**Edge element for computing the resonant frequencies of PEC cavity**

Wei Sha

Department of Electrical and Electronic Engineering

the University of Hong Kong, Pokfulam Road, Hong Kong

[dr.weisha@gmail.com](mailto:dr.weisha@gmail.com)

Dec 6, 2011

The functional form for the air-filled PEC cavity is given by

(1)

Using the edge element and tetrahedron grid, the E-field can be represented as

(2)

where is the vector basis function, and is the unknown coefficients.

Substituting (2) into (1), we have

(3)

where

(4)

(5)

Using the tetrahedron edge element, then we get

] (6)

(7)

where

(8)

(9)

and other parameters can be found in Prof. Jin’s book. (Chapter 5, Section 5.3, The Finite Element Method in Electromagnetics, First Edition).

According to the variation method, the generalized eigen-equation can be written as

(10)

Here, the unknowns are only defined on the inner edges due to the Dirichlet boundary condition () imposed on the outer edges.

The following Table lists the results for the PEC cavity with the size of . The inner edges (unknowns) are 3488. The 8 lowest eigenvalues (k0, cm-1) are given.

|  |  |  |
| --- | --- | --- |
| Mode | Analytical | Numerical (FEM) |
| **TE101** | 5.236 | 5.226 |
| **TM110** | 7.025 | 7.006 |
| **TE011** | 7.531 | 7.535 |
| **TE201** | 7.531 | 7.539 |
| **TM111** | 8.179 | 8.150 |
| **TE111** | 8.179 | 8.177 |
| **TM210** | 8.886 | 8.851 |
| **TE102** | 8.974 | 8.901 |