# Development and Characterization of a Ka Band Mesh Reflector Antenna for Emerging High Performance CubeSats

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CubeSats are a miniaturized class of satellites that are launched as secondary payloads, offering the possibility of carrying out advanced space missions at affordable costs. Such research platforms enable both university and industry research ventures to engage in high impact, high risk research. The wireless communications and sensing capabilities of CubeSats are vital components that ultimately determine the functionality available to the end user, and current antenna implementations have been limited to low-gain, low data rate, and near-omnidirectional patterns. Recognizing the potential impact of CubeSats, developing high gain antennas has become an emerging field of interest in the scientific community. This work investigates the possibility of integrating a *1m offset mesh deployable reflector* with a 6U/12U CubeSat for interplanetary communications or for remote sensing at Ka band. The reflector system must be stowed in a 2.5U (10cm×10cm×25cm) volume within the CubeSat, implying that inevitable compromises must be made between mechanical complexity and RF performance.

The first step towards this goal is to select a reflector geometry that will facilitate packaging and deploying of the antenna. While previous works have integrated reflectors with CubeSats, the large aperture size forced us to develop a customized reflector design for our application. Though this is a significant step towards integrating the reflector with the CubeSat, working at mm-Wave frequencies pose a significant challenge to the RF characterization of the system. The difficulties with simulating, fabricating and measuring antennas with intricate features at Ka band prompted us to investigate the possibilities of developing simpler equivalent models for simulation and innovative methods to measure far field patterns of antennas.

This work describes three major aspects of the RF system design: (a) Our design uses a mesh surface for reducing weight and enhance deployability. Simple models to assess the loss due to complex knits are developed with the intention of achieving the tradeoff between mechanical complexity and transmission loss due to mesh surfaces. (b) We simulate, fabricate and measure a spline profiled horn to optimally illuminate the offset reflector. Particle Swarm Optimization is used to ensure that the horn achieves the desired RF performance while maintaining minimum length. (c) The impact of the chassis and the supporting structures on the reflector performance is assessed through full wave simulations. These particular studies not only demonstrate the feasibility of the next high-gain antenna; they mark a major milestone (a 1m antenna size) for CubeSats, which is among the largest to be utilized for Ka band.