

# A Foldable, Wideband, Dual-Polarized Patch Array

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**Abstract**—A foldable, dual-polarized patch antenna array is presented. Wideband array is normally thick and difficult to fold. Our approach is to make the elements collapsible, so as to make it very thin and foldable. The idea is demonstrated by a 4x4 array with collapsible patch elements and a foldable feeding network. The array is dual polarized, able to cover 1.15GHz to 1.35GHz with return losses better than 7.5 dB, gains about 2dB lower than ideal gain, and cross polarization better than 20dB. A volume reduction by 70% and weight of 150g/per element was achieved.

**Index Terms**—foldable, patch, array, dual polarization

## I. Introduction

Lighter weight, smaller volume and better performance has always been the design goal for antenna research and development [1]. As some examples, John Huang [2], proposed a paper-thin membrane aperture-coupled L-Band Antennas. An active membrane phased array was developed in [3]. Hashemi [4] presented a flexible X-band phased array with low density. Jian Lu [5] proposed a collapsible patch antenna to reduce the stored volume of the antenna while function as wideband antenna when deployed.

As our continue effort, in this paper, we propose a foldable, dual-polarized patch array using the collapsible patch antenna as the elements.

## II. The Element

Figure 1 shows the structure of the antenna element. The antenna consists of a top patch PCB made of 0.4mm FR4, two collapsible side FR4 PCB, and a ground RO4003 PCB housing two planar baluns, and four vertical flexible PCBs [5]. The side PCBs connect the top PCB to the ground PCB through micro hinges. The patch are excited by the two sets of baluns through vertical flexible PCBs. The patch antenna has an overall height of 2cm and can be fell down to 3mm for storage.

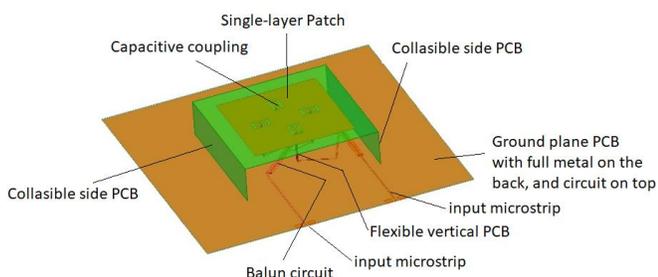


Figure 1: Structure of a collapsible patch antenna as the element

## III. The Foldable Array

Figure 12 shows the array configuration with 4x4 elements, spaced at half wave length at the highest frequency. It is grouped into four subarrays, with each being collapsible. Figure

2 shows the feeding network. Figure 3 demonstrate the foldability of the prototype array. Figure 4 shows the prototype array under test. Figure 5 shows the simulated and measured s-parameters.

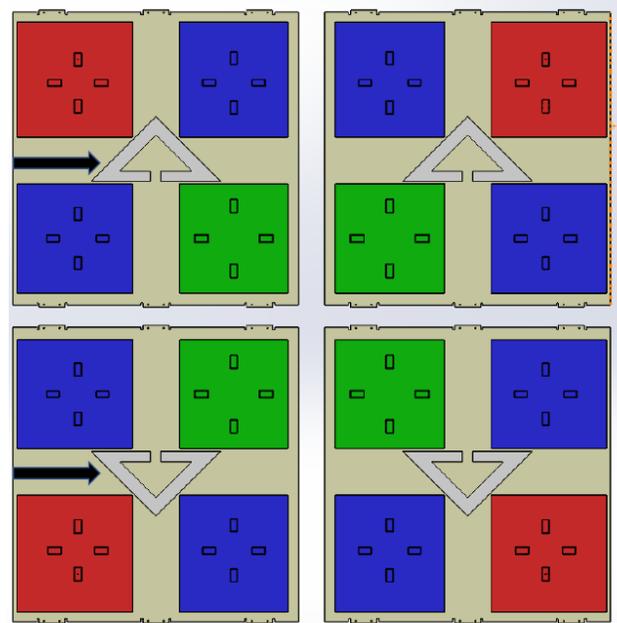


Figure 2: Array structure (front view)

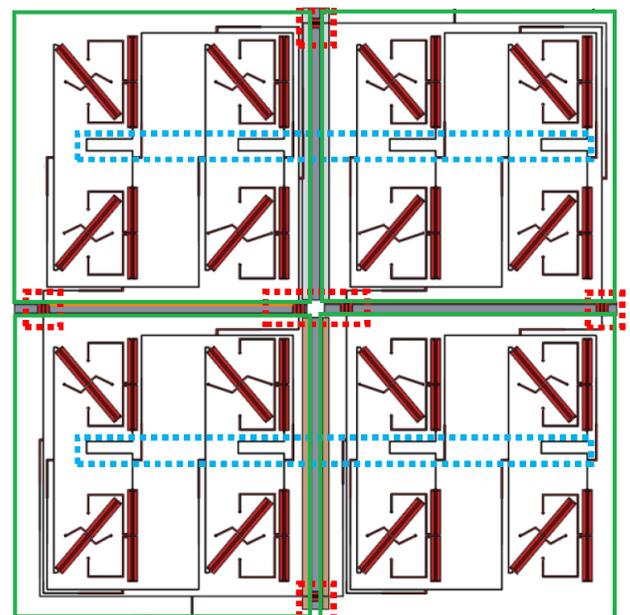


Figure 3: Array feeding network (front view)

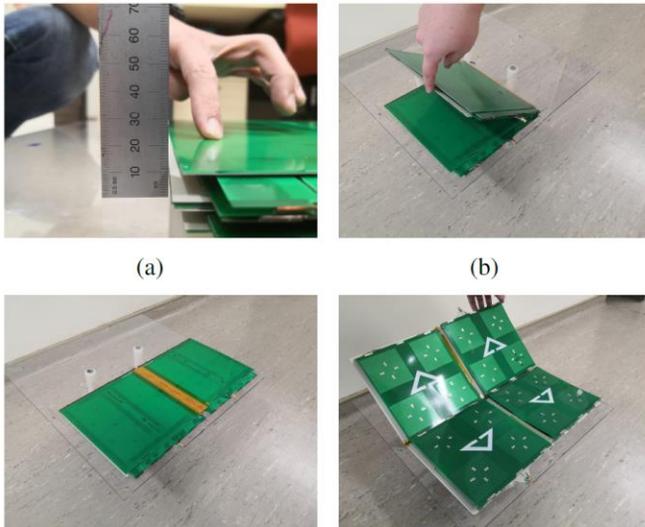


Figure 4: fold demonstration of the array

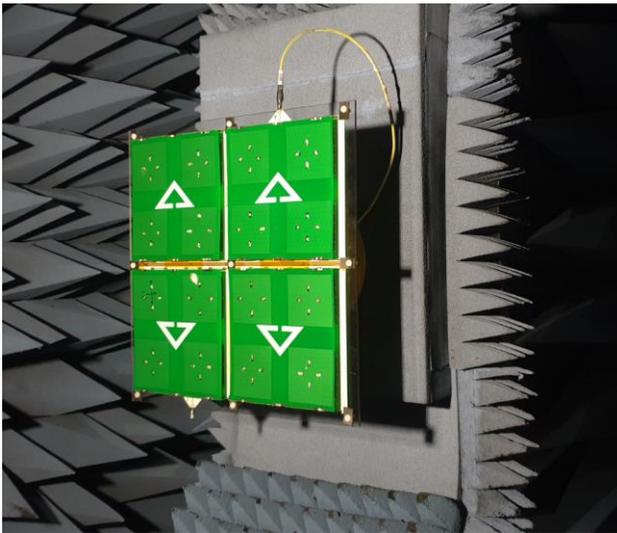


Figure 5: The array under measurement

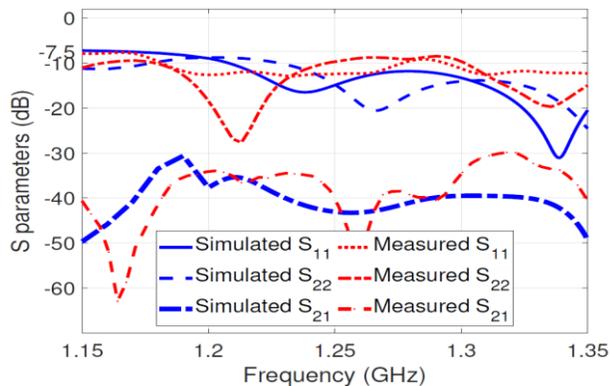


Figure 6: Simulated and Measured S-parameter

Figure 7 shows simulated and measured gain versus frequency. 2dB gain difference between the simulated and measured gain is observed. Which is due to the loss of power distribution network. Figure 8 shows the calculated efficiency.

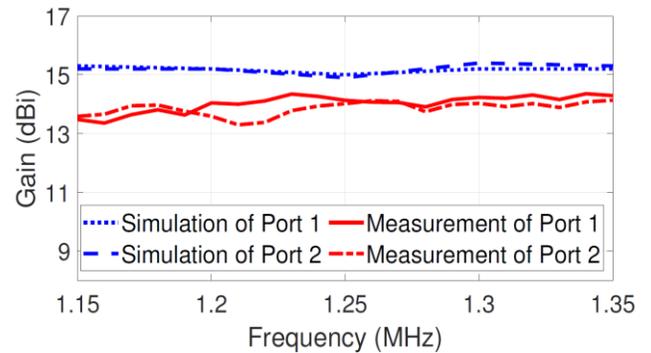


Figure 7: Simulated and measured gain

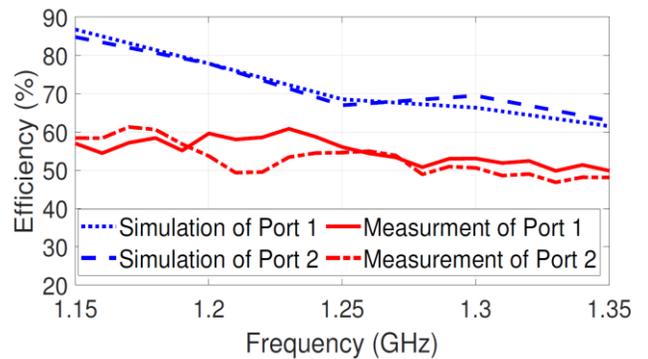


Figure 8: Simulated and measured efficiency

#### IV. Conclusion

A foldable array with collapsible elements was implemented and demonstrated. Volume reduction by 70%, and weight of 150g/per element was achieved. A dual polarization, 4x4 array with bandwidth from 1.15GHz to 1.35GHz was measured with return losses are better than 7.5 dB, and gains about 2dB lower than ideal gain, and cross polarization better than 20dB.

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