Floquet modal based Analysis of Finite and Infinite Phased Array Antennas

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Abstract
Phased array antennas are becoming increasingly popular in communication and broadcasting satellites because of their inherent advantages of beam reconfigurability. For wide angle scan application an accurate analysis of the array antenna including mutual coupling effects is very important. In this talk we present the Floquet modal analysis procedure for analyzing periodic phased array antennas. The talk begins with a discussion on the relevance of Floquet analysis with regard to a scanned beam array design. Effects of mutual coupling on the performances of an array are discussed in details. It is shown how Floquet analysis can be employed to analyze a finite array with arbitrary amplitude taper including mutual coupling effects. Design examples of patch and horn arrays are presented. Method of analysis for multilayered array structures with different periodicities is presented and applications of such structures in phased array antennas are discussed. Accuracy of Floquet model for small finite arrays is discussed. Examples of on-board array antennas in modern communication satellites are shown.

Biography
Arun K. Bhattacharyya received his B.Eng. degree in electronics and telecommunication engineering from Bengal Engineering College, University of Calcutta in 1980, and the M.Tech. and Ph.D. degrees from Indian Institute of Technology, Kharagpur, India, in 1982 and 1985, respectively.

From Nov 1985 to April 1987, he was with the University of Manitoba, Canada, as a Postdoctoral Fellow in the electrical engineering department. From May 1987 to October 1987, he worked for Til-Tek Limited, Kemptville, Ontario, Canada as a senior antenna engineer. In October 1987, he joined the University of Saskatchewan, Canada as an assistant professor of electrical engineering department and then promoted to the associate professor rank in 1990. In July 1991 he joined Boeing Satellite Systems. Dr. Bhattacharyya became a Technical Fellow of Boeing in 2002. In September 2003 he joined Northrop Grumman Space Technology group as a staff scientist, senior grade. At present he holds Distinguished Engineer and Engineering Fellow position at Northrop Grumman. He is the author of “Electromagnetic Fields in Multilayered Structures-Theory and Applications”, Artech House, 1994 and “Phased Array Antennas, Floquet Analysis, Synthesis, BFNs and Active Array Systems”, Wiley, 2006. He authored over 95 technical papers, 5 book-chapters and has 16 issued patents. His technical interests include electromagnetics, printed antennas, multilayered structures, active phased arrays and modeling of microwave components and circuits.

Dr. Bhattacharyya became a Fellow of IEEE in 2002. He is a Distinguished Lecturer of IEEE APS society. He is a recipient of numerous awards including the 1996 Hughes Technical Excellence Award, 2002 Boeing Special Invention Award for his invention of High Efficiency horns, 2003 Boeing Satellite Systems Patent Awards and 2005 Tim Hannemann Annual Quality Award, Northrop Grumman Space Technology.
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Bhattacharyya, K.A. (2012) Floquet Modal Based Analysis of Finite and Infinite Phased Array Antennas. Macquarie University and IEEE Joint Lecture. has been cited by the following article. Then, this work indicated how Floquet analysis can be used to study a finite array with uniform amplitude and linear phase distribution in both x and y directions. To modelize the proposed structures, two formulations were given in a spectral and spatial domain, where the Moment (MoM) method combined with a generalized equivalent circuit (GEC) method was applied. Radiation pattern of coupled periodic antenna was shown by varying many parameters, such as frequencies, distance and Floquet states. In this talk we present the Floquet modal analysis procedure for analyzing periodic array structures. The talk begins with a discussion on the relevance of Floquet analysis with regard to a scanned beam array design. Effects of mutual coupling on the performance of an array are discussed in details. Advanced Horn structures for Reflectors and Phased Arrays. In this talk we present an overview of various types of feed horns that are commonly used in single and multi-beam reflector systems and direct radiating arrays. The presentation begins with a discussion of smooth wall horns with single and multiple apertures, their operating principles, applications, advantages and their design procedures. Keywords: Modeling, Antenna, Array, waveguide, Global Method, Floquet, GECM. Abstract. In this study, we propose a new formulation based on a global method to model a rectangular waveguide array as antenna. Our method consists to combine the method of moment (MoM), the generalized equivalent circuit method (GECM) and Floquet modal analysis. Looking for rigor, simplicity and rapidity, we repose always on the simple discontinuity in an open rectangular waveguide. Floquet modal analysis to modelize and study 2-D planar almost periodic structures in finite and infinite extent with coupled motifs. Progress In Electromagnetics Research B, 62, 63-86. FULL TEXT PDF.