Workshop Details

This workshop has been design for general audience and does not assume any prerequisite knowledge other than basic mathematics and basic Maxwell's Equations.

Topics covered in this workshop are

a) Introduction to Antenna
b) Antenna Radiation and Electrical Characteristics
c) Introduction to Zigbee Communication Systems
d) Introduction to Patch Antenna
e) Patch Antenna Modeling and Design
f) Lab. Exercise to design an antenna for Zigbee

Structure of the Workshop

This workshop has been organized into six chapters with gradual build up of knowledge base in the area of- basic microwave theory, principle of operation of antenna, desired electrical characteristics of an antenna for Zigbee, electromagnetic field configuration in free space and cavities, and application of Method of Moment (ADS Momentum) to patch antenna synthesis.

Chapter one is organized into two parts. Part one defines an antenna and describes its functionality. Basic jargon of spherical co-ordinate system applied to antenna theory is developed. Field zones around antenna are described and differentiated. Radiation Pattern or Antenna Pattern of a typical antenna is described. Part one also shows examples of most popular antenna structures used for communication and defense applications.

Part two of chapter one introduces Maxwell's Equations and discusses the generation of electromagnetic waves from resonant structures like a dipole.

Chapter two is about Antenna Radiation and Electrical Characteristics. Isotropic, Directional and Omni-directional radiation patterns are introduced. Conservation of stored, radiated, and dissipated power for a volume in space that receives power from electric or magnetic current density is explained using Poynting Vector Theorem.

Chapter two discusses various performance parameters of an antenna like, radiation density, radiation intensity, beam solid angle, directivity, half power beam width, first null beam width, beam efficiency, antenna radiation efficiency, antenna gain, plane of polarization, linear polarization, circular polarization, principal E & H planes and 2D & 3D field patterns.

Chapter three introduces Zigbee network comprising of coordinator, router and end nodes. Mesh network and its self healing nature are demonstrated. Spatial coverage and data rates of various communication systems are compared. Bit Error Rate Vs Signal-to-Noise ratio is plotted for Zigbee, WiFi, Bluetooth and FSK modulation schemes to demonstrate robust noise immune nature of Zigbee. Spectral usage of Zigbee is mentioned to specify requirements from our antenna design.

Chapter three concludes by mentioning various application areas for Zigbee technology. It highlights how ultra low power and robust nature of Zigbee is ideal for Industry and Home Automation.

Chapter four shows basic structure of a patch antenna, various shapes it can take and various ways of feeding a patch antenna. Basic field theory for TEM (Transverse Electromagnetic), TE (Transverse Electric) and TM (Transverse Magnetic) Waves in free space is developed by solving Helmholtz equation. The general solution for free space is simplified to obtain field solution between parallel-plates. Field configuration in between parallel plates of a patch antenna is described. Basic performance parameters like characteristic impedance, propagation constant, attenuation constant, mode cut-off frequency, and power handling capability of a patch structure are derived.

Chapter five describes methods for analyzing and synthesizing a patch antenna. Transmission Line and Cavity Models are developed. Design Equations for a rectangular patch antenna are presented. Field configuration between parallel plates of a rectangular patch for TM_{0n0} Mode is developed and demonstrated. Bandwidth of an antenna is discussed. Chapter five concludes by discussing antenna efficiency and bandwidth trade-offs Vs substrate height and dielectric constant.

Chapter six walks through the design flow in Agilent's Advanced Design System 2006A. This chapter is an interactive emulation of the real design environment. Design equations are written in the data display window. Patch layout is performed in momentum. Patch is simulated and results are plotted.

Nature of the Workshop

All the six chapters are shockwave movies that can be viewed from within Internet Explorer or using a standalone shockwave player. There is PowerPoint presentation of each chapter and a lab exercise book for the last chapter. The design lab is a fully interactive and has a corresponding archived ADS project folder for reference.

Effective way to conduct the Workshop

Each participant should run his or her own copy of every chapter followed by PowerPoint presentation by the instructor on that chapter. Lab is interactive and should be run by each participant separately.

Comments from the Author

Chapter four and five are mathematical and can be skipped. Kindly convey the feedbacks for improvements and comments through Agilent's Instructor. I hope you have Happy Learning, Thanks!