Half-Day Short course

"A Hybrid Domain Decomposition Based Numerical and Ray Technique for Analysis/Synthesis of Large Conformal Phased Arrays on Complex Platforms"

Instructors:

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This course will present a brief overview of hybrid domain decomposition (DD) based numerical and ray methods for solving electrically large and multi-scale electromagnetic (EM) wave problems. The focus will be on the analysis/synthesis of large complex phased arrays placed conformally on a larger complex platform. Specifically, non-conformal DD methods will be reviewed and revolutionary breakthroughs will be discussed that make it possible to accurately solve large EM problems, with even billions of finite element and boundary unknowns. Hybrid combination of finite element (FE) method with the boundary integral (BI) method can be performed without introducing any artificial gaps between regions pertaining to the two methods. The application of DD-FE-BI for treating large complex arrays on complex platforms will be described. In case of synthesis of conformal arrays on large complex platforms, it is also possible, in most applications, to further improve the efficiency of this hybrid approach by first obtaining an initial field distribution in the smoothly convex array aperture (that is flush to the otherwise metallic platform) via the uniform geometrical theory of diffraction (UTD) ray approach, to achieve a given direction of scan. Thus, UTD concepts will also be briefly reviewed. An iterative optimization procedure may be implemented in which the UTD is utilized for repeatedly calculating, in a relatively efficient manner, the array aperture radiation pattern at each iteration, and in the presence of the platform, till the desired goal (for beam direction, polarization, sidelobe levels, etc.) is reached. The required feed excitation at the antenna elements of the array, for producing the UTD based array aperture distribution, can then be calculated via the DD based FE-BI numerical method which can be made to either take into account the entire array and the platform simultaneously, or to alternatively treat only the local array platform geometry via the DD-FE-BI for increased efficiency and then use the resulting aperture distribution within the UTD approach to find the final array radiation pattern. If necessary, an additional small set of iterations can always be performed at the end to further enhance the array performance via the DD-FE-BI-UTD hybridization.

Copies of presentation slides will be provided.