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LOVE: A MODULAR ARCHITECTURE OF ALTITUDE-CONTROL BALLOON FOR VENUS EXPLORATION MISSIONS

Abstract

In terms of scientific exploration, Venus is considered as a high priority by the planetary science community. In particular, the specificity of its atmosphere is a domain of high interest but suffers a lack of in-situ missions. Indeed, several missions are currently under development for future exploration using atmospheric probes. For this kind of mission, the use of a sustentation platform presents a relative simplicity and a great value in terms of recoverable scientific data which makes it a particularly well-adapted method. The purpose of this article is to present a probe architecture that can evolve in the habitable layer (between 40 to 60km altitude) of the Venusian atmosphere. This probe is designed as a sub-part of a main mission or multi-cubesats mission that provides interplanetary cruise and atmospheric insertion. The proposed system's architecture is divided into 3 cubesat-format sub-systems : scientific payload, service module, and altitude control module. Payload module will be provided by a scientific institution. The service module will be in charge of communications, power supply, and thermal control. Sustentation platform, using different phase-changed fluids, allows altitude control to meet payload's requirements. Compliance with the cubesat standard allows integration as a co-passenger on a main mission. The project is based on a balloon deployment system without fluid under pressure greater than that authorized by the cubsat standard. To explore different altitudes, the lift control is done with fluids that change phase depending on the altitude. This generates oscillations around a phase change altitude. Several fluids are studied to adapt the median attitude to the scientific need. The amplitude of the oscillation is controlled thanks to the design of the heat exchanger. This presentation focuses on the theoretical study of the sustaining platform of the project. To be operational, it should be completed by a prototyping phase and tests in the terrestrial atmosphere. In parallel, the service module should be developed. Once this development is complete, it would be possible to quickly adapt the design and produce the elements to suit the scientific need.