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Vector-sensing antenna for measuring the direction of arrival of ionospherically propagated HF radio signals

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1 Extended Abstract

The ability to determine the direction of incident radio waves is useful in a wide variety of different applications. Measuring the direction of arrival for high frequency (HF) radio waves which have been propagated via skywave (i.e. via refraction by the ionosphere) is of particular interest for ionospheric sounding and thunderstorm monitoring, and is also useful for over-the-horizon radar and HF communications. The direction of arrival is commonly measured using wide aperture arrays of antennas. However, due to the long wavelengths of HF waves, arrays for measuring such waves must be physically large.

A vector-sensing antenna system, using orthogonal triads of antennas to measure the electric and magnetic field components of the incoming waves, offers the possibility of making these measurements without requiring a large area or a large number of elements. There have been several vector-sensing antenna systems designed and built, with varying degrees of success [1, 2, 3, 4]. The algorithms used to process the data from these systems generally presume that the dipoles and/or loops have ideal gain and phase responses and are sensitive to the differences from these responses exhibited by real antennas [5].

In this talk we will explore how these differences, as well as the effect of the ground plane, cause difficulties for practical vector-sensing antenna systems. We will then look at the performance of various vector-sensing antenna configurations when used to receive ionospherically propagated HF radio signals, and explain why two particular configurations – orthogonal loops and ground-symmetric loops – may not perform well under practical conditions. Finally we will explore a configuration with two loops and a monopole which avoids these problems, making it a practical configuration for a vector-sensing antenna system for receiving HF radio signals.

References

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