VHF/UHF Tightly Coupled Dipole Array for CubeSats

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CubeSats represent a class of miniaturized satellites that can weigh as little as 1.33 kg and occupy a volume of 10x10x10 cm^3 (commonly refered to as 1U). Due to their small size and weight, as well as lower cost and development time, CubeSat missions are rapidly growing. While several Earth science missions with CubeSats at higher frequencies (such as S and Ka bands) are routine, missions for VHF/UHF radar imaging have not yet been pursued due to the requirement of large antenna apertures. Concurrently, VHF/UHF frequencies are attractive for sensing ice thickness, soil moisture, vegetation biomass, and for exploring the nature of asteroids in our solar system. In this paper, we propose methods to equip CubeSats with VHF/UHF ultrawideband deployable antennas. Specifically, we develop VHF/UHF tightly coupled dipole arrays packable within CubeSats for remote sensing applications.

The radar sensors developed in this work will operate at 5 to 60 times lower frequencies as compared to the current state of the art, implying a commensurate antenna miniaturization for CubeSat integration. A key challenge for such a radar is the development of a *low-frequency* & *wideband* apertures that are compact, lightweight and packable within a small form factor.

In this paper we present a CubeSat deployable Tightly Coupled Dipole Array (TCDA) that achieves large bandwidth through mutually coupled dipoles. Using this approach, a 10:1 wideband operation is achieved without use of a ground plane. The absence of ground plane also leads to a significant profile decrease. The presented design has a total length of 1.6 m (λ/3 at 60 MHz), a width of 10 cm and thickness of 1.5 mm. Upon folding, it can fit in a ~0.25 U volume. Packability is achieved by incorporating hinges at carefully chosen positions across the length of the TCDA. Flexible substrates are used to support the foldability of the proposed arrays. The designed TCDA can thus be integrated with a 3U/6U CubeSat, and enable low-frequency operation. Notably, large arrays are possible using a synthetic aperture attained via a constellation of CubeSats. Using this approach, a high spatial and temporal resolution at VHF/UHF frequencies can be achieved. The array design and its folding process will be presented at the conference.