

# A Survey on Polarization Agile Antennas

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**Abstract:** Antennas with dynamically choosing functionalities are the future demand for an efficient wireless communication system. Reconfigurable antennas are having such function to satisfy the need. It provides flexibility in frequency, pattern and diverse polarization. When compared to frequency and pattern reconfigurable antennas, polarization reconfigurable antenna provides better results while considering extenuating the losses due to multi channel transmission. Latest researches based on polarization diversity antennas are described in this paper to present the classifications.

**Keyword:** Circular patch; Polarization; Reconfigurable antennas; Switching.

## I. INTRODUCTION

The demand for an efficient signal transmission in wireless system increases with increasing number of users[6]. Due to multipath transmission, mitigation of losses such as fading must be reduced to minimum level. Diversity in polarization must be achieved to extenuate the losses due to fading [3]. For this, antennas used for transmitting and receiving should have the capability to change its polarization. Antennas which subject to change its parameters, such as frequency, pattern and polarization called reconfigurable antennas. Frequency reusable antennas may offer wideband and different operations at time. Monopole antennas or loop antennas are the first to examine with multiple operations[12]. It was observed that complicated structure and high profile requiring huge quantity of diodes even though they offered expected results. Low profile antennas needed for easy design and fabrication to achieve better reconfigurability[8]. By using switches we can achieve polarization agility. Pin diodes[5], MEMS, varactor diodes, optical switches[2] and mechanically movable slots are the switching methods used in recent researches[9]. Some other switching types also proposed in various researchers and the detailed description will be discussed in later section of this paper.

The state of polarization can be changed from linear to circular or circular polarization itself it is subject change from left hand to right hand circular polarization[11]. Various researches proposed in polarization agile antennas. Two major design procedures followed in those investigations, they are arranging new feeding methods and changes in radiating area of an antenna.

## II. CLASSIFICATION

The polarization agile antennas can be classified based on the switching methods used. Five types of polarization agile antennas explained in detail.

### 2.1 Planar Polarization Agile Antenna

Investigation based on substrate integrated waveguides gives planar polarization reconfigurability. Polarization

can be tuned between linear, left hand circular polarization and right hand circular polarization. Ring antenna with split able square used as slot here to switch the polarization. Array with a size of  $2 \times 2$  designed and measured the important parameters. Special feature of this array is complementary nature of split square ring with TIY-5 substrate. Pin diodes are switching component between the square slots.

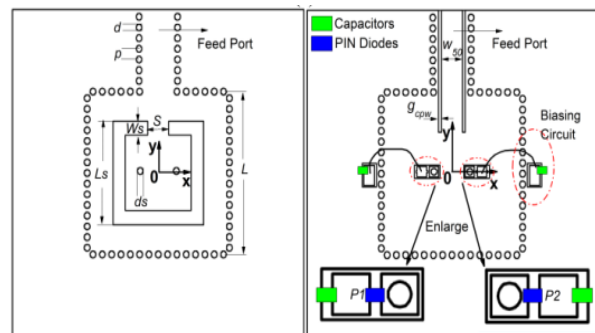


Figure 1 Planar Polarization agile antenna [1]

### 2.2 C-Shaped Antenna with Polarization Reconfigurable

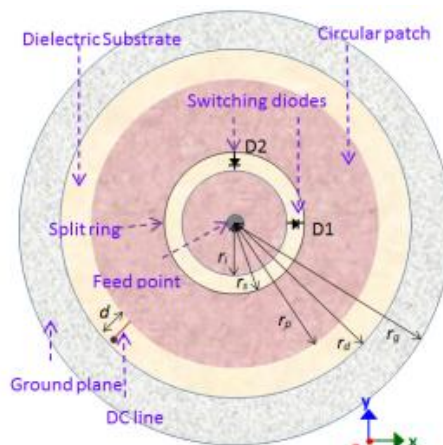


Figure 2 C-Shaped Polarization Reconfigurable antenna[4]

Based on U-Slot structure, C-shaped antenna is designed for circular polarization. Center probe feeding is given to this structure with a large change in concentric ring antenna. As it is designed for polarization diversity, the frequency of operation is fixed for the circular polarization. For switching diodes are used. It acts as a bridge for the inner and outer ring of the structure. If the switch is on state, the ring is split and for off state it is connected. Entire structure is placed on Rogers RT-Duroid substrate.

### 2.3 Water Spiral Polarization Reconfigurable Antenna

A novel tuning method to achieve polarization reconfigurability is proposed. For unidirectional radiation, the antenna put up at a ground plane. For left hand and right hand circular polarization, a glass container with two complementary channels is used. Spiral antenna with polarization diversity is achieved by directing the water flow into the channels. Despite of using conventional methods followed for spiral antenna, water is having high dielectric characteristics than metal strip which used in C-shaped antenna described above.

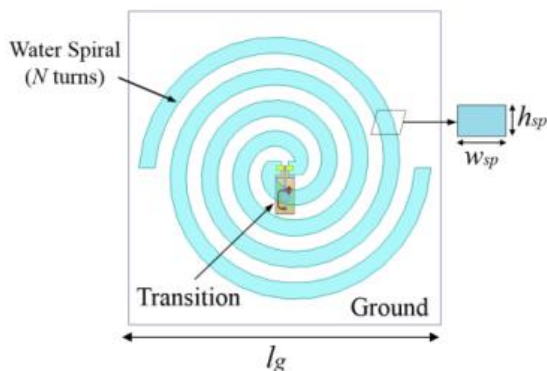


Figure 3 Water Spiral Polarization Antenna [7]

### 2.4 L-Shaped Circular Patch Polarization Antenna

Three different antennas with polarization reconfigurability explained above falls under the category of modifying the radiating structure. The L-shaped probe feeding to the Circular patch antenna offers multiple polarizations. Four states of operation can be achieved by using pin diodes for switching.

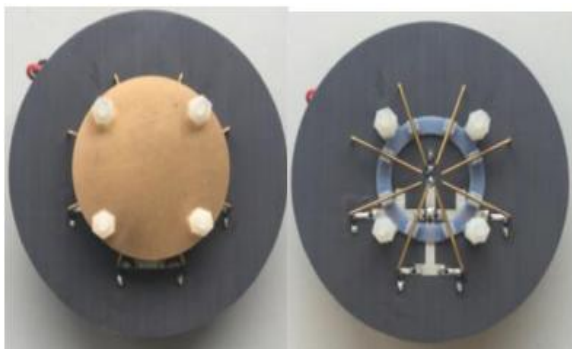


Figure 4 L-Shaped Reconfigurable Probe Feeding Antenna [10]

The design of this antenna is carried out in multiple layers. The layers are circular patch antenna, L-shaped reconfigurable probe feeding and a bias line implemented as separate layer.

### 2.5 Circular Polarized Reconfigurable Antenna

Circular polarized antenna geometry is based on switching. The switching at radiating structure can be changed by using piezoelectric transducer. When the applying DC voltage gets changed the state of the antenna polarization will be changed from its current state. Here the antenna is designed for circularly polarized. For each change in dc voltage the polarization is changed from left hand circular polarization to right hand circular polarization and vice-versa.

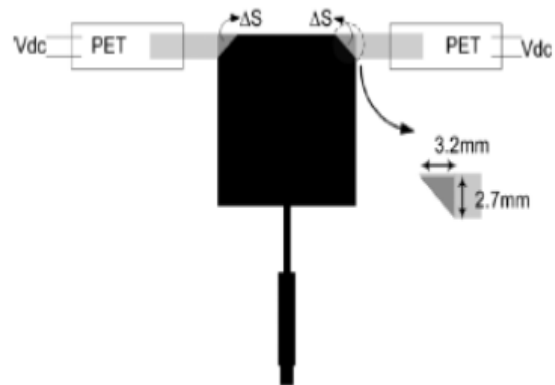


Figure 5 Circular Polarized Reconfigurable Antenna [13]

## III. CONCLUSION

The classifications of polarization reconfigurable antennas are presented in this paper. Polarization agility is achieved through changing the radiating structure or by adapting to new feeding networks. Three types of polarization reconfigurability is obtained and they are linear polarization, left hand circular polarization and right hand circular polarization. To achieve the reconfigure nature diodes, transducers and even water can give switching between the slots. With these features polarization agile antennas are more suitable for wireless transmission.

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