A Novel V-Band Single-Layer CP-FPC Made of Circular-Polarized Capacitive-Metallic FSS with a Linear-Polarized Feeding Antenna

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Fabry-Perot Cavity (FPC) antennas are well-known as a promising solution where fixed-beam high gain antennas are required to establish reliable wireless communication links. More specifically, providing more gain from amplifiers is challenging due to the linearity requirements at the V-band frequency. Several designs are presented by the authors [1, 2] which provide linear/circular-polarized highly directive beam for this frequency spectrum. However, in order to combat delay distortion due to multipath propagation, Circular Polarized (CP) FPCs are desirable over Linear Polarized (LP) FPCs. The handedness of the reflected wave is reversed when a circularly polarized wave is incident on a reflecting surface, the reflected wave is rejected on reception by the receiving antenna. In this work, a novel design of single-layer CP Fabry-Pérot cavity antennas is investigated and their radiation performance is verified using full-wave simulations based on the finite elements method using Ansys HFSS. This antenna is a single-layer CP-FPC antenna formed by a circular-polarized capacitive-metallic FSS and linear-polarized feeding antenna. The novel circular-polarized single-layer FPC antenna, formed by a dual-polarized capacitive-metallic FSS, being fed by a linear-polarized slot-dipole on the ground plane of the cavity. The antenna is made in Rogers RT/Duroid 5880 substrate (with relative permittivity of 2.2) and the thickness of 1.575 mm. The proposed FSS, when being illuminated by an electric field along one direction, excites the same-level electric field aligned in the perpendicular orientation with the phase difference of 90 degrees. The antenna has a maximum broadside gain of 15.8 dB and also is matched to 50 Ohm impedance over the bandwidth from 57 to 64 GHz. The antenna has the 3-dB axial ratio (AR) of 0.6 GHz over the center frequency of 60 GHz. The broadside radiation gain of the antenna has a minimum axial ratio of 1.42 within the operating bandwidth.

References

[1] S. Kabiri, S. A. Hosseini, F. Capolino and F. De Flaviis, "Gain-bandwidth enhancement of 60GHz single-layer Fabry-Pérot cavity antennas using sparse-array," *2014 IEEE Antennas and Propagation Society International Symposium (APSURSI)*, Memphis, TN, 2014, pp. 739-740.

[2] S. Kabiri, E. Kornaros and F. De Flaviis, "A 60 GHz single-layer Fabry-Perot Cavity Antenna using sparse array for circularly polarized radiation," *Radio Science Meeting (Joint with AP-S Symposium), 2015 USNC-URSI*, Vancouver, BC, Canada, 2015, pp. 162-162.