

SIMULATION OF RAYLEIGH FADING GENERATOR

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ABSTRACT

A mobile radio channel simulator is designed as a convenient test instrument for evaluating the performance of the mobile radio equipment in the presence of environmental effects. The proposed multipath-fading simulator is based on the narrowband noise model. The design goals of the simulator were based upon accepted theoretical work.

Adding the inphase and the quadrature components, which are independently modulated with low frequency noise, achieve the fading signal of the Rayleigh fading generator. Using the window method uses FIR digital filters to generate the control signals of the Rayleigh fading generator.

The Rayleigh fading generator is simulated using the MATLAB software based on the Signal Processing Toolbox. In general, the results produced by the simulation process indicate good agreement with theoretical results.

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CHAPTER 1

INTRODUCTION

1.1 Background

Free space, electromagnetic radio wave propagation is the only practical means of communicating with mobile users. However, the radio signal in mobile communication systems is subjected to various types of environmental effects. The most significant propagation problem is due to the effect of multipath fading or Rayleigh fading. Multipath fading is due to the nature of the transmission medium and the effect is more significant as the operating frequency increases. The fading effect causes the signal level to vary in time and under the worst case condition, the envelope of the signal follows a Rayleigh probability density function. In the transmission of speech, fading results in random interruption that degrades the quality of speech, which to a certain extent is unacceptable. However, for digital transmission, the variation in the signal envelope due to fading is critical since it results in the increase in the bit error rate. Further discussions on the environmental effects will be presented in the next chapter.

An accurate model of a fading channel would be needed for implementing a channel simulator. Several models of multipath fading simulator has been discussed and implemented in [1] – [5]. In [1] and [2] analogue noise sources and analogue filters were used to generate the control signals. More recent implementations used analogue signal processor [3], microprocessor [4] and digital logic [5] to generate the control signals. The method proposed in this project use the digital signal processing approach.

A channel simulator reduces the cost in the design and testing of RF equipment because the cost of unnecessary field-testing can be avoided. Instead, testing can be done in the laboratory under controlled environment.