A Reconfigurable Antenna Array (RAA) integrated with RF Switches

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The recent rapid development of wireless communication systems has created a strong need for the development of new antenna structures. The research described in this project introduces the concept of reconfigurable antennas with switching beam control, operable at 5.8 GHz.

Reconfigurable antennas are very attractive for modern wireless communications because they allow the use of a single antenna for multiple systems. The research described in this project introduces the concept of reconfigurable antennas with switching beam control, operable at 5.8 GHz. In this project, a new reconfigurable antenna design was proposed; namely a Reconfigurable Antenna Array (RAA). In the RAA configuration, the behavior of the reconfigurable multiple element linear antenna array system has been investigated with respect to the beam shaping characteristics. Two different beam patterns were achieved by reconfigure the number of patches element.

RAA for different area coverage

A completed project led by Mohd Tarmizi from Universiti Teknologi MARA presented a reconfigurable multiple element micro strip rectangular linear array antennas integrated with radio frequency (RF) switches. Reconfigurable beam shaping is ideal for the detection of small and large targets at both short and long ranges, including where the antenna is mounted on a high tower or hillside. "Reconfigurable antennas

have been applied to many military and mobile communication applications where it is necessary to have a single antenna that can be dynamically reconfigured to transmit or receive on same or multiple frequency bands", says Tarmizi. The development of a new and innovative antenna design is proposed which integrates RF switches to implement beam control in a reconfigurable antenna.

Antenna Design

The team had to involve antenna design, fabrication and measurement in order to develop the optimum type of antenna. The objectives of the project were to study, design and fabricate an innovative RAA with respect of control of beam shape characteristics at a resonant frequency of 5.8GHz. Also to develop and design a Programmable Interface Controller (PIC) power microcontroller circuits that can be used to supply the DC voltage to activate the PIN Diode switch circuits. The simulated and measured results are presented and compared, to demonstrate the performance of the proposed antennas.

The team eventually succeeded in getting a simulation data to demonstrate the concepts of a reconfigurable number of elements that produced broadened beam and narrowed beam radiating pattern characteristics. By using a modified Wilkinson Power Divider (WPD) in the antenna structure, a better performance in terms of return loss was produced. This design solves some of the problems of the original Wilkinson power divider design. The addition of transmission lines in between two quarter-wave transformer arms has been shown to absorb an unwanted wave generated due to mismatch at the switches.

This research has taken advantage of the techniques of flexibly manipulating the number of elements by applying it to the problem of a reconfigurable multiple beam array combination. The reconfigurable dual-beam antenna pattern at fixed frequencies across the entire 5.7-5.9

GHz band is presented as showing excellent radiation patterns. The measured results illustrate that the radiation pattern characteristic of the antenna has been tuned efficiently. Since its structure is symmetrical around the centre, the pattern obtained is directed to θ0. The reconfiguration of radiation patterns for four- and eight-element structures at 3 dB half power produced a beamwidth (HPBW) of 290 degrees and 210 degrees respectively. Meanwhile the return losses for both structures were -20.57 dB. The comparison of gain between both reconfigurable modes can be observed from the results: the eight-element mode had 2 dB to 3 dB higher gain compared to the four-element mode. It shows clearly that when the numbers of elements are increased, the beamwidth becomes narrower with lower sidelobe and higher magnitude.

In order to miniature the size of antenna design, the team has been plans to apply a Low Temperature Co-fired Ceramic (LTCC) substrate to replace with current substrate board in the near future.

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