Guidelines for Student Reports

A SYSTEM-BY-DESIGN APPROACH FOR THE SYNTHESIS OF METAMATERIAL MICROSTRIP-PRINTED WAIMS

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Abstract

Phased arrays supporting wide-angle electronic scanning have a fundamental importance in several applicative domains, including radar, remote sensing, and space communication systems. Most of these technologies require antenna elements capable of supporting high radiation powers, such as waveguide apertures, slots, and horns. Unfortunately, large arrays composed of these antennas are subject to variations of the reflection coefficient at the aperture-air interface with the scan angle. This effect, which is actually caused by the variations in the inter-element coupling when the array is scanned, can damage the feeding network itself if it is not compensated.

In this scenario, the use of thin planar dielectric sheets covering the array surface, also named Wide Angle Impedance Matching (WAIM) layers, has been proposed to widen the effective scanning range of phased arrays. The WAIM thickness and its electromagnetic properties must be carefully designed in order to meet this goal.

To address this issue, in this project the use of WAIMs made of planar metamaterials consisting of an infinite regular grid of suitably designed patches will be considered. More specifically, the aim of the activity will be to design the material composing the WAIM through a System-by-Design (SbD) strategy. Such an approach will comprise a Global Optimization block and a full-wave solver able to effectively deal with periodic structures of equal cells. The overall SbD strategy will therefore work on a "single cell" model, which will be simulated considering periodic boundary conditions. The goal of the synthesis will be to minimize the impedance mismatching for the waveguide-fed phased array when steered. The final result will be the design of a WAIM layer based on a planar microstrip-printed metamaterial.

Reference Bibliography: System-by-Design [1]-[3]; Metamaterials [4]-[9].

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