Analysis of Circular Cavity with Metalized Dielectric Posts or Corrugated Cylinders

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This paper presents the analysis of electromagnetic wave scattering by cylindrical objects located arbitrarily in a circular cavity. The general configuration of the resonators to be investigated is shown in Figure 1. The posts structures can be either homogenous along the height of the resonator or homogenous along their circumference. The first kind of posts is composed of metalized dielectric, cylindrical rod or fragments of metallic cylinder as depicted in Fig. 1(a), while the latter is a corrugated metallic cylinder (see Fig. 1(b)). The proposed structures can be utilized as a key building elements of combline and tunable filters and measurements resonators.

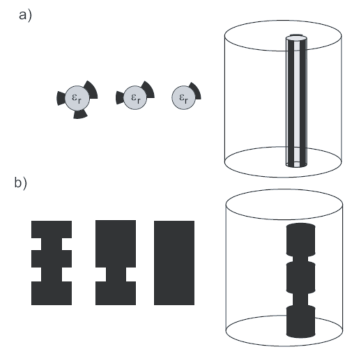
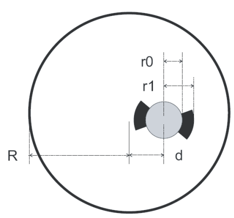


Figure 1: Analyzed structure. a) metlized dielectric, cylindrical post in circular cavity; b) corrugated metallic cylinder in circular cavity.

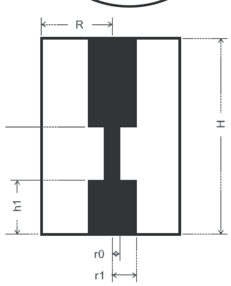
In both cases the exact full-wave theory based on the mode-matching method is applied to analyze the structures. Both TE and TM modes are considered simultaneously in the analysis. Additionally, to elim-inate the phenomenon of relative convergence when sharp metallic edges are presents, the analysis includes the edge condition. A set of integral equations in the tangential electric fields at the interfaces are derived and solved with te use of the basis functions which contain as much as possible information on the behavior of these fields at all sharp metallic edges [1, 2].

This ensures numerical efficiency and fast convergence of the method. The resonance frequencies of the investigated resonators are accurately determined. Validity and accuracy of the approach will be verified by comparing the results with Quick Wave FDTD Simulator, FEM method and experiment. A good agreement with FDTD method for a couple examples was obtained and presented in the tables below.



Data: $r_0 = 5$mm; $r_1 = 10$mm; $R = 30$mm; $H = 100$mm; $d = 0$mm and $d = 10$mm; the resonance frequencies are in GHz

$d = 0$mm			$d = 10$mm		
p	Our Results	FDTD Method	p	Our Results	FDTD Method
0	6.21	6.23	0	5.389	5.398
	6.541	6.565		6.456	6.470
	7.582	7.598		7.056	7.067
1	6.362	6.382	1	5.589	5.597
	6.697	6.718		6.620	6.637
	7.728	7.747		7.162	7.169
2	6.779	6.797	2	6.148	6.150
	7.142	7.154		7.088	7.067
	8.152	8.166		7.446	7.450



Data: $r_0 = 5$mm; $r_1 = 10$mm; $R = 30$mm; $H = 100$mm; $d = 0$mm and $d = 10$mm; $h_1 = 20$mm; $h'_1 = 40$mm; the resonance frequencies are in GHz

$d = 0$mm	
Our Results	FDTD Method
2.880	2.895
3.960	3.945
4.930	4.922

$d = 10$mm	
Our Results	FDTD Method
2.894	2.904
2.994	3.020
3.964	3.961
4.036	4.035
4.838	4.820
4.842	4.834

REFERENCES

1. Amari, S., S. Catreux, R. Vahldieck, and J. Bornemann, "Analysis of ridged circular waveguides by the coupled-integral-equations technique," *IEEE Transaction on Microwave Theory and Techniques*, Vol. 46, No. 5, May 1998.
2. Lech, R., M. Polewski, and J. Mazur, "Scattering in junction by posts consisting of a segment of conducting cylinder," *IEEE Transaction on Microwave Theory and Techniques*, Vol. 51, No. 3, 998–1002 March 2003.