2nd URSI AT-RASC, Gran Canaria, 28 May – 1 June 2018

Proposal of Novel Reflection/transmission Coefficient for Efficient Propagation Analysis at Outdoor-indoor Interface Environment

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In recent years, 5G mobile communication systems are developing to realize higher data rates (Urban: over 1 Gbps, Indoor: over 10 Gbps) and seamless connectivity. Multi and high frequency bands, SHF and EHF, will be used in the systems. To satisfy the high specification of 5G, in addition to the development of radio transmission technology with higher data rates and reliability, it is important to precisely predict wave propagation characteristics in such high frequencies for urban (outdoor), indoor, and outdoor-indoor interface environments. ``Glass window" on sidewall of modern building may be considered as a primary gate between the environments. Hence, detailed investigation of the propagation characteristics from/through the glass window for high frequency is strongly required. However, modern window often consists of thin multilayered glass panes separated by a vacuum, so it may be difficult to carry out the high frequency propagation analysis using conventional propagation analysis tools (as ray tracing (RT) method, FDTD method, and so forth), since much computational cost is required to precisely model the modern window.

In this paper, a modification of RT method for efficient propagation analysis around such interface environment, by introducing novel reflection/transmission coefficients are proposed. Here the reflection/transmission coefficients are derived by solving the Green's function problem in the presence of a multilayered dielectric slab under high frequency condition [1, 2]. Here high frequency asymptotic approximation technique is used to bundle or collect the multiple reflected rays in the slab into the primary one. By using the derived coefficients instead of the conventional ones, we can realize accurate RT propagation analysis from/through the multilayered glass without increase of the computational cost and resource. Analysis results of propagation prediction for some simple interface environments in multi and high frequencies will be presented. Also, we will show that the derived coefficients are useful for propagation analysis for snow covered area in microwave remote sensing using airborne/spaceborne SAR system.

Acknowledgment
This work was supported by JSPS KAKENHI Grant Numbers JP15K06083, JP16K01285, Japan, and Grant-In-Aid for research and development from NAGAI N.S. Promotion Foundation for Science of Perception, Japan.

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