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Investigating the Effects of Delay in FSK Modulation Technique Using Simulink

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Abstract- This paper presents a model-design based approach of investigating the effects of delay in frequency shift keying (FSK) modulation techniques in a digital communication systems.. Living In the Era of communication everything may be video, audio or any information in the form of electrical signal is termed as data and there is an enormous requirement of data transfer between two or more points through the world wide web, every moment of the clock, which is a big threaten to the existing communication systems because of the problems like spectral congestion, severe adjacent & co-channel interference problems and noise corrupted data reception etc. FSK has several advantages over ASK due to the fact that the carrier has a constant amplitude. These are the same advantages present in FM which include: immunity to non-linearities, immunity to rapid fading, immunity to adjacent channel interference, and the ability to exchange SNR for bandwidth. In this work, model-design based approach using Matlab/Simulink was employed. The FSK modulation network was designed, Delays were introduced and the effects were investigated and analyzed. It was observed that for important data transmission, with accurate data synchronization a tapped delay can be used either before modulation or after modulation because it is less prone to delay time interval.

Keywords- *FSK, Modulation, Delay, Matlab, Simulink, SNR*

I. INTRODUCTION

Frequency Shift Keying (FSK) is the most common form of digital modulation technique for high-frequency radio spectrum and has important applications in telephone circuits. It has advantage over other modulation techniques schemes like AMSK, PSK and QSK.

A time delay may be defined as the time interval between the start of an event at one point in a system and its resulting action at another point in the system. Delays, also known as transport lags, dead times or time lags, arise in physical, chemical, biological and economic systems, and in the process of measurement and computation.

Delays also arise in signal processing, where a time delay is also known as a time difference of arrival between two signals; such a measurement arises in underwater tracking applications, biomedicine, geophysics, astronomy, acoustics, seismology and telecommunications. Quite often in these simulations, the time delay is estimated in the absence of other process parameters.

Modulation is the process of modifying or varying one of the parameter amplitude, frequency or phase of the carrier wave in accordance with the instantaneous value of the modulating or message signal.

The aim of this work is to simulate the effect of delay in FSK modulation technique using Matlab/Simulink.

II. RELATED WORKS

In the work published by Tommy Y. Otoshi and A. Ray Howland (1985) they said that since the frequency of the transmitted signal varies with time, the delay between the transmitted and received signals can be determined from the frequency differences between them. These delays can also be determined by varying the modulation rate by the correct (known) amount such that the frequency difference remains constant.

In a similar work by Jean-Louis Laroche (2010) he said that there is an apparatus for determining a time delay between a transmission and a reception of a Radio Frequency (RF) signal in a noisy environment. The apparatus comprises a processing device; a memory device accessible by the processing device; and an application coupled to the processing device.

In the work published by Chen-Yi Lee et al., 2010, it dealt with the delay generating device such that signal phase/frequency control module is configured to receive and compare the delay parameters, so as to determine a delay status of the absolute time delay generating device, and thereby generate a correction signal based on the delay status of the absolute time delay generating device.

Andela Goldsmith (2005) contained vital information on comparing multipath channel with delay spread between the first received signal component and the last received signal component associated with a single transmitted pulse. If the delay spread is small compared to T, then little time spreading in the received signal will occur, otherwise if the time delay is large, significant delay dispersion to the received signal will occur resulting distortion to the received signal.

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chemical, biological and economic systems, and in the process of measurement and computation. Depending on how the delay is measured, the results may be reported in microseconds, nanoseconds, or picoseconds. Depending on the link length and the actual propagation speed, the amount of the delay will vary from one application or execution to the next. (http://com2networks.blogspot.com/2013/09/delays-in-transmission.html).

There are various types of delays in networks that occur due to various factors. These factors can be:

i. The slow transmission rate of the link.

ii. Position of the hosts from each other.

The two types of delay popularly encountered in data transmission are Transmission and Queuing delays.

Transmission delay is usually caused by the data rate of the link. It is the time taken to push all the packet bits on to the link.

Queuing Delay is the time that a packet has to wait in the queue before it can be transmitted over the link. Packets are put in the queue when the speed of incoming link to the router is faster than the outgoing link.

III. METHODOLOGY

The following steps were taken to analyse the FSK model alongside various delay outcomes:

- Introduction of the unit delay block before and after transmission and determining the outcome.
- Introduction of the tapped delay block before and after transmission and determining the outcome.
- Variation of bit samples and simulation time to determine effects on the simulation results.
- Variation of frequency separation and analysis against Delay time.

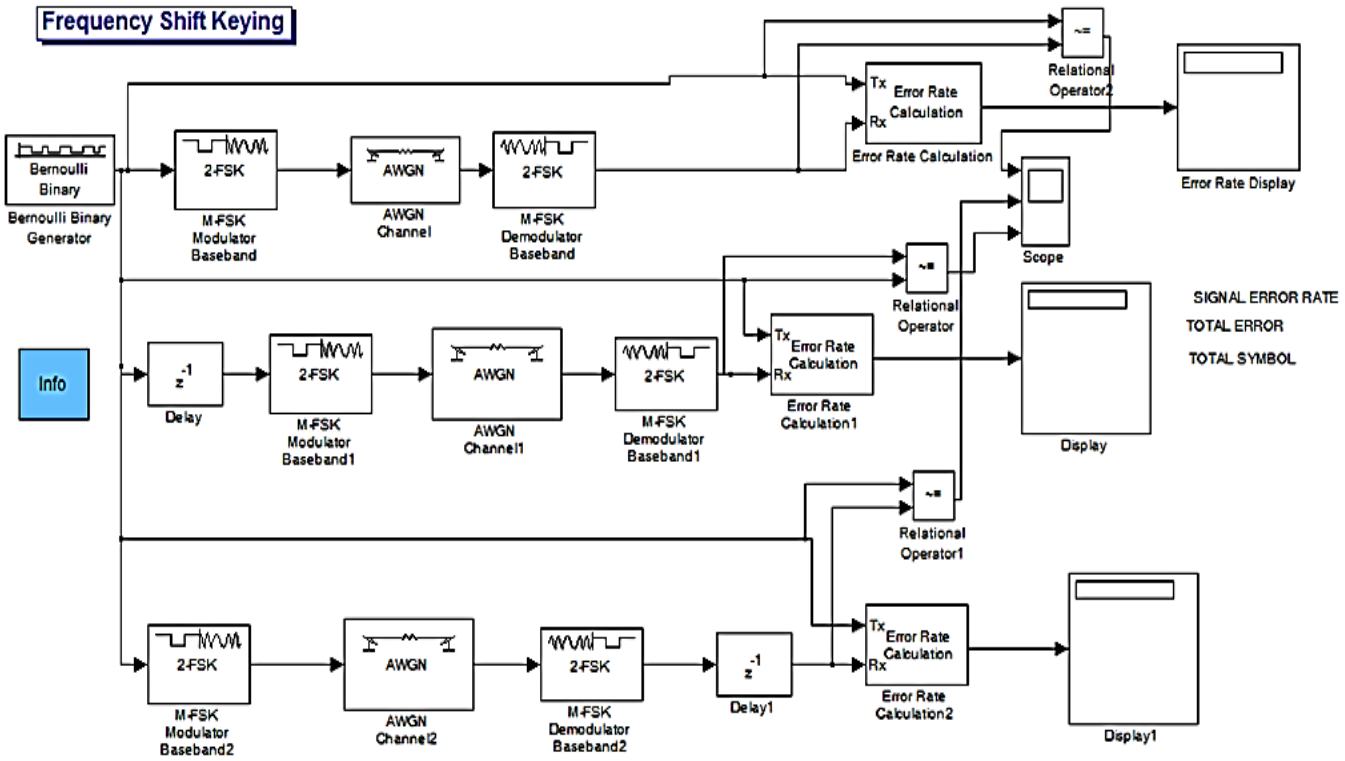

Figure 1. Comparative model for FSK modulation with unit delay and tapped dela

TABLE I. BIT ERROR RATE RESULTS FOR FSK MODULATION WITH DELAY TIME, FREQUENCY AND SIMULATION TIME

S/N	Simulation	Delay Time	Frequency	Total ETSWD	SER	Total ERSWD	SER2	Total ETSWND	SER3
1	15	1	1000	9056	0.5031	9042	0.5023	0.004611	83
2	15	1	2000	9056	0.5031	9042	0.5023	0.004611	83
3	15	1	3000	9033	0.5018	9040	0.5022	0.0055	99
4	15	1	4000	9027	0.5015	9034	0.5019	0.005278	95
5	15	1	5000	9044	0.5024	9051	0.5028	0.004333	78
6	15	1	6000	8950	0.4972	8962	0.4979	0.4959	8926
7	15	1	7000	9041	0.5023	9037	0.5021	0.004667	84
8	15	1	8000	9031	0.5017	9044	0.5024	0.004833	87
9	15	1	9000	9029	0.5016	9048	0.5027	0.005056	91
10	15	1	10000	9037	0.5021	9046	0.5026	0.004389	79
11	15	1	11000	9055	0.5031	9039	0.5022	0.004111	74
12	15	1	12000	9056	1.5031	9040	0.5022	0.004112	72

TETSWD: Total Error Transmitted Signal With Delay
TERSWD: Total Error Received Signal With Delay
SER: Signal Error

TABLE II. VALUES FOR THE SIMULATION OF DELAY WITH FSK MODULATION TECHNIQUE

Simulation Time	Delay (Sample)	Total ETSWD	Total ERSWD	Total ETSWND
15	1	9033	9044	83
15	2	9025	9034	83
15	3	9074	9086	83
15	4	9005	9010	83
15	5	8961	8977	83
15	6	8949	8954	83
15	7	8960	8979	83
15	8	9048	9056	83
15	9	9024	8996	83
15	10	8944	8958	83

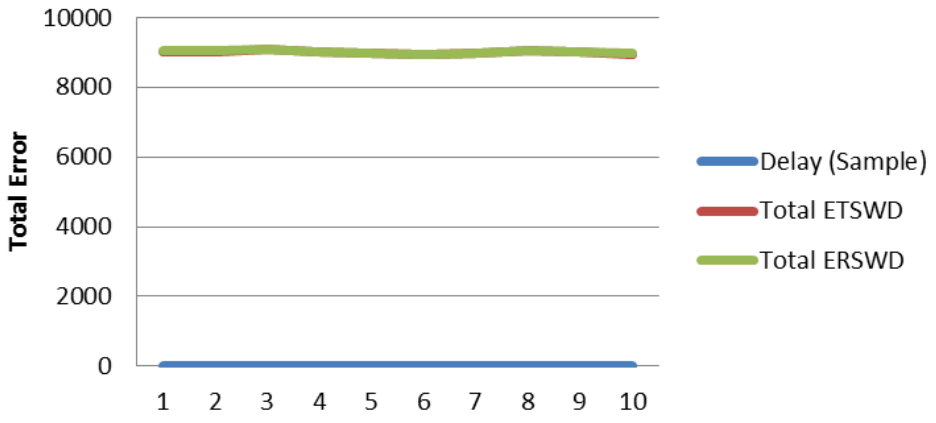

Figure 2. Graphical Output for Simulation of Delay in FSK Modulation Technique

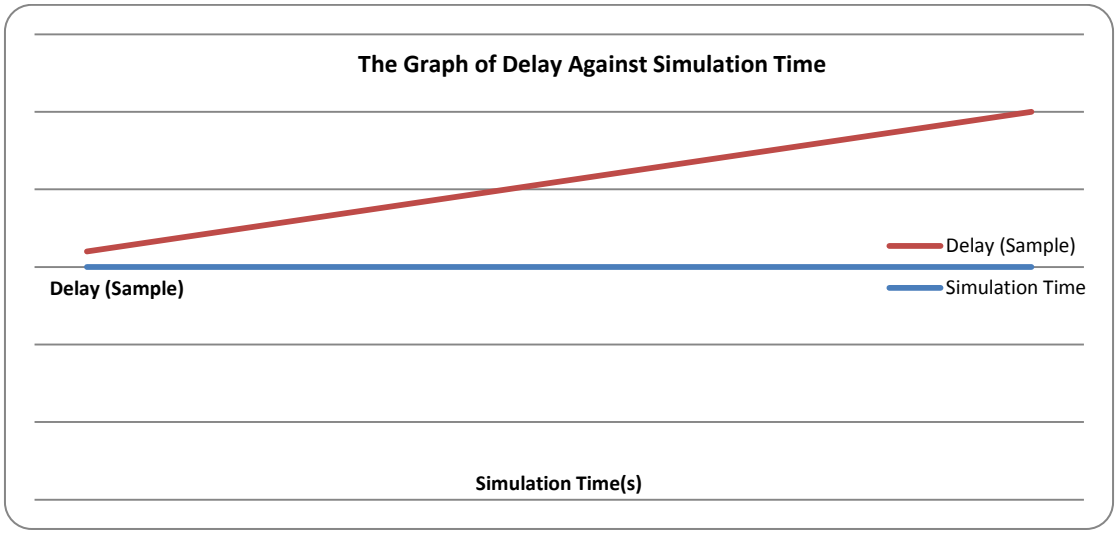

Figure 3. Graph of Delay Against Simulation

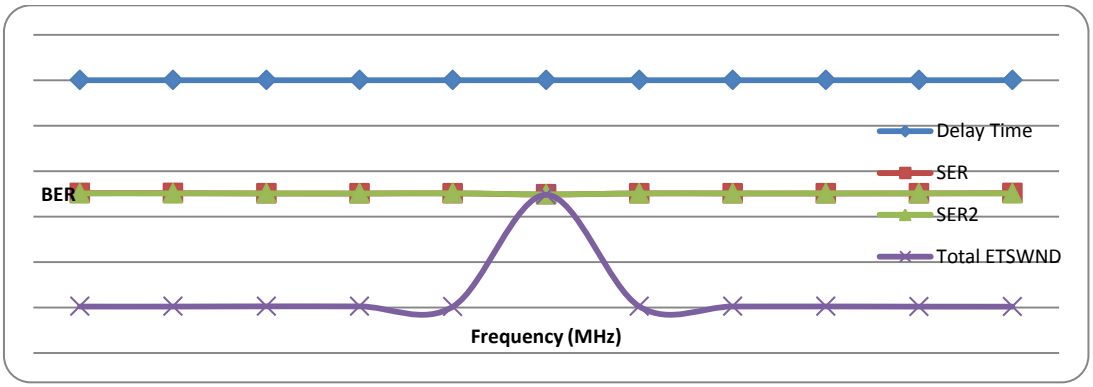

Figure 4. Graph of SER Against Frquency(Mhz)

A. Effects of Delays in FSK Modulation Technique

- The delay block was introduced to holdup the transmitted signal so that it can be accurately compared with the received signal.
- It is used for synchronization and feedback in telecommunication.

IV. RESULTS AND DISCUSSIONS

The delay sample block gave the varying results as the values were varied from 1s to 10s.

- At constant simulation time (15sec) with increase in delay samples, the delay time interval increases the model.
- When delay was introduced before modulation and after modulation, the delay time interval was the same.
- When another type of delay (i.e. tapped delay) was used there was reduction in delay time interval when compared with unit delay.

V. CONCLUSION

It was discovered that the effect of delay in FSK modulation can be high or low depending on the purpose why it was introduced. Finally, for important data transmission, with accurate data synchronization a tapped delay can be used either before modulation or after modulation because it is less prone to delay time interval.

VI. RECOMMENDATION

During the simulation of communication model it is advice-able to introduce the delay factor.

When simulating an FSK model you need to take into consideration the type of delay block you want to use and the purpose of the delay because they produce different results. For instance when you introduce a unit delay, you have more delay time interval when compared with tapped delay which has less delay time interval.

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