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Large Finite Array Antenna

Prof. Ahmed Kishk

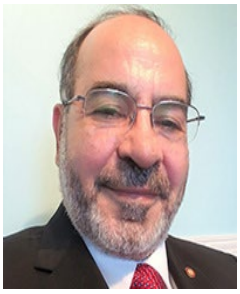
Honorary Professor at the Indian Institute of Technology,
Delhi, India.
Web: https://www.concordia.ca/faculty/ahmed-kishk.html

ABSTRACT

An efficient procedure is proposed to predict large finite planar array performance from a similar lattice's measured or computed small planar array. The analyses are based on port measurements of the mutual admittance matrix. Mutual admittance depends on the element type, frequency of operation, polarization, and lattice arrangement. The larger array mutual admittance matrix is constructed from the small array mutual admittance matrix. Such admittance ignores the mutual coupling between the elements beyond the small array domain. Once the admittance matrix has been constructed for the large array, the array elements' active (effective) input impedance under different scenarios can be predicted easily. Also, from the effective voltage terminal of the elements, an array factor, including the mutual coupling, can be computed to predict the array gain and radiation patterns. The proposed method's efficiency comes from dealing with matrices of order equal to the array number of elements. One can study the array's performance under several scenarios with the corresponding admittance matrix. The effective impedance of the elements can be used to design a feeding network based on the elements' effective input impedance that considers the mutual coupling. Also, it is possible to perform feeding network optimization.

Here, to illustrate the procedure, an example of an air microstrip patch antenna excited by a hook-shaped probe is considered an array element. The full-wave numerical analysis of the sizeable finite array verifies the results obtained using the present method. Also, the gap waveguide technology concept is presented through an example of the feeding network design at millimeter-wave frequencies for an array of magneto-electric dipoles. A procedure is presented to reduce the number of optimization parameters for the sizeable parallel feeding network.

BIO



Dr. Ahmed Kishk received a BSc in Electronics and Communication Engineering from Cairo University, Cairo, Egypt, in 1977 and a BSc. in Applied Mathematics from Ain-Shams University, Cairo, Egypt, in 1980. In 1981, he joined the Department of Electrical Engineering, University of Manitoba, Winnipeg, Canada, where he obtained his M. Eng. and Ph.D. degrees in 1983 and 1986. He was a Professor at the University of Mississippi (1995-2011). He was the director of the Center for Applied Electromagnetic System Research (CAESR) from 2010 to 2011. He has been a professor at Concordia University, Montréal, Québec, Canada (since 2011) and Tier 1 Canada Research Chair in Advanced Antenna Systems. He was an Associate Editor of Antennas & Propagation Society Newsletters from 1990 to 1993. He is a distinguished lecturer for the Antennas and Propagation Society (2013-2015).

He was a co-guest editor for IEEE Antennas and Propagation and Wireless Letter on the Special Cluster on "5G/6G enabling antenna systems and associated testing technologies." He was a technical program committee member for several international conferences. He was a member of the AP-S AdCom (2013-2015). He was the 2017 AP-S president. Prof. Kishk's research interest is broad in Electromagnetic Applications. He has recently worked on millimeter-wave antennas for 5G/6G applications, Analog beamforming networks, Electromagnetic Bandgap, artificial magnetic conductors, soft and hard surfaces, phased array antennas, reflectors/transmitarray, and wearable antennas. In addition, he is a pioneer in Dielectric resonator antennas, microstrip antennas, small antennas, microwave sensors, RFID antennas for readers and tags, Multi-function antennas, microwave circuits, and Feeds for Parabolic reflectors. He has published over 465 refereed journal articles, 550 international conference papers, and 125 local and regional conference papers. He co-authored four books and 13 chapters and was the editor of eight books. He offered several short courses at international conferences. According to Google Scholar, his work was cited over 34959 with an H-index of 80. The bibliometric data for estimating the citation-based metrics were gathered on December 21, 2022. Prof. Kishk was ranked first at Concordia University, 23rd in Canada, and 401 worldwide. ScholarGPS has placed Dr Kishk in the top 0.05% of all scholars worldwide.

Prof. Kishk and his students received several awards. He won the 1995 and 2006 outstanding paper awards for papers published in the Applied Computational Electromagnetic Society Journal. He received the Outstanding Engineering Faculty Member of the Year in 1998 and 2009 and the Faculty Research Award for Outstanding Research Performance in 2001 and 2005. He received the Microwave Theory and Techniques Society Microwave Prize in 2004. He received the 2013 Chen-To-Tai Distinguished Educator Award from the IEEE Antennas and Propagation Society. In recognition, "For contributions and continuous improvements to teaching and research to prepare students for future careers in antennas and microwave circuits, Kishk is a Life Fellow of IEEE, Fellow of Electromagnetic Academy, and a Fellow of the Applied Computational Electromagnetics Society (ACES).