Evaluation of Landing Stability of Two-step Landing Method for Small Lunar-planetary Lander

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Small experimental spacecraft named as "SLIM" (Smart Lander for Investigating Moon) is proposed by ISAS/JAXA [1]. Because SLIM is planned to be launched by Epsilon rocket, the lander is needed to be designed considering Epsilon rocket's envelope area for satellites. Thereby, landing legs cannot spread widely, and center of mass of the lander is high. This may affect landing stability. This constrain is considered to be a trouble for future small lunar and planetary explorers.
Therefore, we need a novel landing method of high landing stability, which is applicable to small lunar and planetary explorers. So, we proposed a novel lunar and planetary landing gear which enforces intentional body tumbling at the contact of main leg [2]. The proposed landing method's sequence is shown in Fig. 1.
Step 1; The lander fall with body attitude tilted, and primary legs contact with planetary surface.
Step 2a; The lander tumble, and lower assisting leg contacts on surface.
Step 2b; Two upper assisting legs contact on surface.
Eventually, lower assisting leg and two upper assisting legs bear the lander's weight. It was found that this proposed landing method can land on steep slope and is needed to tilt body attitude toward inclination direction of landing sites in the case of free falling[2].
This paper discusses landing stability of the proposed two-step landing method under the residual velocity and attitude error due to the guidance error by numerical simulation because the error may give a serious risk of lander tumbling. Numerical simulation models have been designed on Mechanical Dynamics Software "ADAMS", and lander models refer to "SLIM". Two type lander models including monopod and biped type, as shown in Fig.2, were analyzed.

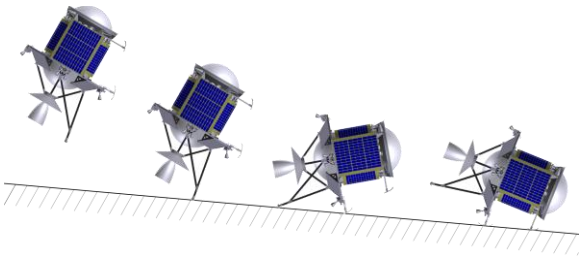

Fig.1. Landing sequence of the novel method

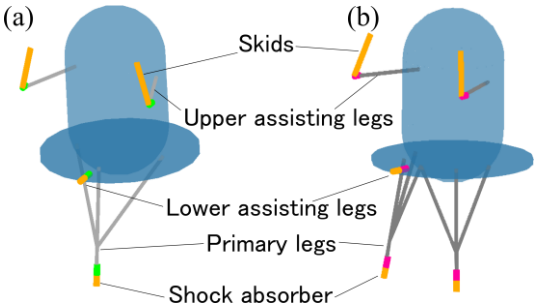

Fig.2. Lander model by ADAMS
((a)monopod type, (b)biped type)

References

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