Modeling Electromagnetic Response of Arbitrary-Shape Dielectric Waveguide Using Broadband Green's Function Method

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Abstract

The unintentional effects of waveguide structures affect the performance of electronic devices in their signal integrity (SI), power integrity (PI), and electromagnetic compatibility (EMC). Electromagnetic interferences (EMI) can be generated and amplified at the resonant frequencies due to these cavity structures. For these problems, a rigorous, accurate and fast approach is needed to predict the resonance/cavity effects of practical electronic devices, often with general geometries and including scatterers, over a broadband frequency range.

In this paper, we will focus on the response of dielectric waveguide excited by a fundamental source inside, *i.e.*, the waveguide Green's function, from which the response of arbitrary source can be determined. A new methodology has been recently developed to calculate the waveguide Green's function over a broad frequency range for a general geometry and including scatterers. The new Green's function is expressed in terms of modes, which are independent of wavenumber, with low wavenumber extraction for accelerated convergence such that only a relatively few number of modes are required. We label this new Broadband Green's Functions with Low wavenumber extractions as BBGFL. A number of novel steps are further developed to accurately characterize the resonant modes and modal functions of arbitrarily shaped waveguides. Waveguide Green's functions, with arbitrary background settings, are also efficiently constructed in a broadband of frequency. In this work, the BBGFL results with higher-order convergence are shown to have good agreement with the direct method of moments (MoM). We also demonstrate the use of BBGFL method to solve the wave propagation problem for a waveguide with scattering objects.

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