

**SURFACE PATCH ANALYSIS OF A
BUILT-IN PLANAR INVERTED F ANTENNA**

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SUMMARY

A built-in planar inverted F antenna is analyzed by a moment method surface patch model technique. The computed input impedance and far field radiation pattern are compared with measured data when different number of patches are used. The prediction of the far-field pattern is possible by using only very few number of patches while for the input impedance the numerical solution converges slightly far from the experience.

INTRODUCTION

Analysis of a built-in planar inverted F antenna (PIFA) is concerned. The structure is consisting of a planar antenna mounted over a metal housing as shown in Fig. 1. For this kind of the problems, analytical solution is almost absent in published papers and numerical techniques are restricted on the wire-grid modelling [1-2]. The wire-grid modelling [3] has been used extensively over the years to treat many problems, particularly for the prediction of the far-field quantities such as radiation pattern and radar cross section pattern with much success. However, the solution is not well suited for calculating such quantities as the surface current, input impedance and near-field. Presence of fictitious loop currents in the solution, ill-conditioned moment matrices and difficulties in interpreting computed wire currents and relating them to surface currents are some of the problems encountered. For any wire-grid model, be it for the near field or the far field, the important question is what wire radius and grid size to choose. The inability to obtain a general criterion for wire-grid modelling that works in all cases limits the applications of the technique [4].

The natural answer to model of the solid surfaces is the surface patches in which the surface quantities such as current and charges are directly presented by surface functions. Most of difficulties caused in the wire-grid technique can be either wholly or partially overcome by the surface patch modelling.

In this work we report the results on the analysis of the PIF antenna

by means of a moment method surface patch modelling technique which employs an electric field integral equation formulation and is based on a triangular patch model and linear basis functions defined on the surface of the patches [5-6].

NUMERICAL RESULTS AND DISCUSSION

The supposed structure for the planar inverted F antenna consists of a rectangular planar radiation element mounted on the upper side of a conducting box, a short pin between the radiation element and the surface of the box, and a feed line, as shown in Fig. 1. The entire structure is modeled by an assembly of planar triangular surface patches and the feeding source is modeled by the delta gap generator.

The measured input impedance and far-field radiation pattern which are presented in [2] are taken as the references to be predicted by the surface patch technique. The patches from 45, for a very low resolution, to 180, for higher resolution, are employed and the input impedance and far-field radiation pattern are computed.

Figure 2 shows the computed and measured input impedance in the frequency range 770-1060[MHz]. The computed results generally are in agreement with the experiments but do not converge them so perfectly with the exception of the resonance frequency which is well predicted. The real part of the input impedances pose important differences of the amplitude and band width for which we do not find any explanation yet. The far-field radiation pattern at frequency 920[MHz] which is presented in Fig. 3 is very well predicted with the exception of E_{ϕ} in Y-Z plane. It is noticeable that the result from the wire-grid modelling for E_{ϕ} is also absent in [2]. Figure 3 presents the results given by a 140-patch model which provides no considerable improvement over the 45-patch model.

The computational cost of the moment method surface patch model technique is presented in Table 1.

CONCLUSION

The application of a moment method surface patch model technique to the analysis of a built-in planar inverted F antenna is reported. By using very few patches to model the antenna the far-field radiation pattern can be predicted very well, but the input impedance, computed with a fine patch model is remained slightly far from the experience

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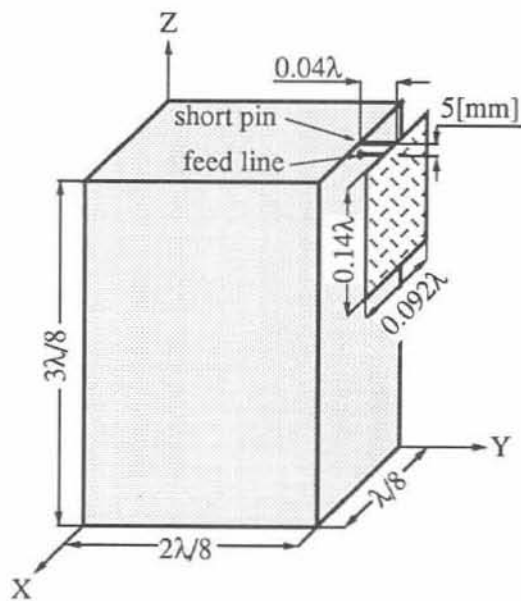


Fig. 1. The configuration of the planar inverted F antenna on a conducting body. λ is the wavelength of a 920 MHz signal.

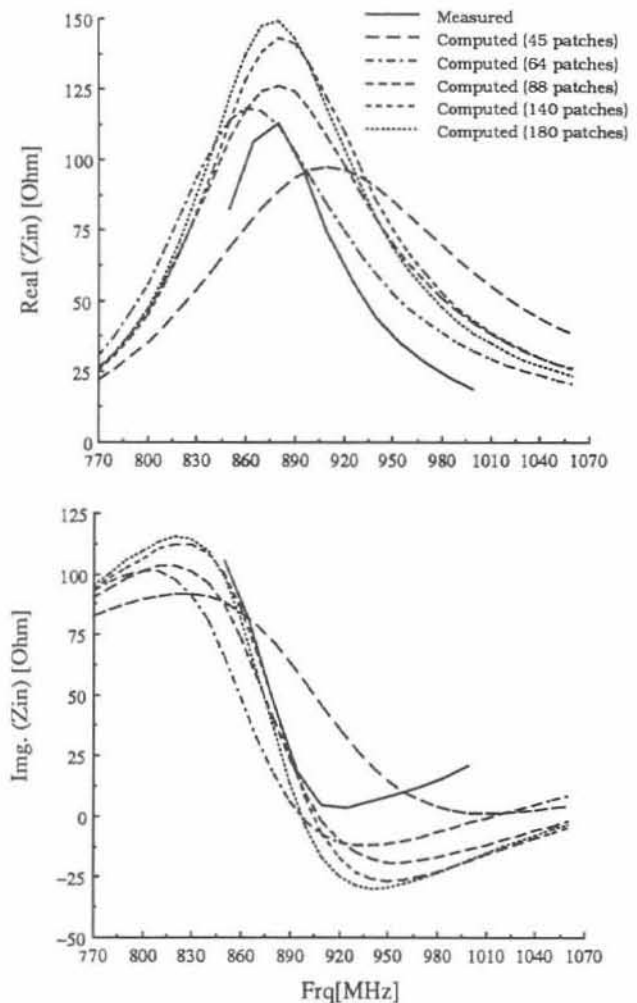


Fig. 2. The computed and measured input impedance.

Table 1. Computation time and storage memory size on a NEC ACOS-2010 mainframe computer.

Number of Patches/Unknowns	45/63	64/90	88/126	140/202	180/252
CPU Time [S]	0.7	1.5	2.9	8.0	13.2
Memory Size [KW]	60	66	78	114	151

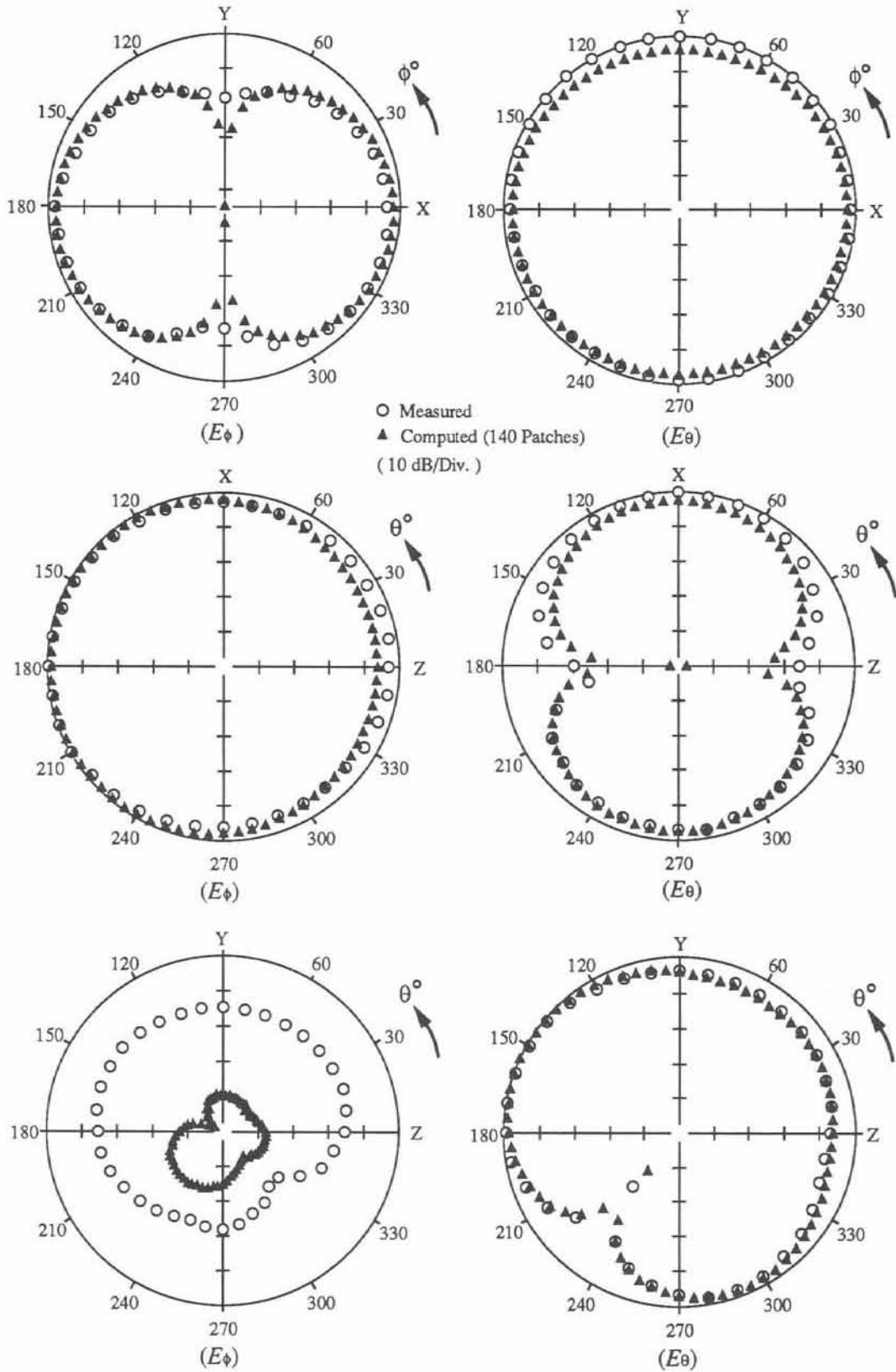


Fig. 3. Far-field radiation pattern of the antenna at Frq=920[MHz].