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The Development of Simulation Tools for Design of Waveguide Filter using Resonant Iris Circuit

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Abstract. This paper presents a development of Electromagnetic simulation tool for design of rectangular waveguide filter using inductive-capacitive resonant iris circuit. The simulation is designed and developed by using the electromagnetic wave propagation and iterative method to calculate the amplitude of waves in the frequency and spatial domain. The developed EM simulation, called WCD (Waveguide Circuit Design) consists of menu, designed, calculating and displayed windows which were designed by using GUI (Graphic User Interface) of MATLAB® software. In this paper, the resonant iris circuit in the waveguide are simulated and compared to the CST Microwave Studio®. The simulated results present correctly the circuit properties and electric and current distribution on the waveguide iris circuit. The results agree with theory, CST simulation.

Introduction

Presently, the microwave circuit design is the most necessary and important for modern communication systems. The problems of design are often a lack of equipment and tools used to design and to build. Revolutions in microwave engineering, numerical methods related to electromagnetic wave have been extracted such as FDTD (Finite Differential Time Domain) [1], TLM (Transmission Line Matrix) [2], Moment method [3]. Despite their accuracy, the problem arising in the application of such methods derives by using the inversion of integral operator. In fact, the matrix size of Moment method is proportional to the meshing pixel number. This leads to huge memory storage while filling and inverting the matrix terms. In the last two decades, an original iterative method [4] based on the traverse wave formulation has been presented for a full wave analysis by using the discontinuity condition [5] in spatial domain and the integral relation in frequency domain. The more detailed description will be presented in section 2.

Waveguide filters have been historically implemented for microwave communication, mainly due to low losses and high power. The inductive iris circuit in the waveguide that is the basic circuit has been designed through approximate modelling utilizing full Mode Matching Method (MMM) and Transmission Line Matrix (TLM) with high accuracy. Some analysis methods for waveguide filter are available in [6-7]. Therefore, the development and optimization of methods are necessary and important for an efficient electromagnetic simulation tool of waveguide circuit analysis.

In this paper, we will study and develop the efficient electromagnetic simulation tool for analysis and design of the resonant iris circuit in rectangular waveguide. The iterative method and wave propagation theory have been combined with mode matching technique to characterize the iris circuit in the rectangular waveguide. To verify the efficiency of EM simulation, a simple waveguide filter is implemented. The computed results between EM simulation, theory and measurement are validated.