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On The Effect of Ground Plane Size to Wideband Shorting-Wall Probe-Fed Patch Antennas

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Abstract:

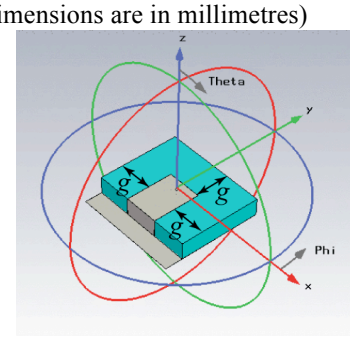
Inserting shorting-wall or shorting-pins to microstrip patch antennas is one of the popular size-reduction techniques for mobile antennas [1, 2, 3]. If the shorting-wall or shorting-pin is properly placed, the area of the resonating element can be substantially shrunk to one fourth or even more of the original half-wavelength full size [4]. Moreover, basic performance can be preserved as well. However, even though as a major part of the antenna geometry, the study of ground plane size to the performance of the antennas is rare.

In this article, we have theoretically investigated the effects caused by reducing ground plane size. A wideband shorting wall antenna reported in [2] is taken as the starting point. CST Microwave Studio was used in the modelling the different cases. The changes in resonant frequency, impedance bandwidth, gain and radiation patterns of the antenna are observed and compared. A recommendation of minimum ground plane size is given. Experimental work is in progress and the results will be presented in the conference.

Table 1 shows the geometry and dimensions of the wideband shorting-wall microstrip antenna. The parameter g denotes the separation of between the edges of the ground plane to the edges of the resonating element in $\pm x$- and $+y$-directions. From Fig. 1 and 2, we may observed that the centre resonant frequency, bandwidth and gain will deviate less then 5% and 10% and 1.5 dB respectively until the ground plane is reduced to smaller than $0.5\lambda o \times 0.5\ \lambda o$ when compared to that of infinite ground case,.

Table 1: Geometry of the shorting-wall antenna under investigation (dimensions are in millimetres)

Width of patch (a)	16
Length of patch (b)	22
Distance from shorting wall (d)	18
Thickness of substrate (h)	8
Dielectric constant of substrate (ε_r)	1.08



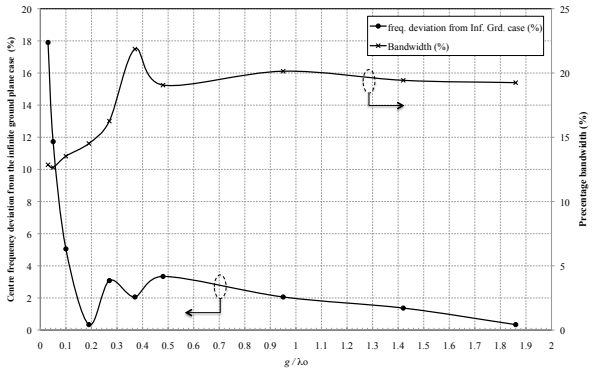


Fig. 1: Frequency performances study of antenna with different ground plane size.

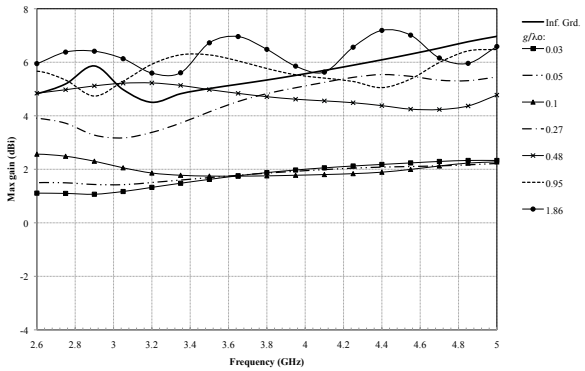


Fig. 2: Gains of the shorting-wall antennas with different ground size.

Reference:

[1] S. Pinhas and S. Shtrikman, "Comparison between computed and measured bandwidth of quarter-wave microstrip radiators," IEEE Trans. Antennas and Propag., Vol. AP-36(11), pp. 1615-1616, 1988.

[2] R. Chair, K. F. Lee and K. M. Luk, "Bandwidth and cross-polarization characteristics of quarter-wave shorted patch antenna," *Microwave and Optical Tech. Letters*, Vol. 22, No. 2, pp. 101-103, 1999.

[3] K. F. Lee, Y. X. Guo, J. A. Hawkins, R. Chair and K. M. Luk, "Theory and experiment on microstrip patch antennas with shorting walls," *IEE Proc.-Microwave, Antennas and Propagation*, Vol. 147, No. 6, pp. 521-525, 2000.

[4] R. B. Waterhouse, S. D. Targonski, and D. M. Kokotoff, "Design and performance of small printed antennas," *IEEE Transactions on Antennas and Propagation*, Vol. 46, No. 11, pp. 1629-1633, 1998.