Development of a Computer Program to Simulate a Noncoherent FSK System in the Presence of Multipath Fading

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I. INTRODUCTION

In studying the problem of a noncoherent frequency shift keyed (FSK) system operating in the presence of multipath fading, one finds there is substantial literature available dealing with the subject.

One of the earliest and surely most important is that of Chadwick (1). In this paper, the results of the work by Glenn (2) and Boyd (3) on noncoherent FSK detection were used and their technique was applied to the problem of multipath interference. This technique relies on the sampling theorem to evaluate the output of an integrate and dump stage in the form of a summation. Variations on this method can be found in papers by Austin (4), Austin and Milstein (5) and Schuchman (6). All of these rely on the approximation of the postdetection filter by sampling and summing techniques.

Probably the most useful work can be found in a paper by Kwon and Shehadeh (7). Unlike the aforementioned authors, they have used the sinusoidal series expansion technique for the representation of a band-limited Gaussian process as developed by Yaglum (8).

Figure 1 shows a diagram of a typical system. The received signal has both direct and reflected components. The most general case must assume the receiver and/or the transmitter are mobile units. The relationship between the reflected and direct signals is thus a random process. Because the characteristics of the direct signal are known, those of the reflected signal are random variables. In addition, the noise in the channel can be assumed to be white Gaussian noise. Because of these factors, signal processing techniques, as well as communication theory, are basic to the study of the problem.

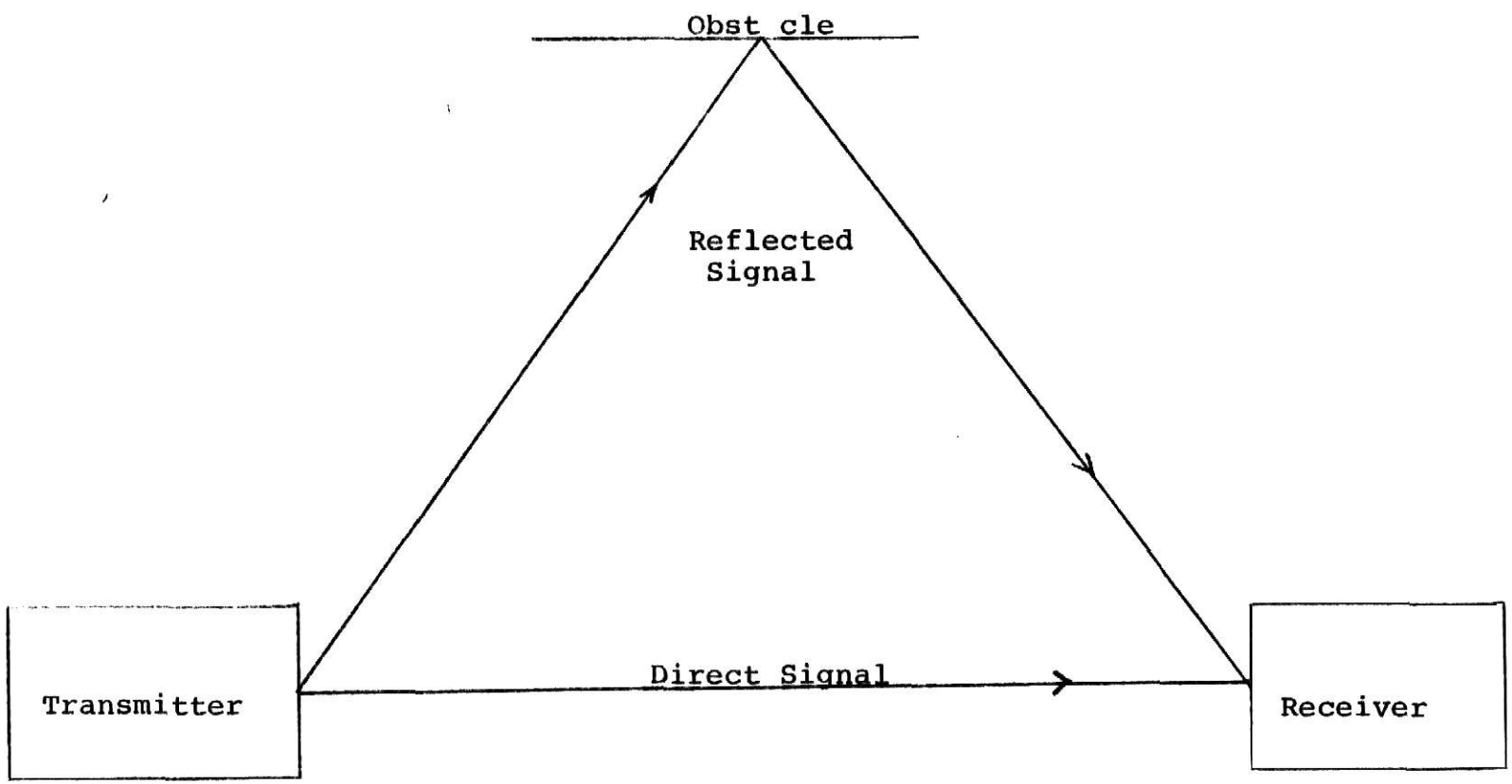

Figure 1. Diagram of System

The major purpose of this paper is to show the development of a package of computer programs to generate the values for probability of error as calculated from the equations derived by Kwon and Shehadeh.

This report begins with a review of the derivation with additional comments where appropriate to clarify some points due to the conciseness of the reference. It is then shown that the equations derived in an earlier paper by Kwon and Shehadeh (9) associated with the noncoherent detection of FSK are a special case of this derivation.

With this, the programs were developed to incorporate the results of both cases (7), (9) and to simulate either system at the user's discretion.

Some considerations in the development which imposed major constraints on the structure and logical flow of the programs were memory available, excessive run time and round-off error. The implications of these factors and the techniques used to overcome them are discussed in detail as their effects appear in the generation of the programs.