Representative Low-Profile Gregorian Reflector Antenna Designs with a Compact Deployment Strategy for Emerging CubeSats

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CubeSats are changing the way we perceive satellites today. The advent of miniaturized high performance electronics has allowed us to envisage a fully functional satellite which occupies a volume as small as 10x10x10 cm^3 and weighs as little as 1.33 Kg. Their small size allows them to be launched as secondary payloads significantly reducing launch costs. The CubeSat standard also provides standardized specifications for the development of CubeSats facilitating rapid development times and collaboration amongst researchers world-wide. The cost affordability of CubeSats has allowed low budget organizations and universities to actively participate and contribute towards space programs, which was difficult before.

A major technological gap in the arena of CubeSats is the absence of antennas that can support missions that require high data-rates (e.g. deep space missions) or high resolution (e.g. remote sensing). The development of VLSI technologies has allowed for rapid miniaturization of high performance circuitry, allowing its integration with the small CubeSat form factor. The challenge now shifts towards the development of an advanced high-gain antenna system that can be stowed in a small volume and deployed once in space that can facilitate such advanced missions. In this work, we propose a novel concept that utilizes a Gregorian reflector antenna system. A feed which is conformal to the CubeSat chassis illuminates an ellipsoidal subreflector, which then illuminates a planar primary reflector antenna which is conformal to the chassis. We explore two options for the low-profile primary reflector: one is an offset reflectarray and the other is a novel metal-only stepped parabolic reflector. Both of them are designed to provide uniform phase at the exit aperture to maximize directivity.

The novelty of this design lies in the deployment strategy, where only the small subreflector is reoriented for deployment. This overall design avoids cable movement and maintains a compact volume when stowed, while achieving desirable efficiencies. We will present our compact antenna arrangement for Ka-band operation with an aperture diameter of approximately 20 cm which integrates with a 6U CubeSat chassis. We present simulation results of the full system along with measured performance for various components of this system.