Reconfigurable Antennas for Wireless Application: A Brief Survey

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Abstract— Multiple standards are used in modern wireless system, so that they need antenna with multiple capabilities and functions. Reconfigurable antenna becomes a popular solution, it satisfy sundry communication demand and reduce the interference. Different antennas with frequency, polarization and pattern reconfiguration are used to meet the requirements of wireless application. For this purpose different techniques are either based on the integration of radio-frequency microelectromechanical systems (RF-MEMS), varactors, PIN diodes, or on the smart material such as ferrites and liquid crystals. In order to achieve optimum performance, various antennas can be used in each different reconfigurable implementation. It provides low cost, low profile, and reconfigurable solution for wireless communication application.

Key words: Multiple-Input-Multiple Output, Multifunction Antenna, Reconfigurable Antennas, RF-MEMS

I. INTRODUCTION

Multiple standards are used in modern wireless system, so that they need antenna with multiple capabilities and functions. Reconfigurable antenna becomes a popular solution, it satisfy sundry communication demand and reduce the interference. Reconfiguring an antenna is achieved through purposely changing its frequency, polarization, or radiation features. This change is achieved by many methods that redistribute the antenna currents and thus alter the electromagnetic fields of the antenna's effective aperture. Several examples of reconfigurable antennas in wireless communication are cognitive radio, multiple-input-multiple output (MIMO) systems etc. These methods reduce the number of components, hardware complexity, and maintenance cost.

A full system integrating reconfigurable antenna using MEMS switches and it provides different polarizations, due to polarized nature this type of antenna will reduce any radio interference by process known as multipathing. This blocks out unwanted radio signals and can give a much clear signal. RF-MEMS use mechanical movement to achieve a short circuit or an open circuit in a surface current path of an antenna structure. Reconfigurable antennas based on varactor diodes demonstrated by combining different antenna by achieving single and dual polarization. By using PIN diodes, it is possible to perform frequency, pattern and polarization reconfiguration. The antenna structure contains three layers, upper layer is metal patch, middle substrate has a dielectric constant of 4.2 and the bottom layer is ground plane.

In this paper, different reconfigurable antenna based on PIN diodes are discussed. The configuration variations are achieved by controlling switches, each implemented as a PIN diode. The response of RF-MEMs switching mechanism is slower than the PIN diode. Major advantages of PIN diodes is their good isolation and low loss property.

II. DIFFERENT RECONFIGURABLE ANTENNAS

There are several antennas already existed for reconfiguration. They are listed out in this section. Reconfigurable antennas can be classified in to four categories. First, the structure used for change its operating frequency by hopping between different frequencies bands is called frequency reconfigurable antenna. Second, the structure that is able to tune its radiation pattern is called radiation pattern reconfigurable antenna. In this category, the antenna radiation pattern changes in terms of shape, direction, or gain. Third, the structure that can change its polarization is called polarization reconfigurable antenna. Fourth, this category is a combination of the three categories.

A Novel hybrid-fed patch antenna has a circular patch with TM_{11} and TM_{01} mode. It can be operated at an overlapped frequency range for 2.4 GHz WLAN. TM_{11} mode reveals good broadside radiation patterns and TM_{01} mode shows monopole-like radiation patterns. The conical mode with vertical polarization can ensure adequate coverage along low elevation planes; it is very attractive for low-profile antennas. However, in conventional circular or ring patches, TM_{01} mode is a higher order mode. By using a hybrid feed network, conical and broadside modes are excited separately. It is attractive for providing hemispherical coverage and is good for polarization diversity application in WLAN and MIMO communication system.

A Monopole like and boresight pattern reconfigurable antenna is used to achieve two different radiation patterns by controlling the bias voltage of switches. The boresight is defined as the normal direction to the aperture surface. The proposed antenna is designed based on a top-loaded monopole antenna, which provides a monopole-like pattern. This monopole antenna is fed by a circular polarized waveguide line. When the diodes on, the antenna works as a slot antenna, which results boresight radiation pattern. When the diodes turn off, it is working as a top-loaded four-element monopole, which results in a monopole like radiation pattern. It is extended to an array configuration for adaptive beam forming or MIMO systems. This technique reduces multipath fading and probability of interference.

A novel reconfigurable antenna can be used for redirecting the main-beam position. By using pin diodes to switch ON or OFF the connections between the radiating patch and shorting walls, the reconfigurable antenna can be operated at the monopolar plate-patch mode or the broadside TM_{11} mode of a square-ring patch antenna, with the two modes resonant at the same frequency. The design concept of the switchable radiation patterns is similar to that in which the conical and broadside patterns are related to TM_{01} and TM_{11} modes of a circular patch antenna, respectively. It is easy to provide hemispherical coverage for

indoor mobile communication and it has low resonant frequency.

A printed antenna with pattern and frequency reconfigurable antenna by combining a planar monopole with microstrip patch antenna. This for achieving a novel reconfigurable planar antenna with frequency and pattern reconfiguration is proposed in this letter. The proposed antenna is reconfigured by combining a planar monopole with a microstrip patch connecting with each other by five p-i-n diodes divided into two groups. The monopole is designed for 2.4 GHz with an omnidirectional pattern, the patch operates at 5.4 GHz with a broadside unidirectional beam, and both radiations are in the same horizontal plane. By controlling the diodes, the monopole mode and the patch mode can be operated separately or simultaneously.

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