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FEASIBILITY AND PRELIMINARY DESIGN OF A CHIPSAT PLANETARY ENTRY MISSION TO INVESTIGATE THE ATMOSPHERE OF VENUS

Abstract

Recent miniaturization of electronics in very small, low-cost and low-power congurations suitable for use in spacecraft have inspired innovative small-scale satellite concepts, such as ChipSats, centimeter-scale satellites with a mass of a few grams. These extremely small spacecraft have the potential to usher in a new age of space science access and democratization. Due to their low ballistic coecient, ChipSats can potentially be used for long-term surveys of planetary atmospheres, providing large amounts of data with high reliability and redundancy, if used in a swarm constellation. The idea behind this paper, carried out at the International Space University (Strasbourg, France) in collaboration with I4IS (Initiative for Interstellar Studies), comes from a question raised by the Executive Director of the Breakthrough Starshot, Pete Worden, during the FemtoSat workshop at the 2018 IAC in Bremen. Worden asked the audience whether it would be possible to use ChipSats for atmospheric entry to search microbes in the upper layers of the Venusian atmosphere, where it is speculated that hyper-acidophilic lifeforms (e.g. bacteria) could exist. The paper addresses this question by providing a preliminary feasibility study of a ChipSat planetary atmospheric entry mission with the purpose of searching for traces of microscopic lifeforms in the atmosphere of Venus. A simplied model simulating the atmospheric entry of ChipSats has been implemented numerically. The results are used to create a high-level design of a ChipSat capable of cruising in the Venusian atmosphere at altitudes favorable for the existence of life. The paper then presents a preliminary ChipSat mission concept, including the selection of a potential payload and a system level design of the hardware.