Kısa Kurslar

1. Fundamentals of Physical Theory of Diffraction (H-Block H507)

Physical Theory of Diffraction (PTD) was originated by this author for investigation of radiation and scattering of high frequency acoustic and electromagnetic waves. This course presents basic ideas and results of the modern form of PTD. With appropriate modifications it can be utilized for the solution to many practical problems. Among them are the design of microwave antennas, mobile radio communication, construction of acoustic barriers to decrease a noise level, evaluation of radar cross sections for large objects (tanks, ships, missiles, etc.). In particularly, PTD was successfully applied in the design of American stealth-fighter F-117 and stealth-bomber B-2 with low radar visibility.

Lecture Notes

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5. Reconfigurable Antennas and Arrays by RF MEMS Technology (H-Block H509)

The objective of this short course is to provide a basic overview of antennas designed and fabricated by RF-MEMS technology. The following topics will be covered: brief overview of RF MEMS technology, its advantages, limitations; Basic principles and techniques for the design of RF-MEMS based antennas; Applications such as micromachined antennas, reconfigurable antennas (frequency tunable, multiband, polarization and pattern reconfigurable antennas), phased arrays, reflectarrays.

Lecture Notes

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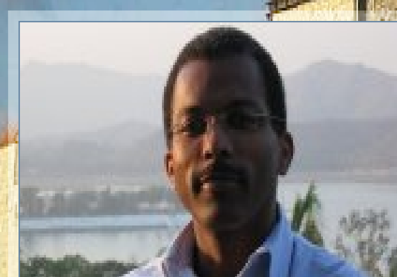
2. Efficient Testing Using a Reverberation Chamber (H-Block H505)

In the past, reverberation chambers were primarily used for military and automotive testing. Today, they are increasingly used for new and diverse applications due to their inherent efficiency and cost effectiveness. New applications include aircraft testing, simulating a wireless environment, and determining the shielding effectiveness of materials and components such as cables and connectors.

A review of reverberation chamber operation is provided including a comparison of frequency versus mechanical stirring as well as a comparison of the testing in an anechoic chamber versus a reverberation chamber. Determining the size of a reverberation chamber and selecting the optimum tuner type given design and performance objectives is also discussed. Reverberation chamber standards including IEC 61000-4-21, MIL STE 461 E/F, (EUROCAE) RTCA DO 160 E/F and others, cost versus benefits, and performance pros and cons will be reviewed.

Recent developments in the statistical basis for the operation and performance of reverberation chambers have increased their popularity. We will introduce some of the theory behind this increasing acceptance of the science behind its use as a suitable EMC measurement environment. The tutorial concludes with examples of new and emerging techniques incorporating the reverb principles. These include the testing of wireless devices and aircraft, evaluation of antenna efficiency, as well as probe calibration.



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3. Waveguide-Fed Slot Arrays: Theory, Design and Applications (H-Block H504)

Waveguide-fed slot array technology has matured, primarily because of advances in electromagnetic modeling in the analysis, design, and optimization of such antennas. It is generally possible to design and build such arrays to meet the demanding specifications of many radar, remote sensing, and communication applications, without any hardware iteration. Elliott's theory, in conjunction with enhancements to the design procedure that account for higher order mode coupling between radiating and coupling elements have enabled accurate design of array antennas. Method of moments solutions of pertinent integral equations for the aperture electric field of all slots in a planar array, have helped not only in the analysis and assessment of designs but also in design improvements. Commercial codes such as the HFSS have been used successfully to analyze and assess the performance of small arrays accurately. In this talk we will review the design techniques and analysis employing the method-of-moments solution to the pertinent integral equations of the entire planar slot array. Examples from recent applications of slot arrays in practical radar and remote sensing systems will be presented. In the first example, Elliott's procedure was extended to design planar slot arrays consisting of subarrays. A large Ka band slot array was designed using an infinite array model to account for mutual coupling, in the second example. Mutual coupling expressions were derived in terms of Floquet series, using the Poisson sum formula. For a radiometer application, antennas requiring low average sidelobes over different angular regions and an average return loss of 15dB over 4% frequency band. An iterative technique was used to choose the array architecture, lattice spacing, and aperture distribution. Moment method analysis was used to assess the performance and Monte Carlo technique to study and account for the effects of tolerances and modeling errors. Genetic algorithm was used with mode matching technique to implement matching capacitive irises in the waveguide to achieve the required return loss bandwidth. The use of global optimization techniques such as the genetic algorithm in conjunction with the moment method analysis of slot arrays in improving the return loss and pattern performance of slot arrays will also be discussed.

Lecture Notes

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4. Circuit to System Level Practical Microwave Education (H-Block H508)

Recent years have seen rapid changes in RF techniques as well as technology. This trend is continuing enabling the use of increasingly higher RF frequencies with their inherent advantages of smaller size components and larger bandwidth. In particular, the use of planar circuit architecture and integration using micro-machining technology has opened up new opportunities in terms of reduction in cost, weight, volume, power consumption as well as extension of operating frequencies. In keeping with the advances in technology, the design approach is also undergoing a rapid change through improved digital signal processing (DSP) techniques and
CAD tools. Thus the scope of RF Design Techniques and Technology, that was confined to lower microwave frequency bands (~10 GHz), has expanded to encompass the millimeter wave frequency band (30-300 GHz). This paradigm places new demands on Microwave Education. The responsibility of microwave educators today is to drive students beyond the basic concepts to circuit and system level practical hands-on-education in order to produce highly skilled and motivated wireless engineers who are directly usable to the industry. The present talk is focused to motivate students to opt for career in RF and Microwave Engineering. Starting with the behavior of conventional circuit elements at RF and Microwave frequencies and describing equivalent lumped circuit models of distributed transmission line
elements, different technologies available to a designer to built Microwave and Millimeter Wave Integrated Circuits and subsystem will be presented. Starting from conventional microstrip technology, other key technologies including suspended stripline, dielectric integrated guides, fin line, MMIC, RF CMOS and LTCC will be briefly described. Design methodology including use of existing CAD tools leading to development of several high performance components/ subsystems at lower microwave frequencies as well as millimeter wave frequencies centered around 35 GHz, 60 GHz and 140 GHz will be presented. Micromachining has recently been applied to millimeter wave field to create low loss and high performance components and antennas. Methodology for the design, development and fabrication of passive components, antennas and switches at millimeter wave frequencies will be described next. Concept of developing reconfigurable RF circuits using either variable capacitors or switches will then be briefly presented. Future research activities in our group in the area of RF Nanotechnology will also be discussed. In the end, practical demonstration of several pre-fabricated passive and active components at Microwave frequencies will be given using a handheld network analyzer and special custom made test jigs.

Lecture Notes

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