29th IAA SYMPOSIUM ON SMALL SATELLITE MISSIONS (B4)
Small Spacecraft for Deep-Space Exploration (8)

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DEEP SPACE SMALLSATS: SUMMARY OF THE CURRENT THINKING, APPROACHES AND LESSONS LEARNED

Abstract

We are on the threshold of a new era of sustainable exploration and development of Earth's Moon and the solar system at large. Programs such as NASA's Artemis, Commercial Lunar Payload Services, Lunar Gateway, and other commercial lunar landers and orbiters continue to be announced. As a result, rideshare opportunities for CubeSats and other small spacecraft or "SmallSats" to reach Cislunar space and other Interplanetary targets will be unprecedented. Already many CubeSat missions to these environments have been manifested, with more and more mission concepts continuing to be proposed. The challenge that is still being addressed by the earliest developers of Interplanetary CubeSats, is how to meet high priority science and technology demonstration requirements while limited by the resources available to missions constrained by the CubeSat paradigm (low cost-cap, relative compactness, higher risk, with rapid development, lean operations, shared tools and essential measurements or demonstrations for highly focused goals). This paper presents the work of the ASU Deep Space Summit, where representatives from early interplanetary CubeSat developers presented and discussed the specific challenges their missions faced, solutions implemented and their degree of their success to date. The participants also addressed what they viewed as the particular challenges of missions of this type and their degree of impact on development, factors that promote or inhibit mission success and recommendations for dealing with these factors. Following team presentations, extensive conversations on the same subjects were held, providing more detailed information on challenges and general consensus on recommendations to future missions. Further information was gathered from participants in the Summit (representing 11 teams) and all other interplanetary CubeSat missions that are currently Post-Phase-D (or equivalent) in development (5 additional teams) using several different methods including interviews and a literature review of current interplanetary CubeSat technology. From this information we make such recommendations in aspects ranging from development and operation approaches, team composition and key role selection, parts selection and qualification, documentation and review, shared tools and facilities. The aim is that future and ongoing interplanetary CubeSat missions can leverage this knowledge to lower risk and costs. The 16 CubeSats covered by this study represent a mixture of pathfinders, technology demos and science missions.