# METAMATERIALS BASED ELECTRONIC ANTENNAS

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Recently, we proposed a transmission line approach of left-handed (LH) (antiparallel phase and group velocities) metamaterials and the generalized concept of composite right/left-handed (CRLH) structures, in which the physically unavoidable right-handed (RH) parasitic effects, acting in concert with LH effects, are fully taken into account. A CRLH structure is LH at lower frequencies and RH at higher frequencies with a transition at a specific frequency where the propagation constant is zero. On the basis of this new concept, a unique backfire-to-endfire leaky-wave (LW) antenna operating in its dominant mode with excellent radiation at broadside was introduced, whereas conventional LW antennas typically use higher-order modes and can not radiate efficiently at broadside.

A novel reflecto-directive system was presented as an application of the CRLH LW antenna described in the previous paragraph. This system, thanks to the backfire-to-endfire property of the CRLH LW antenna, is capable of retransmitting or 'reflecting' a signal incoming under any angle toward any desired arbitrary angle by way of tuning the LO frequency of a heterodyne mixer.

The reflecto-directive system presents, for some applications, the disadvantage that the output angle is function of frequency (frequency-scanned antenna). In the present contribution, we demonstrate theoretically and experimentally a more practical electronically-scanned version of this reflecto-director. Varactor diodes are inserted in each unit cell of the CRLH LW antenna. As the bias voltage of these varactors is varied, the capacitive loadings of the line are modified, and therefore the propagation constant is modified, which induces a variation in the scanned angle. By appropriately designing the novel structure, efficient electronic-scanning can thus be achieved at a fixed frequency.

The full-wave transmission characteristics and dispersion diagram of the structure are studied. An accurate LC parameters extraction procedure is shown, and the extracted parameters are inserted in a CRLH circuit model, from which the dispersion diagram is also computed (and compared with the full-wave one) from an analytical formula based on the transmission matrix and Floquet theorem. First the structure is demonstrated as an antenna and as a reflecto-directive system.

The device proposed may be used in several wireless applications such as WLANs and inexpensive directive antennas/reflectors replacing conventional phase-scanned arrays. The concepts presented can be potentially extended to 2D surfaces.

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