Wideband Antennas on Electrically Large Conducting Cylinders

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Over the last 60 years, there are many examples of conformal or low-profile antenna use on conducting cylindrical platforms for commercial and military applications. Examples include base stations for mobile communications, ice probing, missile communications and electronic support measures, smart munitions, satellite and other antennas on aircraft platforms, just to mention a few. Typically, these antennas are narrow band, directional and in most cases the broadside single or dual-polarized radiation is required. Wideband antennas are commonly used for transmitter sensing, direction finding and guiding, and electronic attack; however, they are typically installed on the flat or conical (front/back-side) cylinder base. The analysis and design of antennas on cylindrical platforms have been carried out using analytical (Green's function), full-wave computational, or hybrid full-wave/high-frequency techniques when cylinders are electrically large.

In this paper, a wideband millimeter-wave omni-directional antenna on an electrically large conducting cylinder is discussed. Effects of the cylinder size (including its length and diameter) and antenna position on the impedance and radiation properties of a side-mounted antenna are studied using finite element and finite integration methods. It is seen that the developed antenna has a consistent radiation pattern and reduced beam squint over the desired 18-45GHz bandwidth. Coupling between multiple antennas placed along different positions on a cylinder and methods for improving this coupling are also studied. Several approaches for achieving dual-polarized operation are evaluated and obtained results will be discussed. Note that the aerodynamics and possible high-altitude implementation issues are considered throughout the antenna design and antenna/platform interaction studies. Finally, carefully designed and executed experiments are used to validate the obtained conclusions.