Experiments to measure the direction of arrival using a vector antenna

Badria Elnour, Danilo Erricolo
Department of Electrical and Computer Engineering
University of Illinois at Chicago
851 South Morgan Street
Chicago, IL, USA
belnou2@uic.edu, erricolo@ece.uic.edu

Most methods to measure the direction of arrival of a plane wave consider the use of an array antenna, where each element of the array measures a scalar component of the electromagnetic field. An alternative to the use of array antennas, is to employ a vector antenna. Vector antennas measures all six components of the electromagnetic field, hence all available degrees of freedom are exploited. Theoretical results by Nehorai and Paldi (A. Nehorai and E. Paldi, "Vector-sensor array processing for electromagnetic source localization", IEEE Trans. Signal Process., Vol. 42(2), Feb. 1994, pp.376-398) show that, by making use of all available electromagnetic information, a vector antenna should outperform the scalar array antenna, in the accuracy of the direction of arrival estimation.

Different solutions have been proposed to design a vector antenna. What appears to be the most obvious solution is a set of three collocated orthogonal dipoles, together with three collocated orthogonal loops.

Another possible approach is to design a planar antenna. Recently, for example, Rajagopalan and Lazzi (A. Rajagopalan and G. Lazzi, "A novel prototype for UWB MIMO vector antenna", USNC-URSI National Radio Science Meeting, University of Colorado at Boulder, Boulder, Co, 4-7 Jan. 2006, p.99) developed a planar UWB antenna consisting of a loop and two bowties, which operates in the frequency range 4 -8.5 GHz.

In this work, we propose to develop experiments to assess the improvements in accuracy of direction of arrival estimation using Rajopalan and Lazzi's antenna, versus the use of scalar array antennas. Experiments will consist in anechoic room measurements of the field received from a source located at a known position.