Inflatable Antennas and Antennas Printed on Weather Balloons

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Inflatable antennas are gaining significant interest in space applications due to several unique characteristics such as being lightweight, easy to deploy, inexpensive, and of small storage volume. In addition, inflatable antennas do not require mechanical actuators or human assembly. Similar to inflatable antennas are antennas printed on weather balloons. These are equally sought-after for payload reduction and expanding real-time communication capacity. While the two types of antennas share similar design philosophies and challenges, the balloon antenna design needs to consider expansion of balloons at different altitudes. This paper is aimed to survey recent advancement and limiting factors, and then propose new antenna designs and prototyping methods that suit inflatable and balloon antennas.

The first step of this research is to study conductive inks that are feasible to print on material for inflatable antennas and balloons. The next step is finding out to what extent printed traces can stand stretching when a weather balloon expands. The assessment of these studies provides the design background for appropriate antenna geometries suitable for inflatable or balloon applications. While a wideband antenna is a feasible design for printing on balloons, an antenna that utilizes coupling from adjacent smaller radiators is another focus of study. For inflatable antennas, one major effort is to study the effect of surface imperfection on the antenna's performance. For example, what happens to a parabolic antenna when it is deployed but portions of it remain not fully inflated?

This paper reports the latest results of inflatable and balloon antennas in terms of material choice, design parameters and optimization, and prototyping methods.