Coding Metamaterials and Programmable Metamaterials

Tie Jun Cui[1]*

[1]*State Key Laboratory of Millimeter Waves, School of Information Science and Engineering*
Southeast University, Nanjing 210096, China
**Email of Presenting Author: tjcui@seu.edu.cn*

We propose coding metamaterials that are composed of two kinds of unit cells with 0 and π phase responses, which we name as “0” and “1” elements. By coding “0” and “1” elements with controlled sequences, one can manipulate the electromagnetic (EM) waves and realize different functionalities. We further present a unique metamaterial particle which has either “0” or “1” response controlled by a biased diode. Based on this particle, we propose digital metamaterials with unit cells having either “0” or “1” state. Using the field-programmable gate array, the metamaterial can be controlled in digital way. By programming different coding sequences, a single digital metamaterial has distinct abilities, realizing real-time programmable metamaterials. Two prototype applications of the programmable metamaterials are introduced: new-concept radar and single-sensor & single-frequency imaging. The concept of coding metamaterials has been extended from 1-bit to multi-bit, from microwave to terahertz wave, and from isotropic to anisotropic.