Reconfigurable Coplanar Metamaterial Unit Cell for Antenna Array Applications

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Lately reconfigurable antennas including frequency, polarization and radiation pattern reconfigurability have gained a lot of interest. In order to extend these reconfigurable designs to construct an antenna array, the importance of feeding network appears. In this work, the frequency reconfigurable antenna designs are the main point of interest and by combining it with an appropriate feeding network the whole system (antenna and feeding network) can be considered as a reconfigurable system.

The metamaterial unit cell studied in this work is based on coplanar waveguide (CPW) technology, where the flexibility of choosing the shape and size of the ground is the main advantage of using coplanar structure in our design. While in Microstrip the ground plane is always covering the bottom layer of substrate, ground in coplanar structure can cover only part of the upper layer of substrate or to cover both the upper portion and the bottom plane to form a grounded CPW line.

The design of a reconfigurable MTM unit cell begins from a coplanar CRLH unit cell that is designed first. The proposed original design is based on "T" equivalent circuit was found to have a very close performance compared to other designs with "Π" equivalent circuit. The simulated insertion magnitude and phase show very good agreement with the unit cell requirements, which are designed to work as a zero phase transmission line at 5GHz, where S_{21}-phase goes to zero with 0.02dB simulated insertion loss.

In order to adapt the original CPW unit cell and make it reconfigurable, (i.e. work as a zero MTM unit cell at two different frequencies) the series interdigital capacitance is changed by adding another rectangular section below the substrate. The ON/ OFF switching states (connecting/ disconnecting the bottom metallic rectangle respectively) of the MTM unit cell are simulated individually. The simulation results show that the added metallic rectangle has minimal effect on the zero phase frequency which still at 5GHz (metallic rectangle is disconnected) with 0.1 dB insertion loss. On the other hand for the ON case (when the metallic rectangle is connected, by means of a pin diode) the frequency shifts down to 4.2 GHz and with 0.23dB insertion loss. The design architecture and measured results of this reconfigurable metamaterial unit cell will be presented and discussed at the conference.

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