Spherical Meander Dipole with Optimum Filling Configuration

Amir I. Zaghloul*, W. O'Keefe Coburn, Louis L. Jenkins, II
US Army Research Laboratory, Adelphi, MD 20783
amir.zaghloul.civ@mail.mil

Electrically small antennas have been realized as a meander dipole or monopole on the surface of a sphere (O.S. Kim, iWAT, 2010) or hemisphere (J. Adams and J. Bernhard, IEEE AP-S Symposium, 2008). The meandering of the antenna line takes the form of connected parallel circles, continuous spiral, normal mode helix on a hemispherical surface, and spherical helix (S. Best, IEEE Transactions on Antennas and Propagation, 2005), among others. The length of the dipole or monopole that results from meandering over the spherical surface determines, among other parameters, the resonance frequency and the operating bandwidth of the antenna. In a recent study (H. Gerlach and H. von der Mosel, The American Mathematical Monthly, 2011), it was shown that the longest rope on a unit sphere can be deduced from the rope's thickness and the filling function over the spherical surface. The theory that determines such optimum filling can be applied to the design of the spherical dipole, leading to the lowest frequency and the corresponding bandwidth of the resulting electrically small spherical dipole antenna. An example of a spherical meander folded dipole is shown in Figure 1. One restriction in applying the sphere-filling procedure is in the choice of the optimum spacing between the meandering lines for a given line or wire diameter. Another parameter in the design is the alignment of the current vectors along the lines that form the antenna. The significance of the current vector alignment in establishing the resonant frequency of a meandering line antenna was reported in cases of planar configurations (S. Best and J. Morrow, IEEE AWPL, 2003). In this paper, we use the optimum sphere filling methods to study meander line spherical dipole/monopole antennas. Parametric simulations are presented to show the lowest frequency and the associated bandwidth that can be achieved for a given sphere diameter and given wire or line thickness. The effects of spacing between the lines and the control of the current vectors to enhance the antenna performance are also presented.

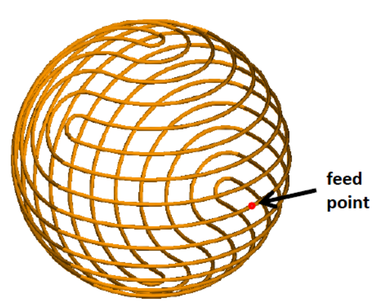

Figure 1. A spherical meander folded dipole