# Wide angle impedance matching by dielectric backed open-ended waveguide radiators

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## Abstract

This paper presents a complete moment method analysis of an array of dielectric flushed waveguide radiators. The methodology followed is the analysis presented in [1]. The whole problem is solved as a coupled boundary value problem and the scattering matrix of the structure is determined by application of the method of moments. It is demonstrated that use of dielectric plugs improve the active admittance of the array significantly even for large beam scan angles. The method is tested for some practical beamshapes and found to be satisfactory. The technique is compared with the parasitic loading technique of the wide angle impedance matching scheme [2]. Apart from the electrical advantage, the fabrication advantages of the dielectric plugs is also pointed out.

## 1 Introduction

For scanning applications, usually a phased array is excited with nonlinear phase distribution. For effective power transfer to free space in those cases, the active admittances of the individual array elements need to be stabilised, particulary at the onset of the grating lobe. One popular stabilisation method is by parasitic loading some of the elements [2]. However, only small angle scanning is possible by this method against a requirement of 30 to 40 degrees scanning. Another problem is the reduction of the number of active elements of the array in parasitic loading, which gives rise to beam flattening. Mechanically also, the fabrication of the grooves or sliding shorts of such small lengths at the backside of the radiating plane with high precision poses difficulty.

## 2 Results

In this paper, dielectric backed waveguide radiators are used to form a linear array of waveguide radiators and the active admittance of the structure is found out by complete moment method analysis. The results are first cross-checked with the element by element approach. Then the variation of VSWR with scan angle is shown and the effect of the onset of grating lobe on the active admittance is pointed out. The same method is used to show the admittance behaviour of the array when a narrow Cosecant beam is synthesised by giving nonlinear phase progression. For high scan values, the radiation pattern of the dielectric loading is compared with the unloaded nine-element linear array and the results are shown in Fig 1. It is observed that at the onset of grabing lobe, the main beam of the pattern is uneffected by dielectric loading, but at the small angles, the sidelobes are disturbed. To complete the picture, some of the elements of the array are parasitically loaded and the active admittance and VSWR of such array element evaluated. This parasitically loaded array is compared with the dielectric backed array in Figure 2. It is seen that dielectric loading is able to stabilise the VSWR of the central element of the array in a much better way than the parisitic loading scheme.

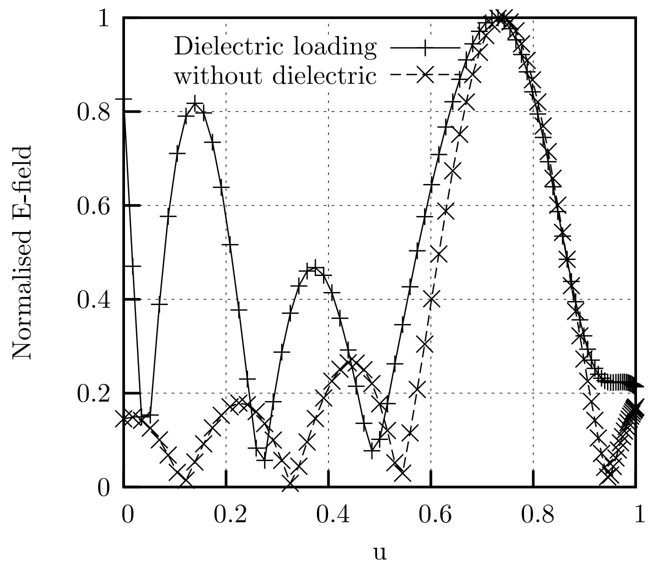


Figure 1: Effect of dielectric loading on the radiation pattern of a linaer array for 45 deg scanning

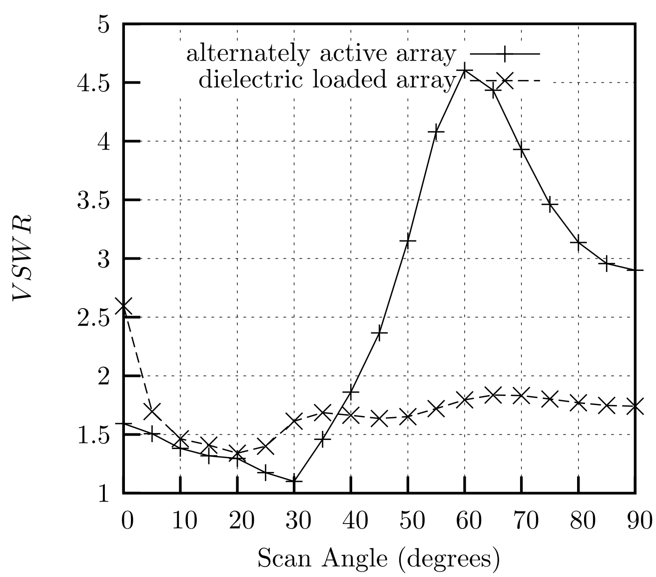


Figure 2: Comparison of WAIM performance between dielectric loaded and parasitic loaded linear array

## References


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[2] F. Arndt, K. H. Wolf et al., "Generalised Moment Method Analysis of Planar Reactively loaded rectangular waveguide arrays, *IEEE Transactions on Antenna and Propagation*, Vol.17, No.6, pp.740-746, Nov.1969.