ANALYSIS OF MUTUAL COUPLING OF ANTENNAS ON A 47-FOOT COAST GUARD VESSEL

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Isolation between the VHF transmitter and receiver antennas is an important issue for achieving satisfactory operation of the communication system on a Coast Guard vessel. For this study, the current antenna configuration, and several different antenna configurations on the 47-foot Coast Guard boat were modeled numerically to determine the isolation between the transmitter and receiver antennas. Some measured data were available of antenna isolation performance that was measured for the current antenna configuration on the vessel. An antenna on a metallic Coast Guard vessel located on the sea does not behave as if it were in free space or over a perfectly conducting ground plane. The gain, impedance, and antenna patterns are a function of the antenna geometry, antenna materials used, antenna height above the ground or sea, ground or sea conductivity, ground or sea dielectric constant, frequency, elevation angle, and azimuth angle. The performance of an antenna near or on the surface of the Earth or sea is also very dependent on the interaction with the Earth or sea, and the metallic vessel structure.

Computational electromagnetics using analytical mathematical expressions are difficult to apply to these types of practical problems, but the use of numerical techiques such as the method-of-moments makes the solution of this problem more tractable. The method-of-moments technique in the Numerical Electromagnetics Code (NEC)was used to model these antennas in this complex environment. The computational mode employed determines electromagnetic fields for antenna structures that are above an imperfect interface such as the ground or the sea, and the algorithms are also valid for antennas close to the interface.

Conventional methods could not be used here due to the close proximity of the antennas with respect to a sea environment and the metallic boat. The results of this analysis will show how the presence of the boat and the sea affect the antenna performance. The NEC model can also determine near fields that are very close to the antenna structure, in addition to antenna far fields, so that it can be used for antenna coupling calculations to determine antenna-to-antenna isolation.

The 47-foot vessel was modeled using wire segments, since there was more flexibility and freedom in using wire only segments, rather than a combination of patches and wire segments. Engineering drawings of the 47-foot Coast Guard vessel were used to generate the model. The model contains just under 10,000 wire segments, which includes the hull, cabin, and vessel superstructure. The 47-foot vessel model also includes details of the antennas mounted on the buoyancy chamber and antennas on the mast above the buoyancy chamber in addition to the HF whip antenna mounted on the port side of the vessel. The model was used successfully to determine antenna isolation and antenna performance characteristics. The mutual coupling prediction resulted in good agreement with the measured isolation.

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