URSI - RCRS 2022, IIT (Indore), India, 1 - 4 December, 2022

Comparative Analysis of Different Bessel functions used inside Dielectric Loaded helix

Ajay Kumar Pandey *(1), Surya Kumar Pathak(2)
Institute for Plasma Research, A CI of Homi Bhabha National Institute, Gandhinagar- 382428, Gujarat, India
[1]ajay.pandey@ipr.res.in, [2]surya@ipr.res.in

High-gain antennas and traveling wave tubes (TWTs) are two microwave components that have received a lot of attention for their electromagnetic characteristics. In general, two alternative theoretical approximations are used to carry out the fundamental analysis of the above structure [1]. These include the tape helix model, which takes into account a limited conductor width, and the sheath helix model, which assumes a wire thickness that is infinitesimally thin. The dispersion equation is inaccurate as a result of the sheath helix approximations mentioned above, and the tape helix model is better recommended. However, if the radial thickness is taken into account, a significant amount of this error can be avoided. Additionally, two Bessel functions are utilized to describe wave propagation inside the dielectric area in the guided mode dispersion equation. This are Bessel I and Bessel J function.

In this work, a comparative study of the dispersion behavior using the above two Bessel functions has been solved based on the field theory approach [2]. The sheath helix physical model, which shows many traits similar to a physical helix, is obtained from the solutions of source-free Maxwell's equations. To find the propagation constant, the dispersion characterization has first been quantitatively performed. The components of the magnetic and electric fields are then calculated after establishing the propagation constant value from the dispersion diagram. In order to estimate the radiation properties of the helical antenna, these field components are employed to identify both the magnetic and the electric vector potentials. The numerical finding along with the result will be discussed in the talk.

1. Barr, L.E., Ward, G.P., Hibbins, A.P. *et al.* Slow waves on long helices. *Sci Rep* **12**, 1902 (2022).
2. Pandey, AK, Pathak, SK. Numerical and computational analysis of radiation characteristics of dielectric loaded helical antenna. *Int J RF Microw Comput Aided Eng*. 2021; 31:e22756.