A Comparative Analysis of Multiple Knife-Edge Diffraction Methods For Propagation Modeling

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A comparative analysis of different multiple knife-edge diffraction methods was performed to support the short-range mobile-to-mobile radio-wave propagation model under development at the Institute for Telecommunication Sciences (NTIA/ITS). The goal of this analysis was to investigate faster and simpler methods for computing multiple knife-edge diffractions. While a rigorous method exists for computing multiple knife-edge diffractions, faster methods are needed for area coverage predictions in situations where many computations are required in different radial directions over many diffraction edges. Faster alternative methods for computing multiple knife-edge diffractions are approximations to the rigorous method, in that they obtain solutions by compositions of single knife-edge diffraction results. In contrast, non-approximated solutions for multiple knife-edge diffraction loss are computationally intensive, which can be a problem for complex environments. The alternative methods that were investigated for computing multiple knife-edge diffractions are typically described as graphical techniques, where the analyst must identify the most important edges through educated guesswork. It was therefore necessary to develop mathematical methods for these graphical methods. The mathematical methods enabled the comparison of the alternative diffraction methods with the rigorous diffraction method to determine a suitable method for the non-LOS propagation scenarios. The investigation was initiated to find an alternative diffraction computation method by comparing the accuracy of four faster diffraction methods to the L.E. Vogler method for many diffraction loss scenarios with multiple edges. The rigorous diffraction loss computation method by L.E. Vogler is very time consuming even with state-of-the-art computers. The rigorous diffraction method of L.E. Vogler has been verified to be extremely accurate when compared to measured data, but the run times for many edges are too excessive. The four alternative diffraction methods that were investigated included methods by Bullington, Epstein/Peterson, Deygout, and Giovaneli. Detailed graphical procedures for each of the methods can be obtained from the literature. This paper will describe the comparative analysis of the diffraction methods.