BANDWIDTH IMPROVEMENT OF HEMISPERICAL HELICAL ANTENNAS

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Spherical helical antenna, first introduced by Cardoso and Safaai-Jazi (Electronics Letts, Vol. 29, No. 4, 325-326, 1993), and hemispherical helical antenna (Safaai-Jazi, A. and Weeratumanoon, E., Electronics Letts., Vol. 36, 607-609, 2000) provide a very broad half-power beamwidth and circular polarization over a narrow bandwidth. Here, we introduce new designs for hemispherical helical antennas which result in significant improvement in bandwidth, while maintaining the gain and broadbeam pattern characteristics of the basic design. In the basic design, a simple wire of circular cross section is wound on the surface of a hemisphere, whereas in the proposed new designs a tapered metal strip forms the radiating element. Furthermore, the tapered strip may be tilted relative to the hemispherical surface. The antenna is fed by a coaxial cable with the inner and outer conductors connected to the metal strip and the ground plane, respectively.

Radiation properties of the proposed antennas are studied using a commercial software based on the method of moments. Three-dimensional far-field patterns, axial ratio, directivity, input impedance, and VSWR are obtained. For a 4.5 turn hemispherical helix designed for operation at 3.2 GHz, an axial ratio of less than 3 dB was achieved over about 18% bandwidth. A directivity of about 9 dB and a 3 dB beamwidth of more than 75 degrees are also obtained. A matching element is incorporated into the design with the aim of reducing VSWR to less than 3 dB over the bandwidth of the antenna. This compact, low profile antenna might find useful applications in avionics, global positioning systems (GPS), high data rate transmission systems.