

Novel Site-Specific Techniques for Predicting Radio Wave Propagation

Praveen T Sheethalnath

Abstract

This thesis addresses various aspects related to site-specific propagation prediction using ray tracing techniques. Propagation prediction based on ray tracing techniques requires that all the different physical objects, which affect the propagation of radio waves, be modeled. The first part of the thesis concentrates on modeling the buildings and the terrain for the above-mentioned application. A survey of the various geographic products that are available to model the environment is presented. The different methods used to model the terrain are analyzed and the most suitable method for a ray based application is suggested. A method to model the buildings in an environment from commercially available data is described. A novel method to combine the building information with the terrain information is presented.

An in depth discussion of deterministic propagation prediction using ray tracing is presented in the latter half of the thesis. An overview of the various ray based algorithms that exists in the literature are presented and the limitations and the computational complexity of ray based methods are discussed. All ray based algorithms model the receivers as point objects and predict the propagation characteristics at a particular point in space. However, to optimize the design of a wireless broadcast or a point to multi point system such as a Wireless LAN (WLAN) or a cellular system, propagation characteristics at multiple points in space need to be known. The standard ray tracing algorithms can be notoriously time consuming when used to predict the characteristics of multiple receivers. A new, computationally less intensive algorithm to predict the propagation characteristics of multiple receivers is described. This algorithm

significantly reduces the computation time by using 'grid mode' predictions for broadcast channels.