COMPACT DIVERSITY ARRAY FOR WIRELESS APPLICATIONS

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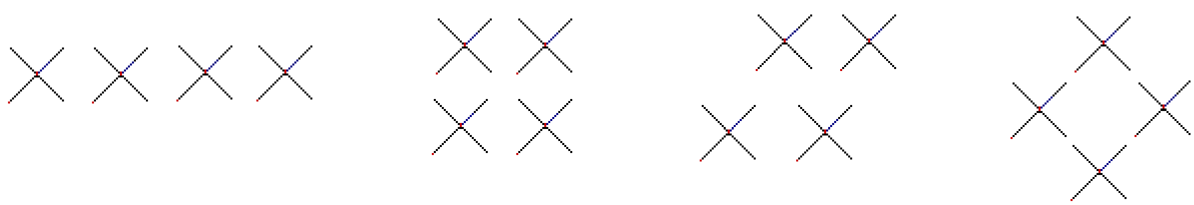
ABSTRACT

An eight element compact array using ±45° polarization scheme was designed for wireless applications. Different lattice arrangements such as linear, rectangular, triangular and circular were analyzed and the square lattice have shown the best performance in terms of power correlation and output SINR.

INTRODUCTION

In this paper, the performances of four different array arrangements using four sets of ±45º slanted linearly polarized patch dipoles over an infinite ground plane are analyzed. The ±45° slanted polarization diversity scheme have shown low correlation between elements and comparable diversity gain with respect to the space diversity scheme. The array lattice arrangements considered here are linear, rectangular, triangular and circular as shown in Fig. 1. The spacing between the elements is $\lambda/2$ except for the circular lattice where a separation of $\lambda/2$ makes the elements too close. The overall sizes of the array arrangements are approximately $\lambda/2*2\lambda$ for the linear lattice, $\lambda*\lambda$ for the rectangular lattice, $\lambda*1.25\lambda$ for the triangular lattice and $1.625\lambda*1.625\lambda$ for the circular lattice. The overall dimensions using eight elements are reasonably compact allowing for convenient integration on the body or on a PC card of a laptop computer for the next generation 5.78 GHz band LAN systems.



(a) Linear (b) Square (c) Triangular (d) Circular

Fig. 1 Array arrangements of $\lambda/2$ dipoles

RESULTS

The radiation pattern of an array element is usually different than its stand-alone pattern due to the mutual coupling between the elements and known as active element pattern [1]. The normalized active element power pattern of the 3rd element is shown in Fig. 2. The power gain for all the arrangements above falls below –20 dB for $\theta \geq 80°$ for all values of ϕ, which shows that all the arrays will have equally bad response for signals incident from near broadside. The far-field power correlation coefficient [2] between elements 3^{rd} and 6^{th} for different values of XPD are calculated by using the active element patterns and are plotted in Fig. 3. The shaded areas in Fig. 3 represent the ranges of angles where the correlation coefficient is greater than 0.7. The nature of the power correlations between the elements is very different for each of the arrangements. The range of angles for which the power correlation is less than 0.7, needed to achieve a reasonable diversity effect, is largest for the square lattice.[1]

[1] This work was supported by Florida Space Grant Consortium and Intersil Corporation, Melbourne, Florida.

The responses from the diversity branches can be combined in many different ways to reduce the multipath/interference effect. By using an LMS adaptive algorithm [3] to null the multipath/interference, the variation of output signal-to-interference-plus-noise-ratio (SINR) with the incident angle of interference is analyzed. The input desired signal-to-noise and input interference-to-noise ratio are set at 0 dB and 5 dB. All possible combinations of the linear polarization state (β = 0º, 30º, 45º, 60º, 90º) of the desired signal and interference and the angle of incidence of the desired signal (θ_d, ϕ_d) are investigated. The results show that when both desired signal and interference have the same polarization all the four arrangements have comparable performance for most of the values of θ_d, ϕ_d, although for some values of θd, ϕ_d the performance of square and triangular lattices are better. However, when the polarizations of the two signals differ the square and triangular lattices outperform the other two. Fig. 4 shows variations of output SINR with the incident angle of interference for all four arrangements. We examine the range of angles where the value of SINR is –2 dB or less, which are shown as the shaded areas in Fig. 4, as the arrays can then successfully null all the interferences except those. For orthogonally polarized signal and interference the range of angles where SINR is –2 dB or less is considerably smaller for the square and triangular lattices than the other two lattices.

CONCLUSION

The eight elements square lattice array has a very compact size with respect to the other arrangements and it shows better performance in terms of SINR and power correlation coefficient.

REFERENCE

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[2] Lindmark B. and Nilsson M., "On the available diversity gain from different dual-polarized antennas", *IEEE J. Select. Areas Comm*., vol. 19, pp. 287- 293, 2001.

[3] Compton R.T.,"*Adaptive Antenna –Concepts and Performance*", Prentice Hall, 1988.

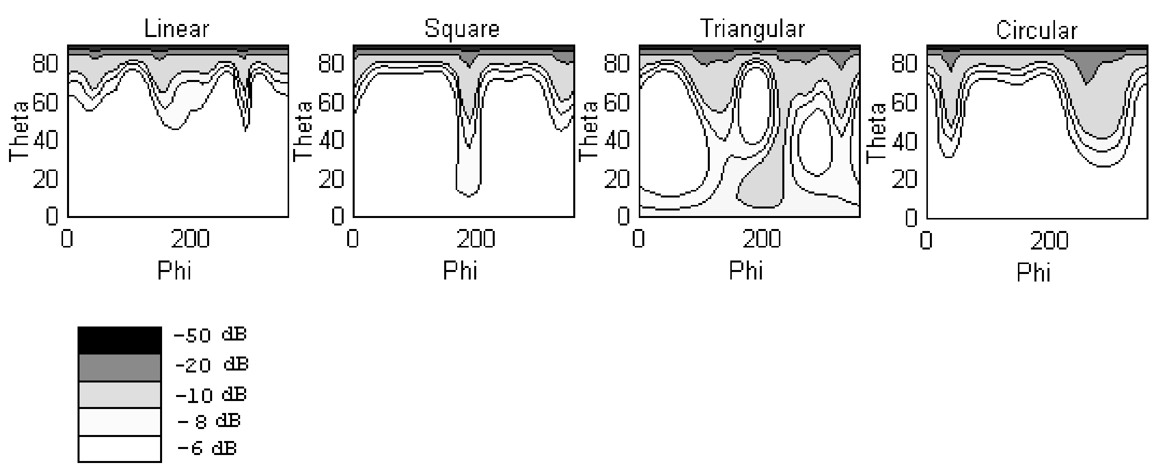
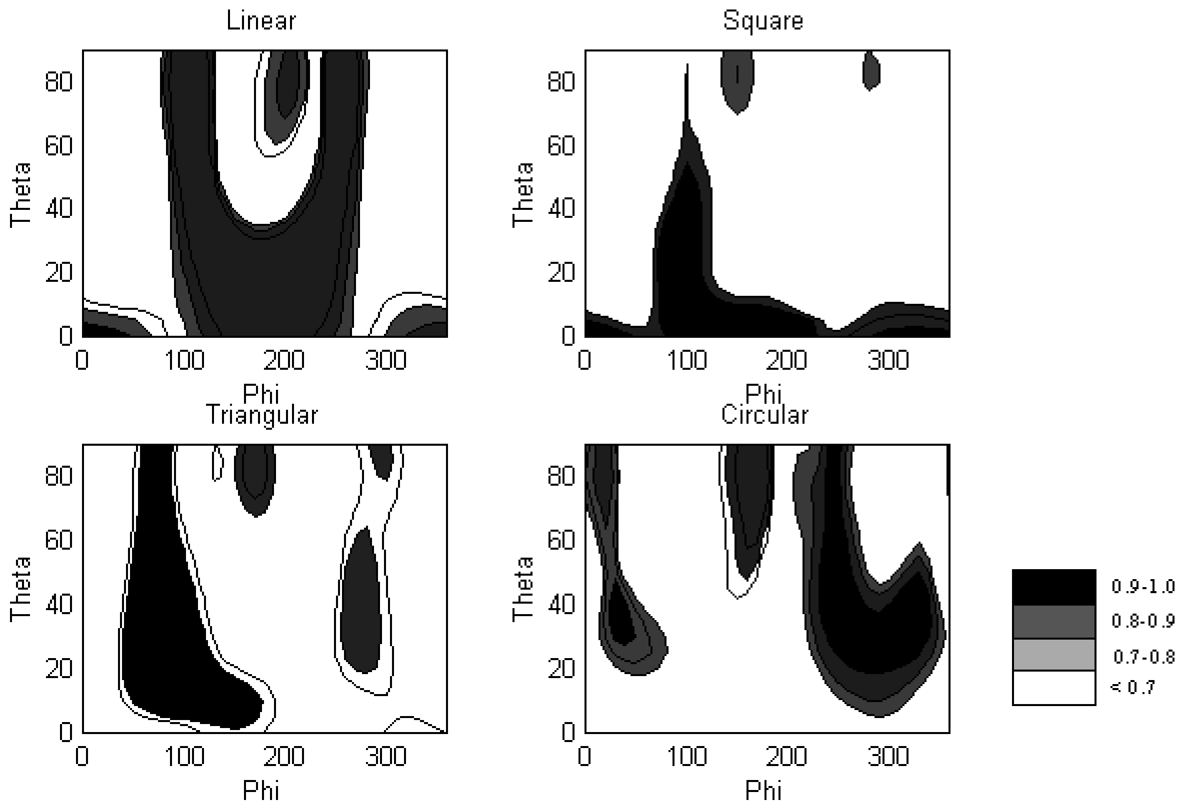
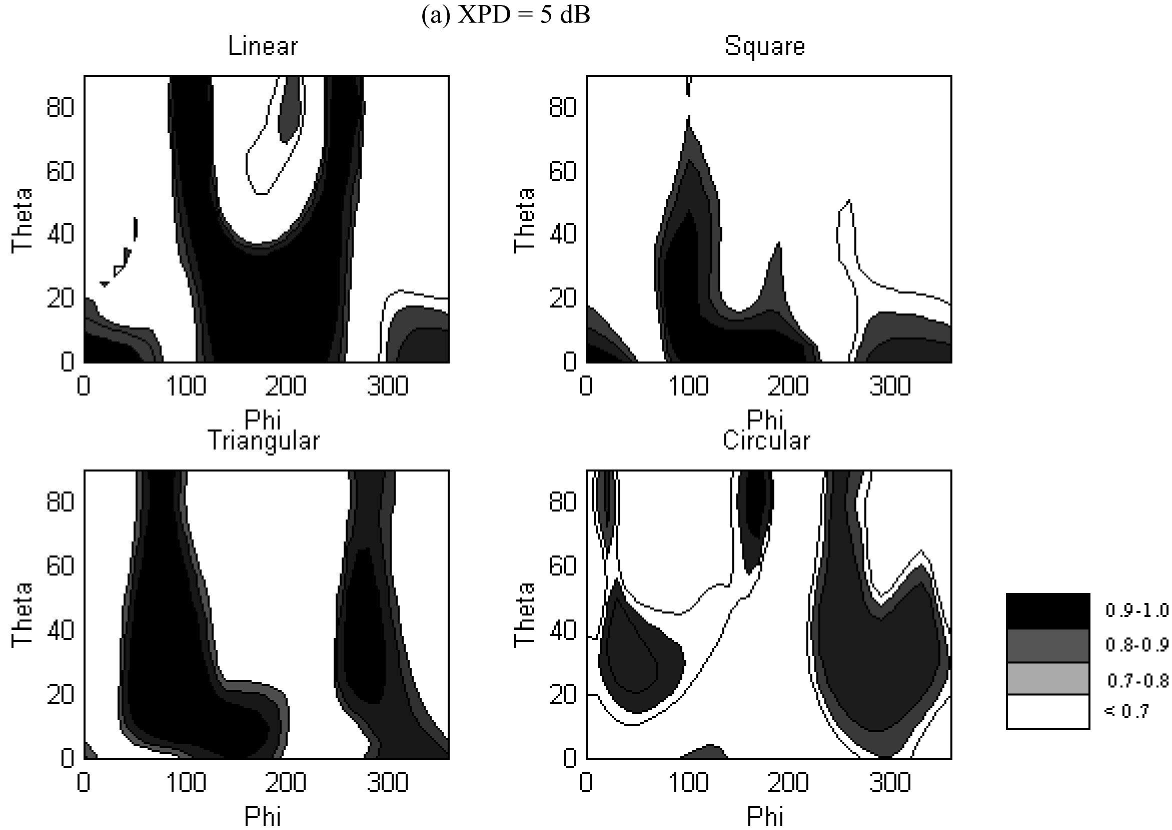


Fig. 2 Element power pattern of the 3rd element for all four arrangements

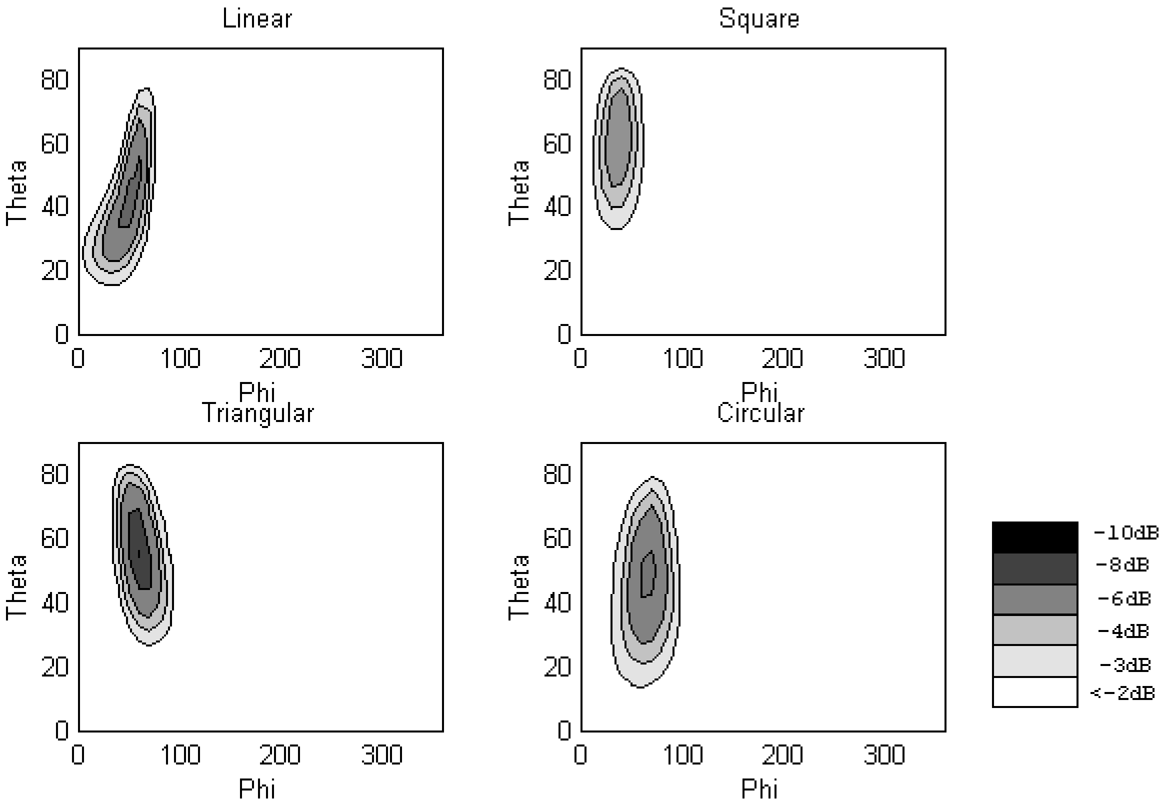


(a) XPD = 5 dB

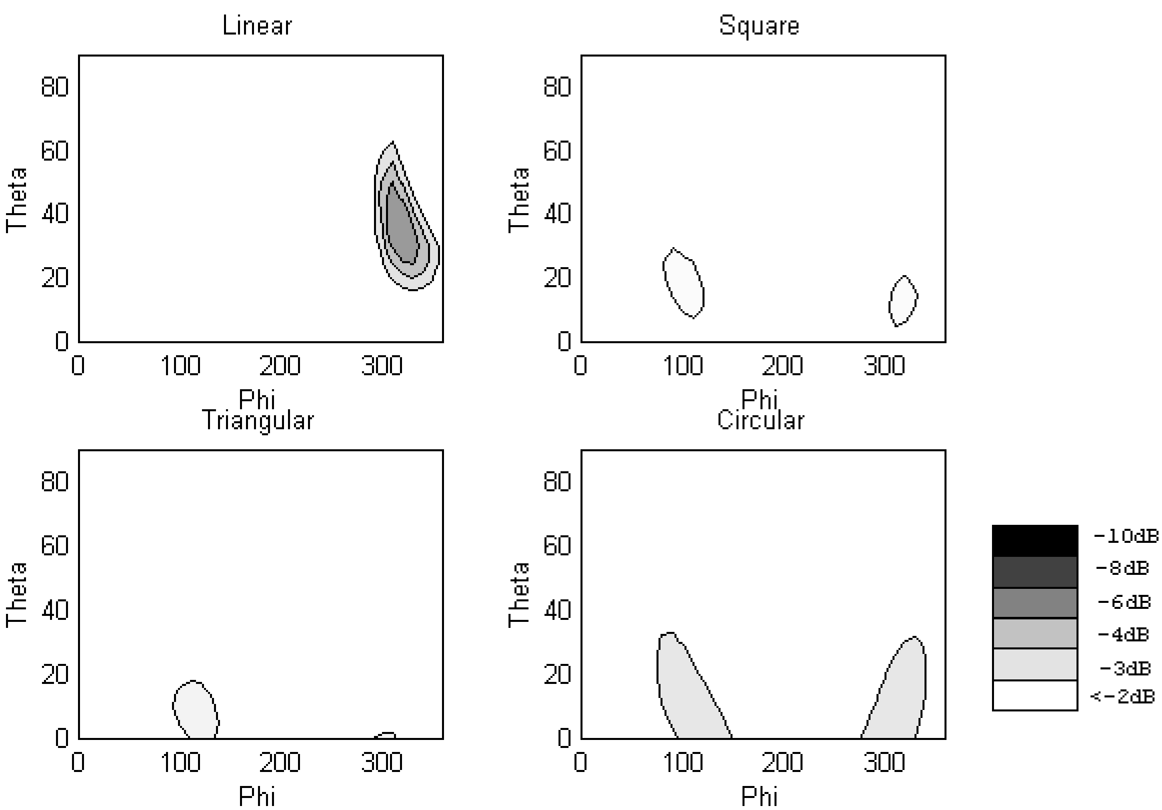


(b) XPD = 9 dB

Fig. 3 Far-field Power Correlation Coefficient between the third and sixth elements



(a) horizontally polarized desired signal and interference, $\theta_d = \phi_d = 60°$



(b) horizontally polarized desired signal, vertically polarized interference, $\theta_d = \phi_d = 30°$

Fig. 4 SINR as a function of the angle of incidence of interference