Slot Antennas Integrated on Solar Panels of a CubeSat

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A CubeSat is a space research small satellite with dimensions usually of 10×10×10 centimeters and weighing no more than one kilogram. CubeSats play very important roles in space science by enabling missions that a larger satellite cannot accomplish, such as gathering data from multiple points with very cheap payloads. The current antennas employed on CubeSats are mainly deployed wire-type antennas. These wire antennas have two major drawbacks: (1) the deployed mechanism is not always reliable and adds additional mechanical costs, and (2) the shadows of antennas on surface-mount solar panels create substantial challenge for power management because of the limited number of solar cells due to the limited surface area of the satellite.

Slot antennas, on the other hand provide a cost effective and straightforward solution for Cubestats. Most solar panels of Cubsats are made of printed circuit board material with solar cells laid on top, and narrow gaps exist between solar cells to enable electric connections. The integrated solar panel antennas we present are designed by realizing effective radiating slot elements in those gaps. The slot elements can be easily produced by etching the printed circuit boards. These slot antennas are highly integrative and lie on the same plane with the solar cells without blocking solar energy.

Although Vaccaro et. al. presented stainless steel slot antennas with integrated solar cells (S. Vaccaro, Electronics Letters, 25: 2059-2060, 2000), their design does not need to take into account the finite cavity backing for slots, whereas such backing is inevitable for a Cubesat. We direct our effort to provide an optimal antenna design in the presence of electronics under the surface-mount solar panels. Ansoft's HFSS is used to study the effect of cavity backing, solar panel substrate, and solar cells on the antenna design and optimization. We report an optimal integrated slot antenna topology, feed methods, progress on fabrication process and measurements.