A NEW EXCITATION MODEL FOR PROBE-FED PRINTED ANTENNAS ON FINITE SIZE GROUND PLANES

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ABSTRACT *– This paper presents a new excitation model for probe-fed printed antennas on both infinite and finite size ground planes. The model has been developed within the general frame of the mixed potential integral equation (MPIE) and the method of moments (MoM). The technique is based on a delta-gap voltage model, and a special procedure is implemented inside the integral equation to effectively impose a voltage reference plane into a floating metallic plate which is acting as a ground plane. The present technique allows the accurate calculation of the input impedance of printed antennas, and the effects of finite size ground planes can be easily accounted for in the calculations. In addition, an efficient technique is presented for the evaluation of the radiation patterns of printed antennas, taking also into account the presence of finite size ground planes. Comparisons with measured results show that the new derived excitation method is indeed accurate, and can be used for the prediction of the backside radiation and side lobe levels of real life finite ground plane printed antennas.*

Keywords.— Integral equation, excitation models, finite ground plane, backside radiation, printed antennas.

1 INTRODUCTION

During the last decades, printed circuits and antennas have played an important role in many branches of electrical engineering and the field of application is spreading to new technologies and to even higher frequencies. The need for miniaturisation is increasing in many applications e.g., telecommunications and space missions. Obviously, these compact geometries are not adequate for the use of models assuming infinite ground planes.

The need to take into account for finite ground plane dimensions in microstrip antennas modelling arises especially in applications where patches are used as free standing structures and front-to-back ratio must be maximized in order to avoid interference problems [Bokhari *et al.* 1992], or to locate a potential main beam deformation caused by the diffraction from the ground plane edges. Moreover, the need to model the excitation on two floating metallic patches can become inevitable in applications like dual band stacked printed antennas where a first patch acts as ground plane for a second radiating element [Zürcher *et al.* 1999].

To solve this problem a new excitation model and de-embedding technique for the computation of the input impedance of probe-fed printed antennas on finite size ground planes using a Mixed Potential Integral Equation technique (MPIE) [Mosig and Gardiol 1988, Hall and Mosig 1996] has been developed. This approach accounts for the effect of the ground plane dimensions on the input impedance, the mutual coupling, and the radiation characteristics of a single antenna element or a finite array.

As a first step to attain this goal, a new attachment mode for probe-fed printed antennas on infinite ground plane has been developed. The most widely used excitation model for probe-fed antennas is the impressed-current model [Pozar 1982, Hall and Mosig 1989]. This model assumes that a constant impressed current is exciting the antenna and it use the derived distribution of currents on metallic surfaces to compute the voltage at the probe location. This method may lead to accurate results but needs the computation of a surface integral over all the metallic surfaces present in the structure to obtain the input impedance. Contrary to the previous one, the model presented here, as described in Sec. 3, uses a delta gap