SIMPLIFIED METHOD TO ESTIMATE MILLIMETER-WAVE REFLECTION FROM ROUGH SURFACES

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ABSTRACT

Two-dimensionally sinusoidal model is used to establish a simplified method to estimate millimeter-wave reflection from rough surfaces. A very simple result is derived for engineering design.

INTRODUCTION

With the rapid development of wide-band wireless access, the study on millimeter-wave indoor propagation becomes more and more important [1,2]. Many studies on millimeter-wave indoor propagation are carried out with the increasing requirement of wide-band wireless access. And millimeter-wave indoor reflection characterization is concerned with many factors, such as medium permittivity, frequency, polarization and direction angles of the incident, the roughness of the reflection surface and so on. In particular, in the actual circumstances, the planar rough surfaces have to be taken into account, which leads to the complexity of accurate analysis and implement. Up to now, there are several rather accurate methods. However, the theoretical derivation and the corresponding calculation of the methods are quite complicated, which are not suitable for
engineering use. Hence it is still valuable to establish a simple but good enough relation that can take main/important factors into account and suitable for engineering design. In the paper, the model, analysis and simplified result are described and presented.

**MODEL AND FORMULATION**

Suppose a rough surface has equivalent space periods $K_x$ and $K_y$, and effective heights $a_x$ and $a_y$, in z and y direction, respectively. As a first order approximation, the profile of the surface can be modeled as:

$$x' = f(z', y') = a_x \sin(K_x z') + a_y \sin(K_y y')$$  \hspace{1cm} (1)

![Diagram](image)

**Fig 1:** Coordinates for wave diffraction by a rough surface

Assume that the wavelength $\lambda$ of the incidence is big but the heights are small so that $\lambda \gg a_x, \lambda \gg a_y$. The diffraction of millimeter-wave can now be described by using the elementary Huygens principle. Each point of the surface acts as a