

Miniaturization and Material Design Methods for Antennas

C.C. Chen and J.L. Volakis
The Ohio State University
Columbus, OH 43212

This short course will cover several topics relating to small antennas for narrowband and ultrawideband applications. Particular emphasis will be on the use and integration of materials (ceramics, polymers, textures and mixtures of these), inductive and capacitive loading using lumped or distributed RF circuits for achieving specific gain, bandwidth and size objectives. Design approaches and guidelines will be described in pursuing small antenna design using material and circuit combinations. Both, narrowband and ultrawideband elements will be considered. Among them will be miniature spirals (from VHF and higher), GPS, SATCOM and printed antenna designs on textured dielectrics. In addition, analysis methods, optimizations and small antenna performance limits will be described.

DRAFT OUTLINE

- **Introduction to Antennas**
 - Review of Antenna Parameters
 - Efficiency, Directivity, Gain, Impedance, Polarization
- **Small Antenna Theory**
 - Q limit
 - Performance limitations: gain, bandwidth, pattern, impedance
- **Antenna Miniaturization Techniques**
 - Material loading
 - Artificial transmission line concept (loading using LC circuits).
- **Material Design and Optimization**
 - Optimization approaches
 - Interfacing optimization and antenna analysis tools
 - Data mining approaches for optimal multi-objective designs
- **Small Antenna Design Examples**
 - Narrowband miniature antennas: dipoles, patches, GPS, SATCOM, etc.
 - Broadband miniature antenna: bowties, spirals, helices, etc.