A Study on Effects of Small Breakages on an Antenna

Dave Barker and Reyhan Baktur

Department of Electrical and Computer Engineering,

Utah State University, Logan Utah 84322, USA

Antenna designs suitable for small aircrafts such as small satellites, unmanned aerospace vehicles (UAV), and weather balloons have been gaining steady interest in recent years. Due to the nature of airborne application, design considerations for these antennas have been mainly focused on size and volume reduction, conformal integration, and ease of deployment. Example development includes: lightweight deployable dish antennas, antennas integrated with solar cells, and miniaturized antennas. While physical stability of these antennas may not pose high concern for most deployment or solar cell integrations, there is higher chance for an antenna to expand or break when being used in inflatable antenna applications or integrated on weather balloons. The objective of this paper is to study how small breakages on several different antenna geometries affect an antenna's properties and link budget, and then accordingly propose an antenna design that is potentially more immune to possible cracks.

The basis of antenna design that is less vulnerable to distortions or small cracks is strong coupling phenomena between antennas in close vicinity. When a wire antenna has a very small crack, the antenna shows three resonances: two resonances associated with each piece of wire and one due to the coupling of the two. The resonance due to the coupling can be close to the original antenna frequency before cracking. Therefore, it is important to examine the size and location of small cracks, which accordingly lead to antenna design and decision making as to where to place the antenna on practical applications (e.g. a balloon) such that the crack should only occur in locations with minimal impact on the antenna.

The paper examines antenna designs including wire, patch, meshes, spiral, and fractal geometry and report a comprehensive matrix that displays how size and locations of small breaks affect an antenna's functionality.