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RESEARCH AND DEVELOPMENT OF MASS DRIVER FOR MICROSATELLITE

Abstract

This paper proposes an innovative application of microsatellites for space science mission and a way for observation of the upper atmosphere by using an artificial shooting star injected by mass driver installed on a microsatellite. A mass driver installed on microsatellite enables it to inject a probe or a pill in order to execute such missions as picking a fragment from asteroid for sample return or revolutionary observation of the upper atmosphere for aeronomy. Although it is well-known that the upper atmosphere affects global environment and its behavior should be understood for weather forecast, aircraft operation, and lifetime evaluation of satellite and space debris by not only numerical model but also practical observation, its observation with balloons or sounding rockets especially between 50 - 200 km altitude is limited so far. Here, we focus on an application of microsatellite with a mass driver to realize a continuous observation of the upper atmosphere by using artificial shooting star with low cost, where a pill of definite materials injected from the mass driver deorbits to be an artificial shooting star and its emission gives us valued information concerning the upper atmosphere by means of spectroscopic analysis. In this paper, we introduce an observation mission of the upper atmosphere with mass driver on microsatellite, and achievements of research and development of a mass driver for microsatellites. Now we are developing a mass driver to inject a pill with 200 m/s of injection velocity and deorbit it into the atmosphere. we already conducted variety of calculation of flow-field simulation and spectroscopic estimation, which gives close agreement with the case of practical shooting stars, and an experiment of the artificial shooting star with arc heater wind tunnel at Institute of Space and Astronautical Science in Japan Aerospace Exploration Agency (ISAS/JAXA) to validate its emission and obtained a result that the emission would be observed as a shooting star by the naked eye. Also, we first present a development plan of the microsatellite being engaged in the above observation of the upper atmosphere by using artificial shooting star.