

Empirical Modeling of a Rayleigh Fading Channel and Computation of Channel Capacity for Multi-Path Wireless Propagation

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Abstract

This work presents the empirical modeling of wireless communication channels and reviews the performance metrics of the multi-path propagation model with the help of the Singular-Value-Decomposition (SVD) method to enhance the channel capacity in 4G and 5G wireless communication systems. MIMO has established a rapid improvement in data rate by lowering the Signal-to-Noise ratio (SNR). Fading is a serious issue in the multi-path propagation model, that decreases the overall average Bit-Error-Rate (BER). In this research, the data rate is analyzed in terms of enhancing the channel capacity of the MIMO system and is analyzed by reducing the SNR using SVD. An Empirical model of the MIMO is postulated, and the Rayleigh-Fading system is modeled to compute the channel capacity. It is found that the maximum channel capacity is achieved up to 6.9 bits/sec/Hz.

Keywords: Multi-Input-Multi-Output, Fading, Antenna Diversity, Rayleigh Distribution, Singular Value Decomposition, Bit Error Rate.

1. Introduction

The 5G technology has received wide attention and a lot of research from global enterprises, research institutes, and universities to improve spectrum utilization through channel capacity improvement in wireless communication systems. Therefore, the communication system demands proper utilization of the bandwidth resources efficiently. Due to the shortage of spectrum resources, it is important to improve the spectrum utilization of the system for future communication technologies [1]. In MIMO, multiple antennas are utilized on both the transmitting and receiving ends to improve transmission reliability.

1.1 Basics of MIMO

MIMO was a paradigm shift in wireless transmission because it broke fundamental barriers to increasing data rates. Before the invention of MIMO, the channel capacity