ECE Department Seminar

Ray, Beam and Hybrid Techniques for Analysis of Electrically Large Antenna Configurations

Prabhakar H. Pathak

The Ohio State University ElectroScience Laboratory

Thursday, January 21, 2:00pm, SEO 1000

At sufficiently high frequencies, for which radiating objects become quite large (or even moderately large) in terms of the wavelength, conventional numerical methods employed for the solution of practical antenna radiation problems become strained or even intractable. It then becomes natural and far more efficient to employ asymptotic high frequency ray and beam methods, and also hybrid methods which combine high frequency and numerical techniques, respectively, to analyze electrically large antenna problems. A uniform version of the geometrical theory of diffraction (GTD), which is referred to as the UTD, is one such ray method which can be used effectively. A significant advantage of the UTD is that it offers a physical insight into the antenna radiation mechanisms involved in terms of diffracted rays together with conventional geometrical optics (GO) rays. Such a direct and vivid picture based on a ray description of the radiation of electromagnetic (EM) waves is typically not shared by any other methods of solution. The power of UTD will be illustrated through applications to antennas in complex environments. In some special situations involving a confluence of ray caustics (or foci) with ray shadow boundaries the UTD alone may become inapplicable. In the latter instance, the high frequency physical optics (PO) method is often employed; however, PO generally needs an integration of the assumed currents on the large radiating object thus making it rapidly inefficient with increase in the operating frequency. A useful and more accurate alternative is the use of beam methods, e.g., the one based on the complex source beam (CSB) approach. An extension of the UTD for CSB illumination is developed and will be described for specific applications. In many practical applications, a radiating object can contain both electrically large and small parts; in such cases it becomes necessary to hybridize high frequency and numerical methods in order to combine the best features of both methods and hence also to overcome the limitations of both. In particular, examples involving the application of UTD, CSB, and hybrid methods, respectively, will be presented highlighting the power of each. Examples will include the treatment of large satellite antenna reflector systems, and other antennas including large complex and conformal phased arrays on complex airborne, space borne or ship platforms, and of antennas in urban/rural environments. In addition, an analysis of near field antenna measurements for far zone pattern predictions will also be considered.

Host: Danilo Erricolo, erricolo@ece.uic.edu, (312) 996 5771