

Recent Progress in Technology for Antenna Beam Forming

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Formation of a null field point within a radiation pattern and formation of a tilted beam have been receiving considerable attention, in response to recent developments in communication systems. This seminar presents recent progress in technology for beam forming and is composed of three chapters. **Chapter 1** discusses a circularly polarized (CP) spiral antenna whose radiation pattern is designed to have a null field point, which contributes to minimizing signal interference from nearby electronic devices. **Chapter 2** investigates an antenna structure composed of metamaterial lines and a patch element. The height of this antenna structure is much smaller than that of the spiral antenna in Chapter 1. Each metamaterial line radiates a CP wave off the broadside direction (normal to the line); and the patch element radiates a CP wave in the broadside direction (normal to the patch plane). A null field point is created within the CP broadside radiation. **Chapter 3** proposes formation of a tilted beam by a metasurface plane made of inhomogeneous loops. The formation is based on Fabry-Perot resonance. The direction of the tilted beam with increase in the number of metasurface planes is investigated.



Dr. Hisamatsu Nakano has been with Hosei University since 1973, where he is now a professor emeritus and a special-appointment researcher at the *Electromagnetic Wave Engineering Research Institute* attached to the graduate school of the same university. His research topics include numerical methods for low- and high-frequency antennas and optical waveguides. He has published over 320 articles in major peer-reviewed journals and 11 books/book-chapters, including “*Low-profile Natural and Metamaterial Antennas* (IEEE Press, Wiley, 2017).” His significant contributions are the development of five integral equations for line antennas and the realization of numerous wideband antennas, including curl, spiral, helical, and body-of-revolution antennas. His other accomplishments include antennas for GPS, personal handy phone, space radio, electronic toll collection, RFID, UWB, and radar. Prof. Nakano received the “*H. A. Wheeler Award*” in 1994, “*Chen-To Tai Distinguished Educator Award*” in 2006, and “*Distinguished Achievement Award*” in 2016, all from IEEE ANTENNAS AND PROPAGATION SOCIETY. He was also the recipient of “*The Prize for Science and Technology*” from Japan’s Minister of Education, Culture, and Sports, in 2010. Prof. Nakano is an Associate Editor of several journals and magazines, such as *Electromagnetics* and the *IEEE Antennas and Propagation Magazine*.