UNIVERSITI TEKNOLOGI MARA

COMPOUND RECONFIGURABLE MICROSTRIP ANTENNA ARRAY USING INTEGRATED CONTROLLED GROUND MODIFIED STRUCTURE AND SUB DELAY FEEDING NETWORK ARCHITECTURE

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AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the results of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

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ABSTRACT

Predisposition to implement multifunction concept in modern wireless communication systems is one of the main reason why Reconfigurable Microstrip Antenna has received extreme attention from engineers and antenna designers, particularly Compound Reconfigurable Microstrip Antennas (CRMA) that capable to control more antenna parameters into single antenna structure. The versatility of the antenna in terms of functionality, is more significant to support multidisciplinary wireless communication systems. However, formal structure of CRMA using contacting feeding line, stacked patch and limited utilization of array element to control radiation beam contributes to performance degradation and increase high volume of patch antenna. According to these issues, this research is conducted to embark on investigating a new structure of CRMA. The antenna has been simulated and fabricated, and further CRMA has constructed with biasing line to control frequency and radiation angle using PIN diodes that designed on the feeding network. To realize the new CRMA, aperture coupled patch antenna with newly Controlled Ground Modified Slot (CGMS) and Sub Delay Feeding Network Architecture (SDFNA) techniques are proposed to allow the antenna tunes two operating frequencies alternately at 7.5 GHz and 8.85 GHz, and concurrently control the direction of antenna beam towards selected angles. Consisting several designs, single element, 2 x 2 and 4 x 4 planar arrays, the reconfigurable antennas were simulated and fabricated in ideal condition to examine their performance and practicality. For single element and 2 x 2 planar array, the antennas generate two frequencies, F1= 7.5 GHz and F2 = 8.85 GHz. The functionality of patch antenna enhanced by designing delay line on feeding line for 2 x 2 planar array in order to control beam direction. The fabricated antenna capable to steer antenna beam between -20, 0, +12 degrees. To improve the proposed antenna, final design of 4 x 4 compound reconfigurable microstrip array antenna with PIN diodes circuit has been fabricated and measured. Consist of 24 switches for frequency reconfigurability and 8 switches to reconfigure radiation beam to three directions, the antenna is successfully to tune operating frequency in range of 7.52 GHz and 7.46 GHz with S_{11} between -22.2 dB to -38.76 dB when the switches are turned OFF. Meanwhile, the antenna generates operating frequency at range of 8.795 GHz to 8.82 GHz with S_{11} between -21.07 dB to -31.9 dB when the switches are turned ON. Activation and deactivation of 8 switches from the antenna can elevate radiation beam between -14, 0, +10 degrees for 7.5 GHz, and at 8.85 GHz, the antenna beam can elevate between of -6, 0, +14 degrees. Further, with directivity gain between 14 to 15 dBi and efficiency in range 60% to 70% the antenna has potential to support outdoor wireless communication systems. The small misalignment between measurement and simulated results for operating frequency significantly contributed fabrication imperfection and small metal line from DC biasing network that linked to antenna feeding network. However, based on gain directivity and efficiency the reconfigurable antenna has potentially suggested for supporting outdoor wireless application systems.

TABLE OF CONTENTS