A Short Course On

High Frequency Uniform Geometrical Theory of Diffraction Ray Technique

Dates: August 17-19, 2015 (3 days)
Time: 9:00 AM-12:00 PM, 2:00 PM to 5:00 PM
Venue: MRC Conference Room, ElectroScience Laboratory

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Course Abstract:

The Uniform Geometrical Theory of Diffraction (UTD) is an analytical asymptotic high frequency method for computing the electromagnetic (EM) fields radiated by antennas in the presence of either their electrically large platform, or other large objects. According to the UTD, the EM fields in this situation propagate sequentially from a source/antenna to an observer, in the presence of their platform, or other structures, via the classical incident and reflected Geometrical Optical (GO) ray paths, and via a new class of diffracted ray paths, respectively. The latter diffracted rays arise from geometrical and/or electrical discontinuities on the platforms or obstacles in the presence of which a source radiates. These new set of diffracted rays were introduced in the 1950s by J.B. Keller in his Geometrical Theory of Diffraction (GTD), which for the first time described the phenomenon of diffraction in terms of rays. Keller did this through his systematic generalization of Fermat's principle for GO along with a couple of other postulates. It is important to note that classical GO rays cannot predict diffraction, because GO rays produced by the source, in the presence of a structure, exist only in the so called lit regions and vanish in the shadow regions behind any opaque structure which obstructs the source. This serious failure of classical GO to predict diffraction was thus overcome by the GTD. On the other hand, in its original form, the GTD fails near and at ray shadow boundaries where it predicts singular diffracted fields. The UTD patches up the GTD in these so-called ray-shadow boundary transition regions; hence it is the UTD that must be used in practical applications. A particularly useful feature of the UTD/GTD is that it provides a clear physical picture for wave radiation and scattering in terms of rays; this property is most useful in antenna placement studies and for controlling the scattering and diffraction effects. The UTD ray technique is based on the principle of localization which will be discussed. The initial amplitudes of the reflected and diffracted ray fields are given in terms of local reflection and diffraction coefficients, respectively. The principle of localization allows one to find the relevant reflection and diffraction coefficients from the asymptotic HF solution to appropriate but simpler canonical problems which model the local geometrical and electrical properties at points of reflection and diffraction as in the original problem. This aspect will also be addressed. Applications of UTD to practical problems such as radiation by antennas on aircraft, spacecraft, satellites and ships, etc.,
will be illustrated. Some new developments and future directions within the UTD area will also be discussed.

**Instructor’s Bio:**

Prabhakar H. Pathak (M’76–SM’81–F’86) received his Ph.D. (1973) from the Ohio State University (OSU). Currently he is Professor (Emeritus) at OSU. He is regarded as a co-developer of the uniform geometrical theory of diffraction (UTD). His interests continue to be in the development of new UTD solutions, as well as fast Beam and Hybrid methods, for solving large antenna/scattering problems of engineering interest. Prof. Pathak has been actively presenting short courses and invited talks at conferences and workshops both in the US and abroad. He has authored/coauthored over a hundred journal and conference papers, as well as contributed chapters to seven books. Prior to 1993, he served two consecutive terms as an Associate Editor of IEEE Trans. AP-S. He was appointed as an IEEE (AP-S) Distinguished Lecturer (DL) from 1991-1993. Prof. Pathak was also appointed as the chair of the IEEE AP-S DL program during 1991 – 1993. He served the IEEE AP-S AdCom in 2010. He received the 1996 Schelkunoff best paper award from IEEE-AP-S; the ISAP 2009 best paper award; the George Sinclair award (1996) from OSU ElectroScience Laboratory; and, IEEE Third Millennium Medal from AP-S in 2000. Prof. Pathak received the Distinguished Achievement Award from IEEE AP-S in 2013. He is an IEEE Life Fellow, and a member of URSI-commission B.