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Tree-Scattering Model for Very High Frequency Propagation Prediction in Residential Environment.

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The current Tree-Scattering models though represent recent consensus are fairly specified for mobile radio frequency networks and do not cover all possible scenarios. Moreover, Tree-scattering models for improving very high frequency (VHF) radio broadcasting networks in residential environment are equally important as it channels are characterized by variety of Trees. Accurate modeling of attenuation of VHF radio wave propagation in residential environment can be very tedious as the channels are rarely characterized by vegetation of the same variety. The main focus of this work is to measure path loss and model specific attenuation coefficient of the coherent scattered field intensity of VHF radio network as it propagates through Mango and Jathropha Trees separately at 98MHz and 103.4MHz respectively.

In this experimental work, the two separate trees were illuminated uniformly at different time at a distance of 6m away from the centre of each canopy with 2.15dBi rabbit ear dipole antenna connected to 6W VHF transmitter located at different height of 1.7m and 2.25m above the ground level periodically. 1.7dBi short dipole connected to GSP-730 Spectrum Analyzer ranging from 150KHz -3GHz placed at 1.5m above the ground was used as reception at 6m from the back of each tree canopy at different angles. The two selected trees have four major Branches with leaves forming similar geometrical pattern. Path loss due to each canopy were estimated from the power received relative to the scattering angles round each canopy. Dry-matter fraction of the leave were estimated using sensitive weigh balance and corresponding effective dielectric properties of the leaves and branches peculiar to each tree were estimated by using semi-empirical formula for complex permittivity of leave and branch. Specific attenuation coefficient models at 98MHz and 103.4MHz were developed separately for the two trees relative to dielectric properties of each tree leaves and branches.

The results show that path loss due to single Mango tree canopy varies from 100dBm to 140dBm and highly significant at the scattering angles with higher leave density at transmitting height of 2.25m than 1.7m due to the Mango tree geometry. Jathropha path loss ranges from 95dBm to 135dBm and equally more significant at transmitting height of 2.25m. The mean specific attenuation coefficients of Mango tree were obtained to be 4dB/m at 103.4MHz and 3.66dB/m at 98MHz. Jathropha tree mean specific attenuation coefficients were estimated as 2.67dB/m and 2.43dB/m at 103.4MHz and 98MHz respectively. The developed models show corresponding decrease in specific attenuation coefficient with increase in imaginary value of complex relative permittivity of the leaves and branches of the two trees.

The proposed tree scattering parameters and models will enhanced prediction of path loss and specific attenuation of VHF radio wave propagation through trees of different variety in residential environment and also assist in VHF radio link planning.