Bandwidth Enhancement of Platform-Mounted HF Antennas Using the Theory of Characteristic Modes

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Many antennas working at the high frequency (HF) band tend to have significantly smaller dimensions than the wavelength at which they operate and thus, suffer from narrow bandwidths. In many military applications, such HF antennas are mounted on relatively large metallic platforms. In this paper, we examine how a platform-mounted antenna can be used to excite the natural resonant modes of the platform itself to increase the bandwidth of platform-mounted HF antennas. In this case, the platform will act as the main radiator and the mounted antennas act primarily as the coupling mechanism between the antenna and external circuit. We use the theory of characteristic modes to identify the appropriate platform modes and determine the efficient means of exciting them. By efficient excitation of the appropriate platform mode, the bandwidth of the antenna system can be significantly enhanced compared to what is achievable by using the mounted antennas in isolation. This approach is employed to successfully enhance the bandwidth of a horizontally-polarized HF loop antenna system by as much as 12 times compared to a stand-alone full loop antenna operating in free space. Six 1:80 scaled models of the proposed antennas with different topologies were fabricated and experimentally characterized. Scaled model measurement results are in good agreement with the theoretically predicted results and demonstrate the feasibility and flexibility of using the proposed approach in designing bandwidth-enhanced platform-mounted HF antennas. The detailed design process as well as the measurement and simulation results of the proposed platform-mounted antennas will be presented and discussed at the symposium.