in a direction normal to the array axis. Two imposed nulls were located at 26 and 32.5° corresponding to the peaks of the fourth and fifth sidelobes. The results for the analytic and the genetic algorithm solutions are shown in Figs. 4 and 5, respectively.

Conclusions: A genetic algorithm has been successfully applied to the problem of array pattern nulling by element position perturbations. It has provided superior accuracy in null location to the analytic method and has maintained the required null depth. The technique also removes the restrictions of relative small perturbations imposed by the analytic solution.

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Coplanar waveguide fed coplanar strip dipole antenna

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Indexing terms: Coplanar waveguide, Dipole antennas

A novel coplanar waveguide fed coplanar strip dipole antenna is presented. Return loss data as well as antenna patterns are shown. The antenna is matched with the use of a novel, wideband balun.

Introduction: In recent years coplanar transmission lines have become more acceptable for many microwave circuit applications. Coplanar transmission lines have several features which make them attractive for use in MIC and MMIC structures. Some of the major advantages are: ease of fabrication; no need for via holes; and simple, coplanar implementation of solid state devices. To take full advantage of these uniplanar structures, many uniplanar components should be developed. The transmission lines themselves have been analysed extensively [1,2]; however, very few coplanar components have been presented in the literature.

Several different antenna feed mechanisms have been suggested in the literature with varying degrees of success [3]. This Letter presents a coplanar waveguide (CPW) fed coplanar strip (CPS) dipole antenna. A novel, low-loss, wideband transition from CPW to CPS was first built and tested to provide the necessary transformation from the unbalanced CPW to the balanced CPS line. The CPS then feeds the dipole antenna. The antenna has a good radiation pattern and a return loss of greater than 19dB.

This circuit has many practical applications in low-cost, compact antenna systems. In conjunction with an active device this antenna is well suited for quasioptical power combining and active antenna systems.

Circuit and antenna configuration: The CPW fed dipole is shown in Fig. 1. The wideband transition from CPW to CPS is accomplished by using a hollow, circular patch. This patch represents a very wideband open circuit which forces the current to flow between the two conductors of the coplanar strip transmission line. By careful design of the hollow patch the optimum operating frequency range of the transition can be shifted. Two back-to-back transitions provide an insertion loss of less than 1dB up to 5GHz. The entire circuit was constructed on Duroid substrate with dielectric constant ε_r = 2.2 and a thickness of 1.524mm. In Fig. 1, the width of the centre conductor, W, of the CPW is 2.0mm and the gap G is 0.1mm. The diameter of the hollow path D is 6.36mm and the antenna length L is 61.25mm which corresponds to slightly less than half the wavelength. Bond wires were placed at the discontinuities to suppress the generation of undesired modes.

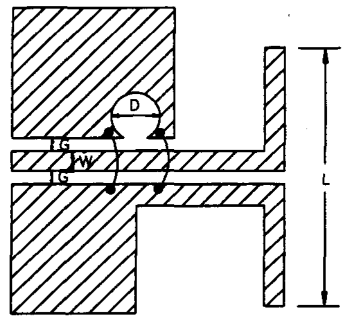

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Fig. 1 *Circuit configuration for CPW-fed CPS dipole*

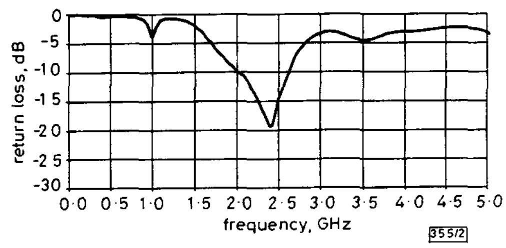

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Fig. 2 *Measured return loss of antenna circuit*

Experimental results: The circuit was first tested on an HP8510B to determine the return loss of the antenna. The results are presented in Fig. 2 and show a return loss of more than 19dB at a frequency of 2.39GHz. The slight dip in the return loss at 1GHz was caused by the test fixture and was not associated with the antenna performance. The antenna pattern and gain were measured using an HP85360A antenna measurement system. The E-plane and H-plane radiation patterns are shown in Figs. 3 and 4 , respectively, with both the copolarisation and crosspolarisation displayed. The radiation patterns as well as the low crosspolarisation levels are typical of normal dipoles. The lower level of radiation in the H-plane at –100° is due to the effect of the test fixture. Because there is no ground plane, radiation is obtained in a full 360°.

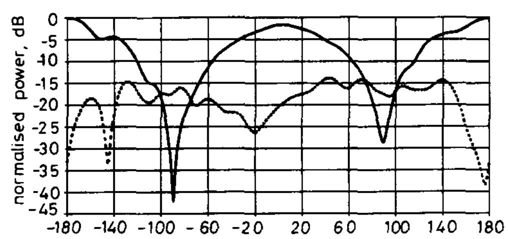

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Fig. 3 *Measured copolarisation and crosspolarisation in E-plane*

——— copolarisation
– – – – crosspolarisation

Conclusion: A novel coplanar waveguide fed coplanar strip dipole antenna has been built and tested. The measured return loss shows very good matching which is achieved through a wideband balun. The antenna has a good return loss and a radiation pattern which is typical of most dipoles. This antenna should find wide application in low-cost, compact antenna systems and is adaptable to many different needs.

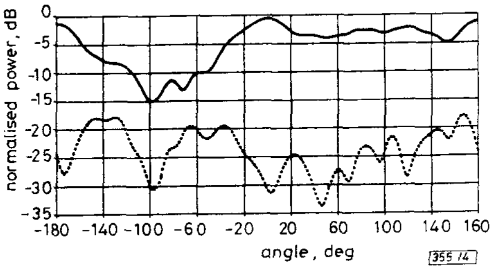

Fig. 4 *Measured copolarisation and crosspolarisation in H-plane*

——— copolarisation
– – – – crosspolarisation

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Effect of an air gap around the coaxial probe exciting a cylindrical dielectric resonator antenna

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Indexing terms: Adaptive arrays, Antenna arrays, Adaptive signal processing

Results of an experimental study pertaining to the effect of an air gap surrounding the feed probe of a cylindrical dielectric resonator (CDR) antenna on its input impedance and resonance frequency are presented. The antennas under consideration consist of a CDR positioned on a conducting ground plane and fed by a coaxial probe to excite either the TM_{01} or HEM_{11} antenna modes.

Introduction: When a dielectric resonator (DR) antenna is fed by a coaxial probe, the electromagnetic field boundary conditions demand that the electric field (**E**) lines terminate normally to the surface of the feed probe. Because the normal component of **E** is discontinuous across a surface separating two media of different permittivities, the introduction of a thin air gap between the feed probe and a high permittivity DR may have a severe effect on the input impedance and resonance frequency of the antenna. Previous air gap studies have concentrated on the effect of a very thin air gap (whose order of magnitude may be that of surface imperfections) between the bottom of the DR and the ground plane on which it resides [1, 2]. The intent of this Letter is to present the results of an experimental investigation which demonstrates the effect of an air gap surrounding the feed probe of a dielectric resonator antenna.

Test setup: Fig. 1 illustrates the antenna under test. The antenna consists of a PVC tube of height h = 2.6cm with inner radius, r_a = 2.57cm, and outer radius, r_b = 3.0cm, which serves as a container for a powdered dielectric material (Emerson & Cuming 'Hi-K powder') with relative permittivity ε_r = 12. A powdered material was selected to ensure that there is no air gap between the DR and the conducting surfaces for the 'no air gap' test case [2]. The feed probe of length l_w and radius a_w = 0.381mm is soldered to an SMA connector. In this study, the air gap between the dielectric material and the feed probe is simulated by inserting the feed probe into a teflon tube (ε_r = 2.1) with an inner radius of 0.3968mm and wall thickness t = 0.3968mm as illustrated in section cut A-A of Fig. 1. Because electrical lengths are inversely proportional to the square root of ε_r, the use of a teflon tube to simulate an air tube is reasonable. All measurements were made using an HP8510B network analyser.

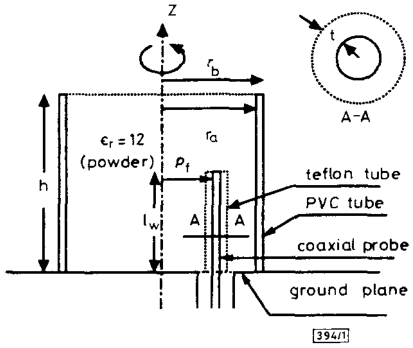

Fig. 1 *Geometry of test antenna*

Results: Using the technique presented in [3], the theoretical resonance frequencies for the TM_{01} and HEM_{11} modes for the CDR under consideration (without the presence of the feed probe) were found to be 2.033 and 1.377GHz, respectively. To excite the TM_{01} mode, a feed probe of length l_w = 1.5cm positioned at ρ_f = 0.0cm was used. Fig. 2 plots the input impedances against frequency for the TM_{01} mode. As can be seen, the resonance frequency shifts from 1.68 to 1.92GHz and the magnitude of the resonance impedance is reduced on the introduction of the air gap. Inserted in Fig. 2 is a plot of the return loss as a function of normalised frequency. The return loss is given to show that the frequency obtained from the minimum return loss is not an indication of the resonance frequency of the antenna. The frequency at which the return loss is minimum for both antennas is near the predicted resonance frequency for the CDR without the feed probe. Note that unlike the antenna without the air gap, the resonance frequency of the antenna with the air gap is near the frequency at which the return loss is a minimum. The 10dB bandwidth of both antennas is about the same; however, the antenna with the gap is a better 50Ω match. The 10dB bandwidth of the no gap antenna appears to be wider only because of the influence of the next higher zero order mode. Also obvious from inspection of Fig. 2 is that introduction of the air gap shifts the next higher zero order mode up in frequency.

To excite the HEM_{11} mode, a feed probe of length l_w = 2.18cm positioned at ρ_f = 1.4cm was used. The measured input impedances are presented in Fig. 3. The effect of the air gap on this antenna is similar to that of the antenna operating in the TM_{01} mode. On introducing the gap, the resonance frequency shifts from 1.278 to 1.326GHz and the magnitude of the resonance impedance is reduced. For this mode, introduction of the air gap