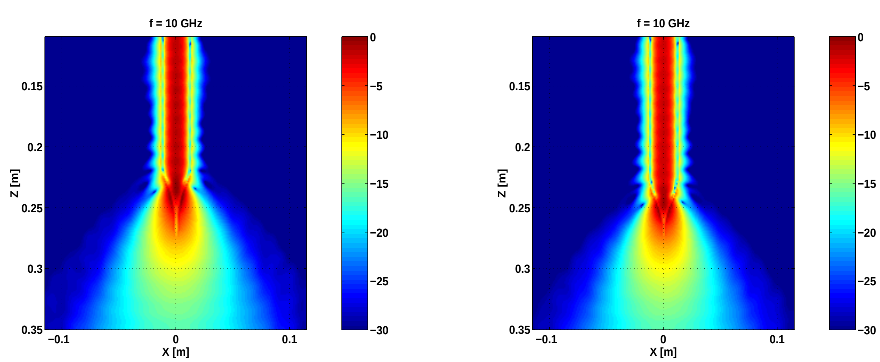
Numerical Study of Broadband Dielectric Rod Probe (DRP) for Near-Field Measurements

Kwan-Ho Lee*, Chi-Chih Chen, Fernando L. Teixeira and Robert Lee

ElectroScience Laboratory
Electrical Engineering,The Ohio State University
1320 Kinnear Rd., Columbus, Ohio 43212
Phone: 614-292-1433, FAX: 614-292-7596
e-mail: khl@esl.eng.ohio-state.edu

In order to be used as a probe for near-field measurements, an antenna must meet basic requirements such as: minimal probe to antenna-under-test (AUT) interaction, isotropic pattern, and adequate polarization properties. Open-end waveguides (OEWG) have been widely used for near-field measurements. However, major disadvantages of OEWG probes include the relatively narrow bandwidth due to the cut-off frequency and large probe-AUT interaction due to the conducting structure of the OEWG. A dielectric rod antenna (DRA), originally developed for landmine detection with reduced antenna/ground interaction and broadband characteristics, has been found to be very suitable for near-field measurements.

The dielectric rod probe (DRP) prototype also exhibits reduced probe-AUT interaction, similar E- and H- plane patterns, and dual polarization capability. The basic DRP probe configuration uses a linear taper with various angles to reduce the RCS level (in general, smaller angles produce lower RCS). In this study, we perform a numerical investigation, using the finite-difference time-domain (FDTD) method, of several different tapers to *simultaneously* reduce the RCS and broaden the beamwidth of such probes. Near field patterns in X-band from various taper models will be presented. Also, electromagnetic wave diffraction and reflection mechanisms caused by the different taper profiles will be discussed.



(a) Concave-quadratic profile

(b) Concave-cosine profile

Figure 1: Normalized Electric field distribution at f = 10 GHz for different taper profiles.