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Design and Development of a High Gain UWB Quasi-Conical beam 3-element Antenna based on the concept of Novel Fabry Perot Configuration

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Single directive beam Antennas suffer from a sufficient number of bottlenecks. Alternatively a multi-beam Antenna(MBA's) where Antennas work independently and concurrently to achieve High Gain and Beamforming in the RF domain can prove as a candidate solution to present day Single Beam Antennas as they serve as key enablers for Massive-MIMO configuration, a breakthrough towards the conventional MIMO where a very large number of service Antennas operate fully coherently and adaptively. Here MBA's operating in the mm-Wave band have attracted much interest and have been rigorously investigated here. With the demanding requirements of 5G which prove as advantageous solutions to today's spectrum shortage at conventional cellular frequencies. Since it is simultaneously difficult to obtain High Gain and Wide coverage , Quasi-Conical Beam Antennas have been proposed as candidate solution to today's problems. Such Antennas produce High Gain pencil beam which electrically scan along a cone to provide enormous special diversity in the time domain. The concept is based on the development of a novel Fabry-Perot-Fermi Antenna with wide Angle steering capability to produce Fan-Beam in the azimuth direction along a cone. Furthermore they are different from conventional MBA's in the sense that no additional beamforming network like Buttler-Matrix or Rotman-Lens is required to produce the multi-beam and FP Antenna itself acts as the radiator. Also the addition of an additional beamforming network increases complexity in terms of Size and Cost. Initially an Array of 3-FP Antenna elements were arranged in a back-to-back tri-element configuration or CONBA-(Conical Beamformed Array) orientation to form diversity combination in the time domain by switching each individual elements for a time period to cover the enormous angular Spatial range. Simulation and measurement results show that the S-parameter is below (S_{11} < -10dB) at an operating bandwidth from (10.17GHz-19.92GHz) and a wide Impedence Bandwidth around 64.805% illustrating a Wideband nature. The novelty of the proposed work is that only 3-FP Antenna elements can cover the entire 360o range in the azimuth plane(φ-plane) which is an improvement over other proposed works where 8 or more than 8 elements cover the entire range. For this enormous Parametric studies have been performed to achieve such a performance improvement. Also the configuration of FP Antennas have wide Scan Angle capability of 50°(8° - 58°) in the elevation plane(θ-plane) which is achievable far better. These characteristics make the configuration suitable for UAV and Space Applications.

Index Terms: High-gain; wide band; quasi-conical beam; Fabry-Perot antenna; beamforming; Rotman-lens; Buttler-Matrix

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