Conceptual difference in reconfigurable antenna from smart antenna

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Abstract

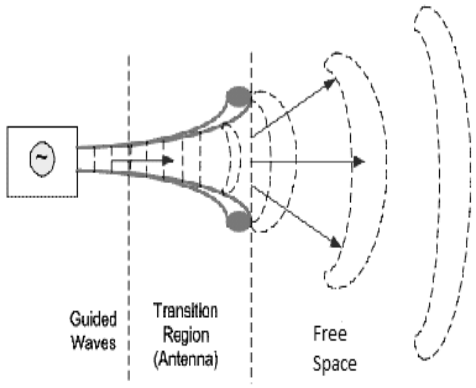
Objectives: To study the basic concepts of reconfigurable antenna and compare it with smart antenna.
Methods/Statistical analysis: Both reconfigurable antenna and smart antenna have similar capabilities, but in the case of reconfigurable antenna it is achieved by single element. In the case of smart antenna it is achieved externally. We study the mechanism involved inside reconfigurable antenna like electrical, mechanical, optical and material changes.
Findings: Combining the concepts of both reconfigurable and smart antenna is to attain better adaptivity for better performance. Combining these two properties can increase the applications and usability of the antennas. A microstrip antenna is capable of combining both the applications of smart and reconfigurable antennas.
Application/Improvements: Further antenna can be designed to adjust for Direction of Arrival, Beam forming which can be reconfigurable to different frequency and polarization.

Keywords: Reconfigurable antenna, Smart antenna, Antenna Parameters, Mechanism, Adaptive

1. Introduction

Antennas are key components of any wireless communication system and it is a device that provides a way for radiation or receiving electromagnetic waves. IEEE standard definition of terms for antenna (IEEE Std 145-1983) defines antenna as a means for radiating or receiving radio wave [1]. Figure 1 explains antenna as transition device [1].

Figure 1. Antenna as a transition device



2. Concept of Reconfigurable antenna

In this antenna type, switching is made possible where the shape of the radiating element is changed. Many reconfiguration techniques such as electrical, mechanical, optical and material changes have been implemented by the designers to satisfy the given conditions.

The electrical reconfiguration technique involves redistribution of antenna current and also based on switching. The optical reconfiguration involves the wide utility of the photoconductive switches which does the ON-OFF operation depending on the light which is incident on it.

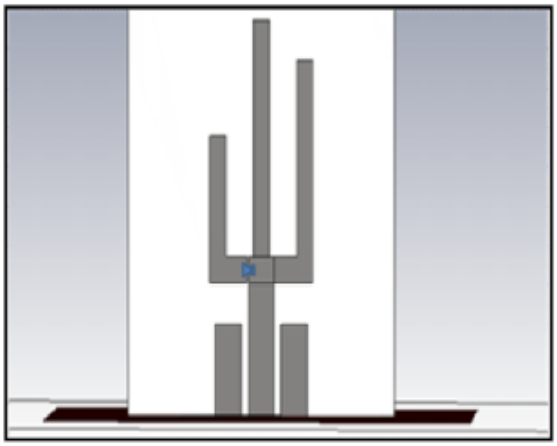
There has always been a tradeoff between the complexity of the antenna and its reliability. This tradeoff is being satisfied by the neural networks. Reconfiguration can also be done on a software platform with the help FIELD

PROGRAMMABLE GATE ARRAY (FPGA). Neural networks can be interfaced on an FPGA or microcontroller board, which is given appropriate training for reconfiguration. Neural Networks are used as a prediction device to predict the behaviour of the antenna.

For the electrical switching pin diodes can be used owing to their fast switching time. These are used as an alternative to the RF-MEMS. These are also done to obtain high bandwidth and low insertion loss. Testing of this re-configurability can be done with the aid of a resonator, magneto-electric dielectric. As far as the design of this antenna is concerned if the size of the antenna compared to the wavelength at around 500 MHz, this introduces a limitation to the radiation efficiency [2-5].

Figure 2, where diode can be switched from ON condition to OFF condition for achieving frequency reconfigurable [6].

Figure 2. Schematic of Frequency reconfigurable antenna with diode switch



3. Concept of smart antenna

Transmission from antennas can be done in a desired direction. For the reception of these signals (by an array of antennas) from a given direction and to make null to all other direction we require smart antennas. This involves suitable sampling, quantization and signal processing which is done by the system.

An inference can be made that the systems are smart rather than the antennas, which leads to the increased directivity in that particular direction and signal to noise ratio. The propagation error which involves dispersion, scattering and intersymbol interference is reduced.

There are two types of smart antennas, switched beam antenna and adaptive antenna. Switched beam antennas are those whose patterns are fixed and defined beforehand by the designer. Whereas adaptive antennas are those with uncountable patterns, with real-time adjustments made.

There is a physical movement of the antenna but for each element of the array of antenna and there is a shift in the phase, without the physical movement of the antenna itself. This can be steered electronically as well which is done by programming the transmitter to send signals over each cable [6]- [9].

In smart antenna very high security of the data transmitted can be achieved which cannot be tracked by any other antenna [10].

Figure 3 and Figure 4 explain the concept smart antenna with switched beam array and adaptive array respectively [8].

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Figure 3. Smart antenna with switched beam array

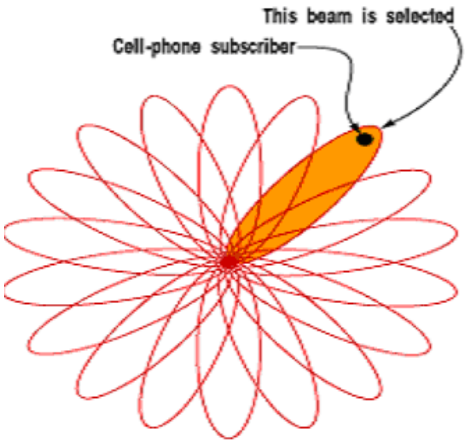
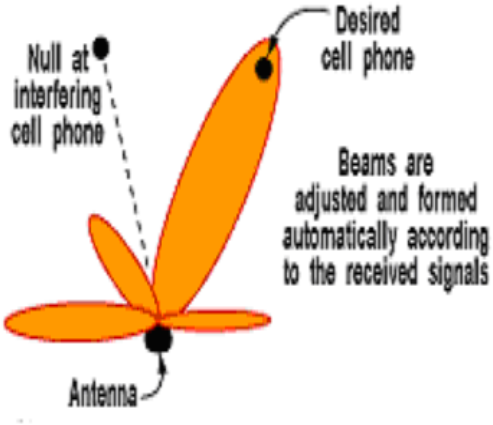


Figure 4. Smart antenna with adaptive array



4. Comparing reconfigurable and smart antennas

Table 1 compares reconfigurable antenna and smart antenna.

Table 1. Reconfigurable antenna compared with smart antenna

Factors	Reconfigurable Antennas	Smart Antennas
Techniques	Electrical, Mechanical, Optical and Material changes	Switched beam antenna and adaptive antenna
Mechanism	Inside the antenna	External beamforming network
Parameters	Frequency, polarization, compound and Radiation pattern	Direction of Arrival and beamforming
Uses	Mobile WiMAX, LTE, LTE advanced and WLAN	WSN and Space applications Mobile WiMAX, LTE, LTE advanced and WLAN

5. Combining reconfigurable smart antennas

In reconfigurable antenna, change of shape can be achieved by switching; this switching property allows the user to roam in any existing network with the help of a single headset. In case of smart antenna, an array of elements changes the radiation pattern in a dynamic manner. With the help of the Least Mean Square algorithm, the combination of smart and reconfigurable antenna can be done in a single array performance. Adaptive antennas usually increase the signal to noise ratio and system capacity is enhanced. Whereas, in reconfigurable antennas the selectivity is in the frequency, bandwidth, polarization and gain. Thus, combining these two properties one can increase the applications and usability of the antennas.

Dual band reconfigurable antenna is designed and for switching between different frequency bands, where switching can be done with the help of RF-MEMS switches for different frequencies. A microstrip antenna is capable of combining both the applications of smart and reconfigurable antennas [11,12].

6. Conclusion

We studied the concept of Reconfigurable antenna and Smart antenna to combine for achieves better adaptively. Further, the antenna can be designed to adjust for Direction of Arrival and Beam Forming which can be reconfigurable to different frequency and polarization.

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