Investigation of the Impact of Copper Thickness on the Center Frequency for Electrically Small Antennas

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Building antennas on air substrates often requires careful attention to the structural integrity of the antenna. To make these antennas self-supporting, designers will often use a thicker material to ensure the antenna is stable. Electrically small antennas (ESAs) are often built on air substrates to maximize bandwidth. To ensure proper design and simulation of ESAs, they must be modeled as accurately as possible. However, to analyze and design these antennas using characteristic modes, it must be assumed that all metallic surfaces are perfect electric conductors (PECs). This assumption neglects the impact of the finite conductivity and the thickness of the material on antenna performance. Because characteristic mode theory provides important insight into antenna synthesis, a strong understanding of the consequences of increased copper thickness is important.

This study evaluates the impact of modeling various thicknesses of conductor as PEC for two different ESAs. The relationships between thickness, center frequency, and impedance are investigated for trends to help quantify the impact of finite conductivity and thickness on the antennas. The investigation also identifies how the change in thickness affects other antenna performance elements. The study creates an understanding of when it is appropriate to model an antenna using PEC instead of real conductors with non-zero thickness. It also provides insight into the changes that occur when using thicker conductors so that antennas designed assuming metallic surfaces are PEC will fit design specifications when fabricated. With the study, it will be easier to match simulated antenna design results to fabricated and measured results.