ECEn 665
Antennas and Propagation for Wireless Communication

Homework #13
Due Mar. 1, 2023

Array Modeling Project:

1. Create a model for the mutual impedance matrix of an array of parallel dipole antenna elements. Choose from the following options for the model:

   Lossless, resonant, minimum scattering approximation (LRMSA): Approximate the open circuit loaded embedded element patterns for the dipole elements with the isolated element pattern. This is related to the theory of minimum scattering antennas (MSAs). Use numerical integration to find the pattern overlap matrix elements. Approximating the elements as lossless and resonant, find the mutual impedance matrix.

   Induced EMF approximation: Implement in a MATLAB function the approximate formulas in Balanis, *Antenna Theory,* on p. 465 for the self impedance of a dipole and on p. 472 for the mutual impedance of a pair of side-by-side dipoles. Be sure to divide by $\sin(kl/2)^2$ to refer impedances to the dipole feed gap. (Note: the formulas in Balanis for mutual impedances are only valid for lengths equal to an odd multiple of a half wavelength.) Check by comparison to the figures on p. 466 and p. 475. Use this to model the mutual impedance matrix of an array of half-wave dipoles with identical orientations and arbitrary spacing.

   Method of moments: Adapt a method of moments code for either Hallén's or Pocklington's integral equations to find the mutual impedance matrix and open circuit loaded embedded element patterns for the dipole array.

   Commercial software package: If you have access to software like HFSS, EMPIRE, student version of FEKO, NEC, or any other similar package, use the commercial package to find the mutual impedance matrix and open circuit loaded embedded element patterns for the dipole array.

   Give the mutual impedance matrix from your model for a two element half wave dipole array with half wavelength element spacing and parallel orientations.

2. Problem 4.8 [Directivity of a ULA of isotropic radiators]

3. Problem 4.9 [array of parallel half-wave dipoles, using the dipole model of your choice]