Vegetation path loss modeling using a modified parabolic equation Toolbox

Proceedings of the 4th International Conference on Electrical, Communication and Computer Engineering (ICECCE), Dubai, UAE, 30-31 December 2023

Manamela, Selolo S
Council for Scientific and Industrial Research (CSIR)
Meiring Naude Drive, Pretoria, 0184
Email: SManamela@csir.co.za

In this paper, the problem of modelling radio wave propagation through vegetation using parabolic equation methods is investigated by modifying the parabolic equation toolbox (PETOOL) to incorporate a mechanism to model vegetation. The vegetation was modeled as a lossy dielectric slab. The geometry of the problem was configured as a stratified three-layer homogeneous medium model (air, vegetation, and ground) with each layer modeled by its dielectric properties (permittivity and conductivity). The discrete mixed Fourier transform was used to propagate the radio wave through the lossy dielectric slab. To evaluate the model, a scenario with the both transmitter and receiver antennas located inside the vegetation canopy was configured as a simulation setup, and the results compared to the well known results by Tamir. The result of interest from the model was the propagation path loss of radio waves in the presence of vegetation. To assess agreement between the modified PETOOL and Tamir's results, the root mean square error between the results was calculated. It was found that as the imaginary component of the complex refractive index approaches zero, the solution to the discrete mixed Fourier transform, for which the propagation calculation is based, becomes unstable leading to failed agreement with Tamir's results.