Abstract

THIS research aims to develop compact pattern diversity antennas for handheld terminals at the 2.4 GHz band. Low profile Yagi-Uda type antennas are employed for generating directive patterns. Printed dipole driven Yagi antennas with microstrip or coplanar waveguide (CPW) feeds require a balanced-to-unbalanced transformer (BALUN), which increases the size and are large for these type of terminals. In this research, we design a BALUN-less CPW-fed printed pseudo monopole antenna (PPMA) and a folded-strip printed inverted-F antenna (FS-PIFA), which produce dipole-like radiation pattern with -40 dB cross-polarization ratio (CPR) in the case of PPMA and -9 dB CPR in the case of FS-PIFA. We carry out partial element equivalent circuit (PEEC) analysis and antenna-mode/differential-mode (AM/DM) modeling of the PPMA in order to investigate its dipole-mode operation. It is shown that the AM current, flowing on the PPMA, is similar to that of an asymmetrically fed dipole. Followed by AM/DM modeling, a compact model of PPMA is introduced, where the effect of AM current is incorporated through the asymmetrically fed dipole.

The PPMA and FS-PIFA are employed as driver elements for the Yagi-Uda array. Placing two such arrays back-to-back produces pattern diversity antenna. The optimal design of Yagi antennas is carried out using in-house code of position mutated hierarchical particle swarm optimization with time varying acceleration coefficients (PMHPSO-TVAC). The front to back ratios of the PPMA-driven Yagi-Uda antenna and the FS-PIFA-driven Yagi antenna are about 23 dB and 17 dB, respectively. The size of the PPMA based pattern diversity antenna is 65×65 mm^2 and that of the PIFA based diversity antenna is about $41 \times 68 \times 5$ mm^3. The port level isolation is about 3 dB higher in the FS-PIFA based diversity antenna, compared to that of the PPMA based diversity antenna. The signal envelope correlation coefficients of the PPMA-driven pattern diversity antenna

and FS-PIFA-driven pattern diversity antenna are 0.023 and 0.074, respectively.

***Keywords*:** pattern diversity, Yagi-Uda antenna, pseudo monopole, BALUN-less dipole, strip dipole, antenna mode, folded strip PIFA, PSO.