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ATTOSATS: CHIPSATS, OTHER GRAM-SCALE SPACECRAFT, AND BEYOND

Abstract

Miniaturization of electronic and mechanical components have allowed for an unprecedented down-scaling of spacecraft size and mass. Spacecraft with a mass between 1 to 10 grams are called AttoSats. An example for an AttoSat is the ChipSat, a credit-card sized spacecraft. Due to their small size, they introduce a new paradigm in spacecraft design, relying on agile development, rapid iterations, and massive redundancy. However, no systematic survey of the potential advantages and unique mission concepts based on AttoSats exists. This paper presents an integrated approach for assessing the potential of AttoSats for future space missions. First, we present the state of the art of AttoSat projects, their underlying technologies, and current technology trends. Next, we map out unique AttoSat characteristics and map them on future mission capabilities. We then derive a number of potential mission architectures for LEO and deep space missions. Finally, we go beyond AttoSats and explore how smart dust and nano-scale spacecraft could allow for even smaller spacecraft in the milligram and microgram scale.