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Miniaturized planar defected ground structure antenna enabled with Yagi directors for enhanced gain performance in mm-wave 5G applications

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ABSTRACT

The compact and miniaturized high gain antenna for millimetre wave 5G applications is proposed in this paper. The antenna is designed on RT Duriod 5880 substrate with dielectric constant, tangential loss, and specific heat of 2.2, 0.0009, and 0.23 Cal/g/C respectively. The peak gain of 9.5 dBi in E-Plane is achieved for high gain characteristics by applying Microstrip circular Yagi Directors. The antenna operates over the frequency range of 26.5–28.5 GHz with a good reflection coefficient of −25.60 dB at a resonance frequency of 27.56 GHz. Moreover, Defected Ground Structures (DGS) are adopted in the structure to optimize the characteristics by widening the path of surface current. The proposed antenna structure is fabricated and the measured results are found in good agreement with the simulated results. The better performance of the proposed antenna makes it a viable candidate for 5G millimetre-wave communications.

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1. Introduction

The wide spectrum available in millimetre-wave frequency proves to be a promising hope for Fifth-generation mobile communication [1, 2]. High propagation loss of millimetre-waves due to atmospheric absorption is a great concern and this puts a challenge for the design of millimetre-wave 5G networks. To make high capacity and high-speed millimetre-wave 5G communication possible the likely solution will be to incorporate antennas with higher directivity [3, 4]. Additionally, the size of antennas at higher frequencies shows a sharp reduction up to a few millimetres which proves to be challenging for the utilization of traditional antennas like Horn antennas, Yagi antennas, Sector antennas, and Dipole arrays despite having higher directivity and gains at some specified geometries [5–10]. Moreover, the cost of such antennas for the implementation increases many folds. Therefore, high gain and efficiently compact antennas are needed for an hour to incorporate 5G millimetre-wave links. The compactness in the size of antennas at higher frequencies enables the designer to achieve higher spectral efficiency, better coverage of signal, lesser interference, and much

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