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EXPLORATION OF THE LUNAR SOUTH POLE THROUGH AUTONOMOUS NAVIGATION AND MAPPING SYSTEMS FOR MAXIMISING SCIENCE RETURN.

Abstract

ispace is a space resource utilization company headquartered in Japan whose vision is to expand and sustain humanity's presence in space by utilizing resources available on the Moon. The company was created in 2010 when it entered the Google Lunar XPRIZE competition. Since then, they have fully developed, flight-qualified, and delivered their SORATO rover to the lander partner, Team Indus, by the end of 2017. ispace was one the five finalists when the prize was terminated in early 2018. At 4 kilograms, the SORATO rover remains the lightest flight-qualified planetary rover whose development was privately funded. With support from the Government of Luxembourg, ispace Europe, the European subsidiary, is developing rover missions to the lunar poles to prospect for water resources. To this end, the SORATO baseline needs to be equipped with enhanced autonomy to make the most out of the short mission lifetime which the company's comparatively small rovers are designed for. Traveling to the lunar south pole presents major challenges to the current relative localisation systems for space exploration rovers, as the difficult lighting conditions of the low standing sun affect the quality of the images used by the rovers to produce localisation through image processing for cameras. The research can be divided into multiple stages. The initial focus is to generate accurate localisation data whilst exploring new low power, low weight sensors, including a combination of cameras and laser range scanners. In addition, ispace will also explore efficient data processing involving FPGA hardware and optimised processing algorithms. Next, on top of such systems, ispace will build autonomous navigations systems, starting with simple low drift GoTo commands, eventually evolving to obstacle detection and optimised path-planning with regards to solar power generation. Additionally, such systems will also produce data which can be used to map the environment, allowing for scientific data to be registered on accurate maps with elevation measurements. To achieve this ambitious goal at a reasonable cost, ispace will be exploring synergies in the field of unmanned aerial vehicles and the automobile industry, where autonomy is already a well-established field of research. This will provide added benefits of using COTS (commercial off-the-shelf) hardware, lowering the cost and thus, opening the gates for cost-effective space-exploration. In summary, ispace is exploring novel sensor technologies and algorithms while also trying to tap into more developed robotic research domains to fulfil the ambitious goals of their lunar exploration roadmap.