A NEW FOURIER'S EXPANSION-DIFFERENTIAL METHOD FOR ANALYZING GROOVE GUIDE WITH ARBITRARY SHAPE

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Abstract
A new Fourier’s expansion-differential method for analyzing groove guide with arbitrary shape is firstly presented in this paper. It is convenient to solve practical application problems of arbitrary groove guides. The calculated results of the guide wavelengths of typical groove guides are in good agreement with ones in references, and its computing precision is fairly high. Hence the computational correctness of the new method is verified. The new method has the advantages of clear conception, direct-viewing expression, simple and easily feasible computation, etc. So it is of important application values for enriching groove guide theory and in solving actual engineering application problems for millimeter waves.

Key words: Fourier’s expansion-differential method; arbitrary groove guides; engineering applications; millimeter waves
I. Introduction

As a kind of millimeter wave transmission line, groove guide with many advantages has been researched for a long time \(^{[1]}\). There are two methods for solving groove guide, i.e. the first one is the analytical method, and the second one is the numerical method. Both methods own respective characteristic and application limit. If these two methods are combined, it is a so-called analysis-mixed method.

A fewer kinds of groove guide problems with regular boundaries were researched by the analytical method before this paper\(^{[2,3]}\). At the meantime, there were several methods for analyzing some characters of arbitrarily shaped groove guides such as the finite element method\(^{[4]}\), the boundary element method\(^{[5]}\) and the equivalent network method\(^{[6]}\), etc. But they did not all-sided study various performances of arbitrary groove guides because of the limitation of these methods. The Fourier’s expansion-differential method presented in this paper is belonged to the analysis-mixed method. It is not only more direct and simple than the analytical and numerical methods, but also the various characteristics of groove guides with arbitrary shapes can be entirely analyzed. The method has at the same time merits of the analytical and numerical methods and their shortages are also overcome.

II. Theoretical Analyses

The cross-section of groove guide with arbitrary shape is shown in Fig.1. The whole cross-section can be divided into