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Title :
A Reconfigurable Stacked Patch Microstrip Array Antenna

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The rapid development of wireless communication systems in recent years has created a strong need for the development of new antenna structures. In this context, reconfigurable antennas have become very attractive for modern wireless communications because they allow the use of a single antenna for multiple systems. The research described in this thesis introduces the concept of reconfigurable antennas that are capable to operate at two different operating frequencies, either at 2.6 GHz or 3.5 GHz and were able to switch their beam control to various patterns. At the early stage of this project, a new frequency reconfigurable antenna design namely Aperture Coupler - Reconfigurable Stacked Patch Microstrip Antenna (AC-FRSPMA) of Structure 1 and Structure 2 with different substrate materials was constructed. It uses a combination of aperture-coupled technique and stacked patch for the radiating elements to reduce the spurious radiation and increase the bandwidth performance. These designs successfully achieved frequency reconfigurability by implementing new coupling methods in the aperture coupled technique. The used of C-foam material in Structure 2 contributed to the high gain performance as compared to Structure 1 due to its characteristics which is similar to air. Then, by applying these concepts, three new reconfigurable antenna designs which can operates either at 2.6 GHz (WiMAX) or 3.5 GHz (LTE). They are the frequency reconfigurable stacked patch microstrip antenna with single structure and array configuration (FRSPMA and FRSPMAA) and the pattern and frequency reconfigurable stacked patch microstrip array antenna (PRSPMAA). The FRSPMA antenna design was constructed from three layers of RT-Rogers 5880 materials due to the fact it reduces the fabrication error as compared to C-foam material. The FRSPMA design has achieved a high gain of 6.119 dBi (ON mode) and 6.196 dBi (OFF mode) by implementing the air gap with 3 mm thickness in the antenna design. Meanwhile, the second antenna design of FRSPMAA has successfully solve the problem of low gain issue which is not to the wireless technology standard faced by the FRSPMA by implementing a 2 x 2 array configuration. The gain of FRSPMAA increases up to 9.415 dBi (ON mode) and 10.49 dBi (OFF mode) with the fix operating frequencies. Last but not least, the third antenna design, PFRSPMAA was designed to control the specific direction of radiation patterns at ±32°, +3°, –1° or at ±28°, +23° and –24° respectively at 2.6 GHz and 3.5 GHz with the condition of the gain is maintained. This was achieved by turning ON all the PIN diodes switches at the L-stubs and controlling the number of activation radiating elements. The contribution of this PFRSPMAA design is the function of L-stubs itself, where it was used to activate the direction of radiation patterns instead of behaving like the matching elements as the conventional stubs. However, it is very difficult to control all the PIN diodes switches manually in this antenna design. Thus, the PIC power microcontroller has been designed and developed to be integrated with the PFRSPMAA structure to control all the outputs automatically. The advantages of embedding the PRSPMAA with PIC were that the structure became more efficient, user-friendly and easier handling of the previous programmed output from the PIC. Results will later be displayed on the LCD available on top of the PIC board. The simulated and measured results were presented and compared to demonstrate the performance of the proposed antennas.

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