



Ionospheric HF Radio wave propagation Simulator

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Upper atmosphere is partially ionized medium & acts as a dispersive medium for the radio waves propagating through it. HF radio waves travelling through ionosphere interact with the free electrons present there and are sometimes reflected back towards the surface of earth. Whether the wave will get refracted or reflected depends on the frequency of the wave. On one hand this phenomenon of reflection from ionosphere act as a boon in applications such as the long-distance HF communications (skywave) and OTH guidance & detection applications, but at the same time it acts as a hindrance for trans ionospheric radio wave communication over a wide of frequencies. Further the ionosphere is a highly dynamical region, particularly at equatorial low latitude regions like India, and it undergoes substantial variations during both quiet & disturbed periods. Hence predicting the path of radio waves through highly dynamical three-dimensional ionosphere is very important for several radio applications. In this context a HF radio wave propagation simulator has been developed by solving the Ray equations for obtaining the position and direction of radio wave as it travels through ionosphere for any given background ionospheric conditions. Under the presence of magnetic field, the radio waves become birefringent in Ionosphere and the O and X mode propagated waves reflect from different virtual heights. Both O and X mode wave will travel different paths in ionosphere and travel different distances. Using our simulator, we can trace both O and X mode rays separately. The Simulator results have been thoroughly validated with a ground based ionosonde observations. The simulator results have also been used to find the propagation paths under highly disturbed equatorial ionospheric conditions & the result were discussed.

Ref.:

1. Fontell, Mathias. Numerical Ray Tracing of Medium and High Frequency Radio Waves in the Terrestrial Ionosphere. Diss. University of Oulu, 2018.