Paper ID: 59908
oral
student

18th IAA SYMPOSIUM ON VISIONS AND STRATEGIES FOR THE FUTURE (D4)
Innovative Concepts and Technologies (1)

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CHIPSATS - NEW OPPORTUNITIES

Abstract

Future, sustainable space exploration and utilization can be realized through ChipSats, satellites with a mass of less than 10 grams. Their design modularity, low development costs and low entry barrier for technology allow for extraordinary potential for new applications. Although there is a need for technology advancement, ChipSats could not only alter the objectives of missions, but also the manner in which they are achieved.

After conducting an extensive literature study with a broad, forward-looking view on ChipSat technology, this paper establishes an interdisciplinary focus on the state of the art and potential opportunities for ChipSat applications, missions and developments. Albeit their low functionality, short orbital lifetimes and the lack of regulations, ChipSats offer progression over current capabilities. By surveying existing ChipSat mission designs and characteristics, and assessing current and future developments in technology, the implications of the small size of ChipSats are identified.

This research is centered around cross-cutting considerations for the International Space University (ISU) to develop and launch ChipSats within three to five years, in the form of a roadmap that sets the tone for the university to become the global leader in space education. As current technology only allows for low-functionality payloads, a Sputnik-like mission with elementary communication functionalities is seen to be a germane precursor mission for ISU's ChipSat mission. The outcome of the roadmap for ISU's own ChipSat launch is incorporating the lessons learned after a critical assessment of current technology and is based on three pillars: (1) space education; (2) introduction of the ISU ChipSat laboratory for assembly, integration, and testing; and (3) guidance in law, policy, and regulation to analyze the legal framework and boundary conditions. While the roadmap for the ISU is targeting educational outreach, two potential missions and applications are also analyzed, where ChipSats can be transcendent constituents to innovative concepts: a lunar and a space weather mission proposal.

While current technology allows the implementation of ChipSats in Earth orbit, technology gaps restrict their payload functionalities, resulting in limited applications, while legal challenges remain to be

solved. Including endorsement in nanotechnology development for component miniaturization, this paper clears the path to enabling innovative opportunities of ChipSats for novel space missions.