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Moon Exploration – Part 3 (2C)

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LUNAR EXPLORATION THROUGH CHIPSATS

Abstract

Chip satellites (henceforth referred to as ChipSats) are a recent form factor introduced in 2011 as a technology demonstration. ChipSats are becoming more popular with the rapid minimization of technology and improvement in swarm robotics. A new class of science missions will be possible, thanks to ChipSat "sensor clouds."

Large ensembles of ChipSats equipped with a range of different electromagnetic, micro-electro-mechanical (MEMS), and nanofluidic sensors could enable, for example, large-scale in-situ surveys of planetary atmospheres or asteroid surface composition. ChipSat sensor clouds would uniquely allow thousands of data points to be collected simultaneously over large spatial volumes while also providing a high degree of robustness to individual spacecraft failures. An accepted notion is a compromise on reliability, with more dependence on sheer numbers. They usually have only necessary instruments, usually MEMS sensors. The general constraints we face in ChipSats are size, power availability, and a lack of shielding. In this paper, we are working specifically with the form factor and specifications proposed by the Great Lunar Expedition for Everyone (GLEE), an international collaborative effort by the Colorado Space Grant Consortium (COSGC) at the University of Colorado, Boulder.

We have presented a thorough examination of the payloads that can be explored and the limitations put on them due to restrictions of the form factor and existing technologies. Additionally, a brief explanation of possible payloads, namely micro-meteoroid detection, radiation detection, lunar seismology, dust

detection, and gas detection, have been provided. We have highlighted the required technological developments in sensors and the underlying bus itself and quantified the current stage of the development using TRL (Technology Readiness Level). We have also presented a summary of missions with these payloads. Further, we have examined the feasibility of testing the proposed payloads and required improvements to reproduce known lunar conditions within a reasonable range.

Pinpointing the technological requirements for different payloads and their testing, and the present gaps in their realization, would help engineers and researchers all over the world to develop better technologies. The resulting innovations would make lunar exploration using ChipSats a lucrative endeavor. We aim to create an introductory guide to ChipSats for anyone looking to utilize this unexplored frontier of space expedition.