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DESIGN OF CIRCULARLY POLARIZED MICROSTRIP ANTENNAS

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Submitted in partial fulfillment of the degree of Master of Science in the Department of Electronics & Telecommunication Engineering University of Moratuwa

February 2002

ABSTRACT

Circularly polarized antennas are used in mobile communication, satellite communication and in other communication systems. The receiver is then able to pick the transmitted signals without a polarization mismatch due to the alignments of the antennas. It can also mitigate multipath interference. In multipath conditions the reflected signal changes the hand of the circularity giving a polarization mismatch with respect to the signal that arrives from the direct path. Therefore a circularly polarized receiving antenna will pick only the direct path signal which has the desired hand of circularity.

Circularly polarized microstrip antennas can be used in communication systems where the geometry and the size are constraints because it is lightweight, miniature in profile and etched on a double sided printed circuit board.

Analysis, design and implementations are presented of square, nearly square and circular single feed circularly polarized microstrip antennas. In order to get familiarized with the basic theory. A linearly polarized microstrip antennas were first made. Circularly polarized 4 patch planner array antenna, circularly polarized circular patch antenna, circularly polarized microstrip Yagi array antenna and a circularly polarized microstrip frequency scanning antenna were designed with the help of the single patch designs. Transmission line model and resonance cavity model were used in the analysis while the mode detuning method was used to obtain circular polarization.

The single square patch and the single circular patch antennas designed for 9.4 GHz for RHCP showed broad radiation patterns, both in the E-plane and the H-plane, as expected from theory. The polarization was nearly circular while no measurable gain was observed.

The circular patch with protruding perturbations for mode detuning behaved very similar to the circular patches having perturbations with depression. Therefore both methods appear equally good to produce circular polarization.

The circular patch antenna designed for RHCP for 1.4 GHz had a total gain of 5.74 dBi . Its radiation pattern is broad and hemispherical and thus this antenna could be fixed on a vehicle for MSAT applications.

The 4-square patch planner array designed for RHCP for 9.4 GHz had a gain of 4.5 dBi. Its measured radiation pattern had 2 major lobes as expected but it also showed minor lobes which was not seen in the theoretical radiation pattern. This could also be a useful antenna for MSAT applications.

The microstrip Yagi antenna for RHCP designed for a frequency of 1.150 GHz had a total gain of 6.2 dBi and its major lobe was tilted by 35^0 from the broadside direction. By suitable alteration to the element separations, it is possible to tilt the beam by a desired angle.

A 2-element square patch array for RHCP designed for a frequency of 1.4 GHz showed a gain of 4.88 dBi. The measured radiation patterns obtained for the frequency rage from 1.17 GHz to 1.625 GHz had a significant similarity with the theoretical radiation patterns and demonstrated the possibility of frequency scanning with the antenna.