AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING
Electronics and Communications Engineering Department

Metamaterials for Wireless Component Design

A Thesis
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ABSTRACT

In this thesis, two applications of the coupled line composite right/left-handed (CL-CRLH) unit cell, compact size rat-race hybrid and arbitrary-coupling directional coupler (DC) are presented. Benefiting from the slow-wave effect present in both the right-handed (RH) and left-handed (LH) regions of the CL-CRLH unit cell, two compact size rat-race hybrids were realized. 60% area reduction was achieved while preserving the conventional rat-race performance. The arbitrary coupling directional coupler (DC), which operates in the stopband around the balance frequency, showed excellent in-band and out-of-band performance. To reduce its size, a slow-wave CL-CRLH unit cell was proposed. The proposed unit cell achieves a 38% size reduction. The rat-race hybrids were fabricated on microstrip technology, whereas the directional couplers were fabricated on stripline technology. Simplified circuit models for the unit cells were developed. Theoretical expectations were confirmed by EM simulations and measurements.

A tunable CL-CRLH is also proposed. Simulated results showed the capability of the unit cell to be used as wide-range-load matching section and as a reconfigurable rat-race/branch-line hybrid.

Key words: Composite right/left-handed transmission lines, directional couplers, metamaterials, power dividers, wide-range-load matching section.

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