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Introduction of SLIM, a small and pinpoint lunar lander

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Small experimental spacecraft ”SLIM” is proposed to demonstrate accurate ”pinpoint” landing technology on a celestial body with gravity. Conventional landing missions, such as Apollo or Chang’e achieved lunar landing with km-order accuracy. Since modern spacecraft provided extensive high-resolution data on the Moon, such as the fruits of SELENE spacecraft, now the place of interest comes to be ”exactly that point”, not ”somewhere on the Moon”. Marius Hill’s Hall (MHH), which is one of the candidates of SLIM landing target, is an interesting vertical hall, for example, and to carry out some exploration on MHH, pinpoint-landing with 100 meter-order accuracy is desired. To enable such 100 meter-order landing accuracy on a celestial body with gravity, several novel technologies has been researched and developed with the effort of SLIM working group members. Practical crater detection and recognition algorithms were proposed for image based guidance system, which can be implemented on an existing space qualified FGPA device. Novel landing radar system was newly developed, and was already evaluated with a bread board model in the field flight test. Detection and avoidance of harmful obstacles around the landing point based on camera image were also researched.

SLIM spacecraft is designed as a small 500 kg-class spacecraft, to pursue lower project cost and shorter development time. To realize lunar lander in this restricted size and weight, unique ideas have been also investigated. Improved ceramic thruster will be applied based on the heritage from AKATSUKI mission, and inherited one is now discussed to be a candidate main thruster for future ESA mission. Propellant tank is designed as a part of spacecraft main structure, to minimize the total weight of SLIM spacecraft. Unique aluminum foam based landing gear is also studied and experimentally demonstrated, and electrical power system is designed with novel ultra-lightweight space solar sheet. Numbers of these engineering researches have been carried out in many universities, and with these efforts, the SLIM is just proposed to the third mission of Epsilon launch vehicle.

SLIM mission is important for its original purpose, to demonstrate the accurate landing technology, and at the same time, key technologies to realize lunar lander in small size and light weight will contribute a lot to the future exploration missions based on Epsilon launcher. In the presentation, the detail of each technology researched and developed by the member of SLIM working group will be introduced, with the result of the system design of SLIM spacecraft. The future perspective on the Epsilon exploration missions based on the SLIM design will be also discussed.

Keywords: Moon and Planetary survey, Lunar landing, Guidance and Navigation for landing, Precise landing, Epsilon Rocket