Periodic Leaky-Wave Antenna Based on Complementary Pair of Radiation Elements

ABSTRACT

In this work, we propose and develop a leaky-wave antenna (LWA) by periodically loading shunt radiation element pairs along a host transmission line (TL). Each pair of radiation unit consists of one capacitive element and one inductive element, which are susceptance-complementary with each other. The complementary radiation element loading leads to an effective open-stopband (OSB) suppression, thereby facilitating a continuous leaky-wave beam scanning from backward, through broadside, to forward. Compared with the previously studied OSB-suppressed LWAs containing only one type of susceptive radiation elements, the proposed LWA features two unique properties: constant radiation efficiency over the operation band, and unit cell period only related to the host TL regardless of parameter values of the radiation elements. The aperture synthesis of the proposed LWA is hence straightforward as the radiation elements can be designed to be equally-spaced. Experimental prototypes are designed and fabricated based on microstrip line structure as a proof of concept. Desired measured results agree well with the theoretical predictions.

EXISTING SYSTEM

- In existing methods, to suppress OSB, such as implementing reflection cancelling mechanism utilizing geometric asymmetry, simultaneously loading series and shunt resonant circuits in LWA unit cells and deploying impedance-matched P-LWA unit cells.
- Therefore, both inductive and capacitive radiation elements are used to design a P-LWA for realizing a constant radiation efficiency over an entire operation band of interest.
- Specifically, the inductive and capacitive radiation elements in the LWA deployed are alternatively loaded along the host TL, and each radiation element causes significant reflection, which hinders the broadside radiation.

PROPOSED SYSTEM

- The proposed LWAs feature constant radiation efficiency over the entire operation band. As an easy realization example, a microstrip line is loaded with complementary stub pairs.
- In this paper, the unit cell length of the proposedLWA only depends on the host TL regardless of the radiation components.
- Therefore, the proposed LWA can be designed with all the unit cells having the same unit cell length, which makes aperture synthesis much easier.

SYSTEM REQUIREMENTS

HARDWARE REQUIREMENTS:

- Processor - intel core i3
- RAM - 2GB
- Hard Disk - 20 GB

SOFTWARE REQUIREMENTS:

- Ansoft HFSS(High Frequency Structure Stimulator)

REFERENCE

[1] A. A. Oliner and D. R. Jackson, Antenna Engineering Hand Book, Ed. 4th ed. New York: McGraw-Hill, 2007.

[2] F. Xu and K. Wu, "Understanding Leaky-Wave Structures: A Special Form of Guided-Wave Structure," IEEE Microwave Magazine, vol. 14, pp. 87-96, 2013.

[3] Y. J. Cheng, W. Hong, K. Wu, and Y. Fan, "Millimeter-Wave Substrate Integrated Waveguide Long Slot Leaky-Wave Antennas and Two- Dimensional Multibeam Applications," IEEE Transactions on Antennas and Propagation, vol. 59, pp. 40-47, 2011.

[4] D. Xie, L. Zhu, and X. Zhang, "An EH₀-Mode Microstrip Leaky-Wave Antenna With Periodical Loading of Shorting Pins," IEEE Transactions on Antennas and Propagation, vol. 65, pp. 3419-3426, 2017.

[5] Z. Li, J. Wang, M. Chen, and Z. Zhang, "New Approach of Radiation Pattern Control for Leaky-Wave Antennas Based on the Effective Radiation Sections," IEEE Transactions on Antennas and Propagation, vol. 63, pp. 2867-2878, 2015.