High-Performance Universal GNSS Antenna as a New and Practical Approach

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In anticipation of the addition of the new Galileo satellite navigation system to the present GPS and GLONASS constellations, GNSS (Global Satellite Navigation System) receivers and antennas capable of operating on all three services are envisioned. The availability of more signals in the constellations can be used to greatly enhance the precision for geolocation, which is highly desirable for certain applications such as geodetic survey.

However, coverage of all three systems requires a broadband antenna having a wide frequency bandwidth of 1.164-1.610 GHz with a phase center stable with spatial and frequency variations. Fortunately, successful development of such an antenna has been reported [1, 2]. A key component in both approaches is a planar four-arm spiral as the radiating aperture, which is uniquely suitable, with performance not achievable by conventional GNSS antenna approaches such as the patch antenna or other broadband antennas, as noted in [1].

Although the details of the design in [1] have not been fully disclosed, those of [2] can be traced back to as early as 1995 [3] with a number of papers and patents. This paper will address new and practical considerations of this type of GNSS antenna.

It has been noted for more than three decades that the performance of a multiarm planar spiral antenna is critically sensitive to errors in its feed network [4]. Therefore, a significant effort is being made to improve the excitation accuracy, in both phase and amplitude, from the feed network to the feed region of the spiral.

Other major sources of errors in GPS are multipath scattering and noises, generally at low elevation angles. Conventional method for reduction of these interferences at the antenna level was made by antenna pattern shaping with sharply reduced gain at low angles; but this measure also results in a reduction of the available constellation, thus limiting the geolocation accuracy.

A new approach for GNSS antenna design now takes advantage of the denser constellation. A narrower antenna beamwidth optimized for the particular low-elevation-angle noise/interference environment, yet wide enough for the greatly expanded constellation, can immensely improve the performance in the new age of combined GPS/GLONASS/Galileo constellation.

Other advantages and features of this new antenna approach will also be discussed.

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