Addressing Mutual Coupling between UWB Planar Monopole Elements with and without Metallic Enclosures
USNC-URSI National Radio Science Meeting

Seth A. McCormick* (1) and Amir I. Zaghloul (1)
(1) US Army Research Laboratory, Adelphi, Maryland, 20783
seth.a.mccormick.ctr@mail.mil

An investigation into the improvement of the isolation between co-linear ultra-wide-band (UWB) antenna elements is presented. The antenna elements are circular UWB monopoles fed using a co-planar waveguide (CPW) and are to be used as individual channels in a forward-looking radar system, which necessitates high isolation between elements. Another factor to consider is the packaging and ruggedness of the antennas. The original design called for individual ground planes for each element with a plastic enclosure encapsulating the antenna and ground plane. The elements are placed a quarter wavelength, at the middle of the desired band, above the ground plane. In another realization of the original design, a common ground plane was used for all co-linear elements. Both designs have disadvantages that could prove problematic. The plastic enclosure could potentially lead to larger mutual coupling than desired, and would provide additional weight. The shared ground plane also tends to increase the coupling between the elements through surface wave propagation on the ground plane. To address these issues, a light-weight aluminum enclosure is used in the current design, which potentially improves the isolation between elements.

Another issue with the original design that uses individual ground planes is that the ground plane is too small at the lower frequencies, causing the radiation pattern to have high back-lobes. The metallic enclosure in the new design alleviates this problem by performing like a cavity, allowing radiation in the forward direction only. The comparison of the three designs is done through Method of Moments (MoM) simulation and measurements. The impact on the isolation from a shared ground plane between three UWB elements, from individual ground planes for each element, and from using an open metallic enclosure for each element is investigated. Also discussed is using metallic enclosures capped with a polycarbonate sheet for each element. The results show that the metallic enclosures help to improve the isolation between elements and reduce the back lobe radiation.