RADIO WAVE PROPAGATION MECHANISMS

Fundamentals and Applications

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Murat Ambarkutuk
Mechanical Engineering Department
Virginia Polytechnic Institute and State University
murata@vt.edu

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Abstract

abstract-text

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Acronyms

CNN Convolutional Neural Networks. 3, 4

EM Electromagnetic. 1

NN Neural Networks. 3, 4

RNN Recurrent Neural Networks. 3, 4

RX Receive. 2

TX Transmission. 2

1 Fundamentals of Radio Wave Propagation

This section will briefly describe the fundamentals of radio waves and their propagation mechanisms. In order to describe radio waves, the Electromagnetic (EM) waves should be described since radio waves are a small subset of EM waves. When electrons move through a conductor medium, they create EM waves that can propagate through in space. These waves can display different characteristics depending on the fundamental properties of the wave, i.e. their wavelength. Figure 1 depicts the EM spectrum by the wavelength.

Figure 1: Electromagnetic Spectrum

1.1 Overview of Wireless Communication Technologies

Explanations about the current technologies.

1.1.1 Cellular Telephone Systems

1.1.2 Cordless Phones

1.1.3 Cellular Telephone Systems

1.1.4 Wireless LANs

1.1.5 Wide Area Wireless Data Services

1.1.6 Fixed Wireless Access

1.1.7 Paging Systems

1.1.8 Satellite Networks

1.1.9 Bluetooth

1.1.10 HomeRF

1.2 Radio Wave Propagation Mechanisms

1.2.1 Reflection

1.2.2 Diffraction

1.2.3 Scattering

1.3 Path Loss, Shadowing and Fading

Transmission (TX) Receive (RX) Path loss is caused by dissipation of the power radiated by the transmitter as well as effects of the propagation channel. Path loss models generally assume that path loss is the same at a given transmit-receive distance1. Shadowing is caused by obstacles between the transmitter and receiver that absorb power. When the obstacle absorbs all the power, the signal is blocked.

Variation due to path loss occurs over very large distances (100 – 1000 meters), whereas variation due to shadowing occurs over distances proportional to the length of the obstructing object (10-100 meters in outdoor environments and less in indoor environments). Since variations due to path loss and shadowing occur over relatively large distances, this variation is sometimes refered to as **large-scale propagation effects** or **local mean attenuation**.

2 Indoor Radio Wave Propagation Models

3 Fundamentals of Function Approximation and Neural Networks (NN)

Neural Networks (NN), Recurrent Neural Networks (RNN) and Convolutional Neural Networks (CNN)

3.1 Neural Networks (NN)

3.2 Convolutional Neural Networks (CNN)

3.3 Recurrent Neural Networks (RNN)