Talk at the Dept. of Engineering, Unipg:

New Insights into Millimeter-Wave Higher-Order Mode Array Antenna Design

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Abstract

This presentation explores innovative strategies for designing mm-Wave array antennas, focusing on higher-order modes to overcome the challenges of high feed-network complexity and transmission loss. As mm-Wave technology and large-scale array antenna design become crucial, conventional designs face significant parasitic effects and manufacturing costs. This presentation introduces two design breakthroughs. The first is a 79 GHz high-gain, low-sidelobe TM_{05}-mode patch array antenna. By utilizing higher-order TM_{05} modes, the gain of a single patch is significantly increased, thereby drastically reducing the number of array elements while maintaining performance. This significantly simplifies the feeding network. The design incorporates differential feeding to suppress cross-polarization and sidelobe levels, effectively aligning grating lobes with radiation nulls to achieve a measured gain of 18.2 dBi. The second focus is a circularly polarized filtering array antenna fed by higher-order substrate integrated waveguide cavities (SIWC). The research details the control of quasi-TE_{410} and quasi-TE_{330} modes within an SIWC to simultaneously excite a 2×2 patch subarray without power splitters. By integrating a compact RW-SIW filtering transition with sequential rotation feeding, the design achieves high frequency selectivity and polarization purity. The resulting 4×4 array demonstrates a 3-dB axial ratio bandwidth of 8.9% and a gain of 15.9 dBic. In conclusion, the lecture demonstrates that mastering higher-order mode distribution in patches and SIWC structures provides a powerful path toward high-efficiency, low-complexity antenna systems for future wireless applications.

Biography

Kuo-Sheng Chin received the B.S. degree in electrical engineering from the Chung Cheng Institute of Technology, Taoyuan, Taiwan, in 1986, the M.S.E.E. degree from Syracuse University, Syracuse, NY, USA, in 1993, and the Ph.D. degree in communication engineering from National Chiao Tung University, Hsinchu, Taiwan, in 2005. From 1986 to 2005, he was with the Chung Shan Institute of Science and Technology, Taoyuan, as a Research Assistant, becoming an Assistant Scientist, and then an Associate Scientist. He joined Chang Gung University, Taoyuan, as a Faculty Member, in 2006, where he is currently a Professor with the Department of Electronics Engineering. He was one of the recipients of the Best Paper Award of the International Conference on Electromagnetic Near Field Characterization and Imaging in 2009, the Best Student Paper Award of the International Symposium on Next-Generation Electronics in 2014, and the Best Student Paper Award of 2018 The 8th International Symposium on InfoComm & Mechatronics Technology in Bio-Medical & Healthcare Application. Dr. Chin received the Outstanding Teacher Award from Chang Gung University in 2014 and 2021. He served as an Associate Editor for Microwave and Optical Technology Letters in 2019–2020.

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