Overview of ispace-EUROPE's upcoming lunar rover mission: Tenacious. S. C. Casanova[1], [1]ispace Europe - Rue de l'Industrie 5, Paul Wurth InCub, 1811 Luxembourg

Introduction: ispace specialises in developing lunar landers and rovers to facilitate high-frequency, low-cost access to the Moon. Following Mission 1, ispace's HAKUTO-R Mission 2, aims to further validate ispace's technological capabilities and explore the commercial and scientific potential of lunar operations. Central to this mission is the deployment of the micro-rover TENACIOUS by the RESILIENCE lander. The rover, developed by ispace-EUROPE in Luxembourg, is designed to deliver commercial payloads to the lunar surface and conduct a series of surface scouting and regolith characterisation activities. These activities will contribute valuable data to lunar science and help establish the feasibility of commercial resource utilisation on the Moon.

The HAKUTO-R Mission 2 – RESILIENCE : HAKUTO-R Mission 2 is a pivotal step in ispace's roadmap to establish a commercial high frequency lunar transportation service. The RESILIENCE lander, engineered and developed by ispace Inc. in Japan, is tasked with delivering multiple payloads to the lunar surface. The lander will carry a total of six payloads, each serving specific commercial and scientific purposes.

ispace Europe's Micro-rover: TENACIOUS: The TENACIOUS micro-rover, developed by ispace-EUROPE in Luxembourg has a compact design optimised for mobility and precision tasks. Its HD camera system enables high-resolution imaging for navigation, payload deployment documentation, and regolith characterisation studies.

In December 2020, ispace-EUROPE was selected by NASA to acquire regolith from the lunar surface to be purchased by the space agency [1]. Once on the lunar surface, ispace operators plan to use a specially designed shovel to collect a sample of lunar regolith and photograph the collection with the camera mounted on the rover.

Operations will be managed from ispace-EUROPE'S mission control centre in Luxembourg, with planned sequences for traverses and experiments to ensure mission success and safety. The team is currently conducting field tests in analogous environments to refine operational procedures using our operations centre, ensuring readiness for the rover's activities on the lunar surface.

Landing Site and Mission Planning: The landing site for Hakuto-R Mission 2 is situated in Mare Frigoris, an expansive basaltic plain located in the Moon's northern hemisphere [2,3]. The selection process for this site involved a rigorous analysis to optimise operational safety and scientific return. Utilising high-resolution topographic and image data, the ispace landing site selection team performed a comprehensive assessment of candidate locations. Factors such as terrain roughness, slope gradients, and surface hazards were evaluated to minimise landing risks and ensure the viability of rover operations. Mare Frigoris was ultimately selected as the primary landing zone for the RESILIENCE lander due to its favourable terrain characteristics and potential for scientific investigation.

From an operational standpoint, Mare Frigoris offers a safe environment for the deployment and movement of the TENACIOUS rover. The region's relatively flat and stable terrain reduces the risk of mechanical issues during landing and rover operations, such as tipping or entrapment. The low presence of large boulders and steep inclines in this area facilitates extended rover traverses and payload delivery tasks, ensuring that the rover can operate effectively without significant obstacles.

To support this critical decision-making process, ispace-EUROPE developed the Mission Planning Toolkit (MPT). The MPT is an advanced software suite designed to facilitate effective landing site selection, rover operation planning, and traverse mapping. The integration of the MPT into the mission planning workflow has been critical in refining the landing site selection process. By using this toolkit, ispace-EUROPE ensured that the chosen site and its backups align with the scientific and commercial objectives of the mission while mitigating operational risks.

Conclusion: HAKUTO-R Mission 2, with the deployment of the TENACIOUS micro-rover, represents a significant advancement in ispace's lunar exploration capabilities and marks an important milestone for Europe's role in space exploration. The mission's focus on commercial regolith transfer, payload deployment, and scientific investigations will provide critical data on the Moon's surface properties and validate methodologies for in-situ resource utilisation. By operating the rover from Luxembourg, ispace-EUROPE continues to demonstrate its role in the development and execution of complex lunar missions. The insights gained from this mission will contribute to the broader goals of sustainable lunar exploration and resource development, paving the way for future lunar missions and commercial partnerships.

References

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