by 2050.

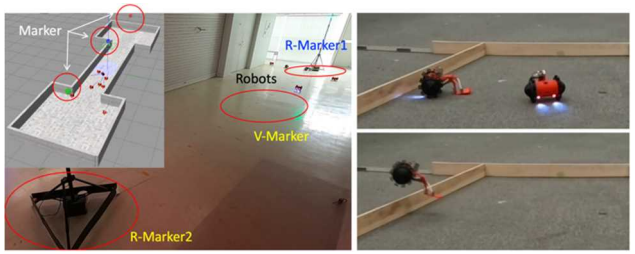


https://fanfun.jaxa.jp/jaxatv/files/20171018_kaguya.pdf

2. Overview of the R&D and the Challenges

Japan's lunar orbiter "Kaguya" has revealed the existence of an underground gap-space extending from a vertical hole on the lunar surface, suggesting the presence of volcanic lava tubes. Due to its subterranean location, it is impossible to observe the interior from the outside, and predicting the internal conditions is challenging due to the distinct lunar environment. However, these lava tubes provide a safe and stable environment for long-term human habitation compared to the lunar surface. This project aims to overcome the limitations of traditional methods by focusing on decentralized and self-organizing AI robot technology. The goal is to develop robots capable of long-term surviving and operating in high-risk and unfamiliar natural environments with unpredictable conditions. Specifically, the project concentrates swarm robotics with AI toward achieving human habitation within lava tubes, aiming to conduct internal exploration, discover suitable habitats, and construct human bases in these demanding environments. The project acknowledges the challenges involved in relying solely on high-precision measurement and control by a few large robots and seeks alternative solutions. At the core of our approach is the self-organizing shared AI known as "Network Intelligence," which emerges from the collective functionalities distributed among individual robots. This enables the small robots to demonstrate a high level of capability, surpassing that of conventional large robots. We view this endeavor as an exciting and meaningful challenge.

In pursuit of our goal, we have identified three research and development themes: 1) Evolutionary Network Intelligence System, 2) Individual and Collective Evolutionary Functions, and 3) Network Intelligence RT Platform. Through these themes, we actively work on utilizing a large number of small and low-functionality robots that collaborate and evolve as a collective. Our focus is on maintaining collective behavior, adapting to the environment, enhancing exploration capabilities, and developing small robots capable of jumping. Our efforts have produced promising results, including the swarm's ability to navigate diverse environments, and overcome obstacles. We remain dedicated to advancing the capabilities of the swarm of robots and achieving our objectives.



3. Future plans

We aim to achieve highly intelligent and evolving robot swarms as a collective through the development of small robots equipped with autonomous, decentralized, and self-organizing intelligence. It involves studying strategies for intelligent group behavior, designing specifications and algorithms for shared intelligence, creating adaptable approaches for modifying robot functionalities, and developing innovative designs for robot containers. These efforts will lead to the realization of advanced and highly intelligent robot swarms that evolve and adapt together.

In addition, developed technologies can be applicable to the earth such as natural disasters and etc.