A Ray Tracing Algorithm Using the Discrete Prolate Spheroidal Subspace

Author(s) - Institution(s):
Mingming Gan, FTW
Francesco Mani, ParisTech
Florian Kaltenberger, Eurecom
Claude Oestges, UCL
Thomas Zemen, FTW

Corresponding author email: gan@ftw.at

Corresponding WG group: TWGI, WG1

Abstract:

Ray tracing (RT) is an accurate propagation prediction tool that has been widely used to simulate channel characteristics in indoor environments. To date, the developed RT tool includes not only specular reflection, penetration through dielectric blocks and diffraction, but also diffuse scattering mechanisms. The accuracy, provided by a detailed modeling of the environment, comes at the cost of a high computational complexity, which directly scales with the number of propagation paths considered. We are interested in simulating the radio propagation conditions for a mobile terminal, communicating in a frame based communication system indoors with several fixed nodes. This communication shall be used to obtain the position of the mobile terminal in indoor scenario. Therefore, the correlated temporal and spatial evolution of the channel impulse response is of utmost concern. In this paper, we propose a method to significantly reduce the computational complexity of RT by using a projection of all propagation paths on a subspace spanned by two-dimensional discrete prolate spheroidal (DPS) sequences. With this method the computational complexity can be reduced by more than one order of magnitude for indoor scenarios. The accuracy of our low-complexity DPS subspace based RT algorithm is verified by numeric simulations.