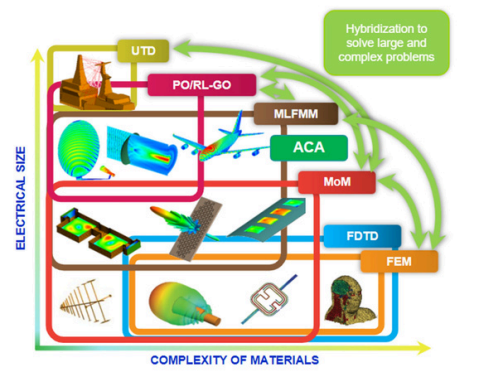
SC01- Advanced Antenna Modeling and Simulation Techniques



Abstract

Nowadays antennas have become an integral and important part of almost any wireless communication system. In the field of antenna engineering, theoretical analysis is of paramount importance in understanding the basics of the antenna radiation characteristics. While the basic concept of antennas is well known, closed form, exact analytical solutions to many antenna problems are not practical and impossible in many cases. Advances in electromagnetic (EM) simulations have significantly impacted the antenna design process by providing exact solutions by solving Maxwell's equations using numerical methods. It is a common practice now in academia and industry to use various commercially available EM simulation tools for antenna design process. In this tutorial, we will introduce basics of antenna modeling and simulation process with pros and cons of various numerical methods, such as Method of Moments (MoM), Multilevel Fast Multipole Method (MLFMM), Finite Element Method (FEM), Finite Difference Time Domain (FDTD), Physical Optics (PO), Ray Lunching Geometrical Optics (RL-GO), and Uniform Theory of Diffraction (UTD). We will then discuss modeling and simulation of various antenna types, starting from simple configurations such as dipoles and loops and eventually leading to more complicated and practical designs such as microstrip patches and high-gain reflector antennas.

Recommended prerequisites

This tutorial is intended for users of Electromagnetic Simulations tools (commercial or otherwise) to understand the basics of various simulation methods so they can use appropriate methods for efficient simulation of different classes of antennas. Experience with simulation tools will help to appreciate the tutorial, but not required to attend the tutorial.

Learning objectives

After the tutorial, participants will be able to understand differences between various computational methods used for antenna simulations. This knowledge will help them to choose suitable methods for different classes of antennas for efficient simulations with reduced computer resources.

Course outline

- Introduction to Antenna Analysis
- Computational Electromagnetics (CEM)
- CEM Solver Technologies for Antenna Modeling
  - Full wave Solutions (MoM, MLFMM, FEM, FDTD)
  - Asymptotic Solutions (PO, RL-GO, UTD)
  - Hybrid Solutions
- Antenna Arrays
  - Infinite Arrays
  - Finite Arrays
- Advanced Topics
  - Characteristic Mode Analysis – CMA
  - Machine Learning for Antenna Design and Optimization
- Discussions

Note: Participants do not need to bring a laptop.

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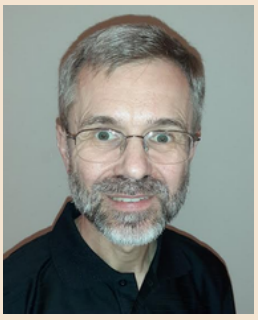
Dr. Martin Vogel is Senior Technical Specialist - Electromagnetics at Altair Engineering, Inc. Dr. Vogel has worked at TNO Defense and Security in the Netherlands, with a one-year assignment at the Air Force Research Laboratory at Kirtland Air Force Base, New Mexico, U.S.A. He worked for many years at ANSYS in several technical roles related to high-frequency electromagnetics, signal integrity and multiphysics, and at Altair in several technical roles related to high-frequency electromagnetics, RF propagation, wireless communication and multiphysics. In 2023/2024, between Altair employments, he worked for 18 months at Georgia Tech Research Institute as a Principal Research Engineer.



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