UTD Based Prediction of Propagation Loss over Spherical Earth Surface

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An effective modeling of wave propagation over the spherical earth surface is of importance for target tracking, radar detection and wireless system analysis. This topic has been intensively studied in the past several decades (V. A. Fock, Electromagnetic Diffraction and Propagation Problems, Oxford: Pergamon, 1965). Meanwhile, the uniform theory of diffraction (UTD) for smooth convex surfaces has been developed and widely used in electromagnetic radiation and scattering. However, applying UTD to an effective analysis of propagation over a spherical earth surface still remains a challenge so far.

This paper discusses a UTD based prediction of propagation loss over a spherical earth surface. It is shown that the current UTD solutions for some scenarios in the point-to-point propagation over a curved earth could be invalid when the source and observation points are located in the surface boundary layer or close to the surface boundary layer. These scenarios are in the situations that could not be defined as scattering, radiation and coupling, that is, could not be characterized by any of current UTD formulations. On the other hand, when the source and observation points are far away from the surface boundary layer, a UTD based propagation prediction can be undertaken, with its correctness and effectiveness validated through a comparison between our results and those previously published in the literature, for instance: (M. P. Shatz and G. H. Polychronopoulos, IEEE Trans. Antennas and Propagation, Vol. 38, No. 88, pp. 1249-1252, Aug. 1990).