Miniaturized Wideband GNSS Patch Antenna

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A very light weight and miniaturized right-hand circularly polarized GNSS patch antenna that covers the whole GNSS band (1.16 GHz to 1.61 GHz) has been successfully developed using proximity-coupled L-probe feeding technique. An aluminum patch is fed through four metal L-probes (Liu, Qiang, et al. "Compact broadband circularly-polarized directional universal GNSS antenna with symmetric radiation pattern and stable near-zenith coverage." IET Microwaves, Antennas & Propagation, 11.5 (2016): 657-663.). The inherent wide bandwidth performance of the antenna is due to the L-probe feed (i.e. capacitive feed), in which the feed network is coupled to the radiating patch using proximity coupling instead of direct connection to the patch. Meanwhile, the inductance of the feed probe is counteracted by the associated capacitance between the L-probe and patch to provide proper impedance match.

To achieve a wideband circularly polarized patch antenna an ideally broadband feed network that can split the input power into four output ports with equal amplitudes and 90° sequential phase difference is needed. The main challenge of designing such a wideband feed network is its size. Previous designs included a feed network that required a large space due to the implementation of multi-stage wideband baluns and quadrature hybrid power splitters. Here, a multi-layer structure with high dielectric substrate material is used to significantly reduce the size. The total area of the proposed feed network is only 5.5 cm × 5.5 cm. The diameter, height, and length of the four copper L-shaped probes connected to the output ports of the feed network to excite the aluminum circular patch with a 90° sequential phase difference are the design parameters and have been optimized. The various parameters of the circular patch are optimized as well. The results of simulation and measurement of the proposed antenna indicate that the antenna has good and reliable performance over the entire GNSS frequency band. The return loss and axial ratio are lower than 15 dB, and 2.3 dB, respectively. The realized gain is relatively high and positive (0 dB < Gain < 3.03 dB) over the band. The developed has been used to build a compact 2 × 2 array and array performance results will be presented.