DEVELOPING DIGITAL COMMUNICATION LINK USING MATLAB/SIMULINK

COMMUNICATION LINK

ADITYA C[1],VIGNESH K2, SHREYAS H[3],MANOJ H.[4]

[1]TELECOMMUNICATION,RVCE,adi.rv93@gmail.com
[2]TELECOMMUNICATION,RVCE,vigneshkrishnan842@gmail.com
[3]TELECOMMUNICATION,RVCE,shreyasy94@gmail.co
[4]TELECOMMUNICATION,RVCE,manojhegde95@gmail.com

ABSTRACT-- This report explores the communication link design concepts with respect to the aerospace applications. The communication link is like a nervous system as it allows data transfer between the aircraft and the ground station. This work also describes the realization of communication links using MATLAB-SIMULINK platform.

KEYWORDS- Channel capacity, Bit error rate and symbol error rate, error robust coding techniques with error detection and correction capabilities,error robust protocols, minimization of the electromagnetic exposure of jammers with by for example directed or narrow beam antennas, frequency hopping methods**,** spread spectrum techniques**.**

I. INTRODUCTION

Wireless communication has revolutionized the technological developments in almost all the fields. Designing a reliable and secure communication link is a challenging task and requires thorough understanding of DSP concepts. MATLAB-SIMULINK provides a useful platform for design and analysis of communication links. This report describes the communication link with respect to Unmanned Air Vehicle (UAV).

In civil aviation, a data-link system (known as Controller Pilot Data Link Communications) is used to send information between aircraft and air traffic controllers when an aircraft is too far from the ATC to make voice radio communication and radar observations possible (Telemetry). This system uses the aircraft's flight management computer to send location, speed and altitude information about the aircraft to the ATC. ATC can then send messages to the aircraft regarding any necessary change of course (Tele-command). In military aviation, a data-link may also carry weapons targeting information or information to help warplanes land on aircraft carriers.

The communication going from an aircraft to ground is called a downlink and when it is going from ground to an aircraft it is called uplink**.**

II.CHANNEL MODELLING

Communication between a transmitter and receiver is largely dependent on the propagation channel characteristics between them. Hence, there is a need to create accurate generalized models to characterize the propagation channel. The propagation channel is usually characterized in a statistical manner based on measurements.

II.A Elements of statistical channel model

Statistical models are required to characterize the propagation channel for system design. These models can be broadly classified into three categories based on the phenomenon which they characterize.

- **Large scale path loss models** are used to estimate the average signal strength for a given

distance (electrically large) between the transmitter and the receiver.
- **Shadowing** model is used to estimate the attenuation of the signal due to electrically large obstacles.
- **Small scale models** are used to predict the fading characteristics, i.e. the fluctuation of the field strengths in the near vicinity of the receiver for very short distances.

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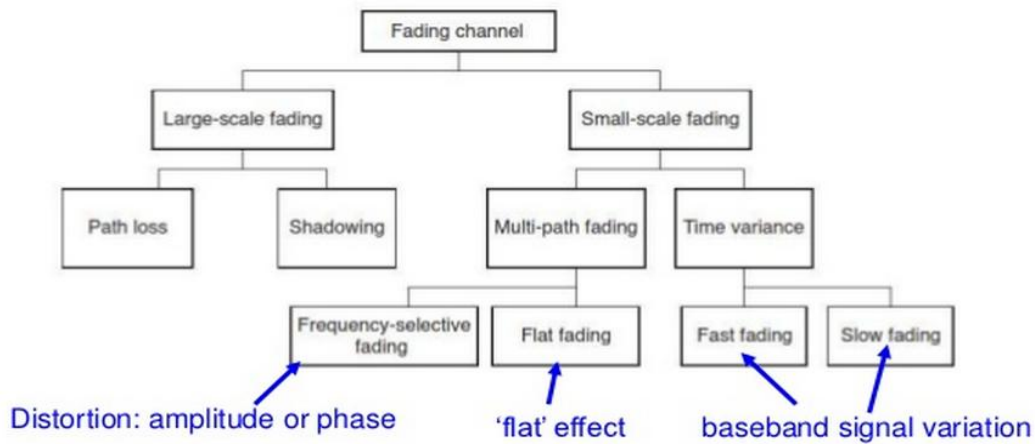
Figure 1 : Different types of fading channel

III.SIMULINK

Simulink is a block diagram environment for multi domain simulation and Model-Based Design. It supports system-level design, simulation, automatic code generation, and continuous test and verification of embedded systems. A Model-Based Design improves the product quality and reduces development time by 50% or more. Simulink and add-on products enable Event-Based Modeling, Physical Modeling, Control System Design and Analysis, Signal Processing and Communications, Code Generation, Rapid Prototyping and HIL Simulation, Verification, Validation, and Test, Simulation Graphics and Reporting.

III.A Realization of Data link and Video link
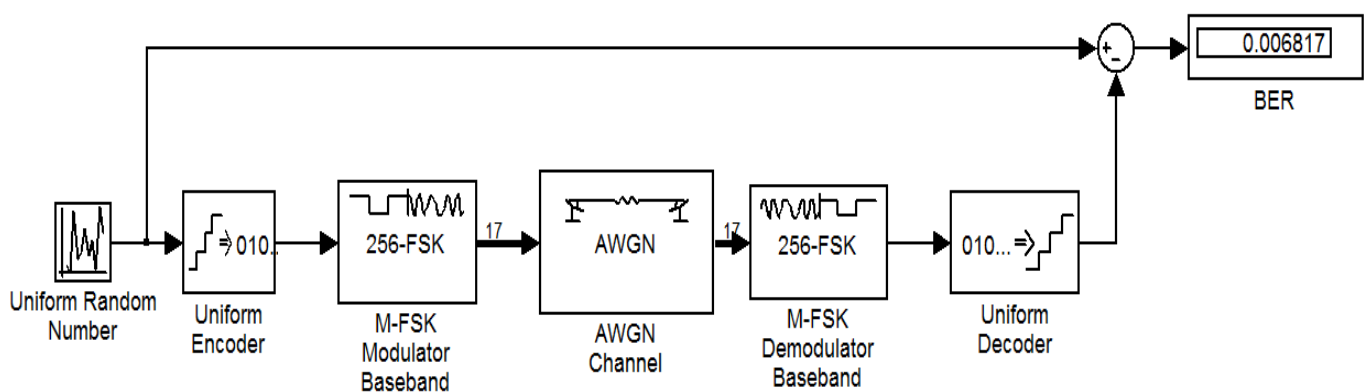
Figure 2: SIMULINK model for data link

III.A.1Description Of The Blocks Used in Realizing the model

Input simulation

For Data link - A uniform random data generated from Simulink model is used as the information

being transmitted.

For Video link - The From Multimedia File block reads audio samples, video frames, or both from a multimedia file. The block imports data from the file into a Simulink model.

Setting up of Sample Rates

The sample rate that the block uses depends on the audio and video sample rate. While the FMMF block operates at a single rate in Simulink, the underlying audio and video streams can produce different rates. In some cases, when the block outputs both audio and video, makes a small adjustment to video rate.
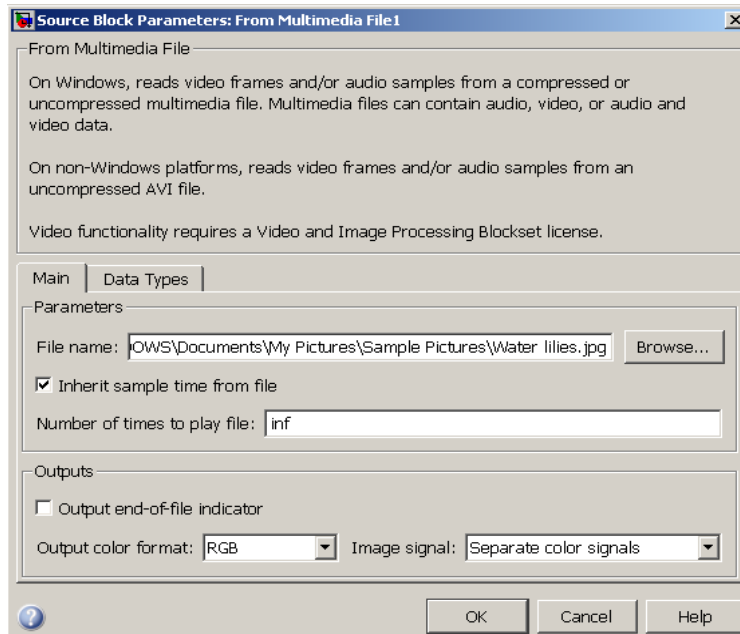
Source block parameters: from multimedia

Figure 3 : configuration block from multimedia file

File name:

Specify the name of the multimedia file from which to read. The block determines the type of file (audio and video, audio only, or video only) and provides the associated parameters. If the location of the file does not appear on your MATLAB path, use the Browse button to specify the full path. Otherwise, if the location of this file appears on your MATLAB path, enter only the file name. On Windows platforms, this parameter supports URLs that point to MMS (Microsoft Media Server) streams.

Inherit sample time from file:

Select the Inherit sample time from file check box if you want the block sample time to be the same as the multimedia file. If you clear this check box, enter the block sample time in the Desired sample time parameter field. The file that the From Multimedia File block references, determines the block default sample time. You can also set the sample time for this block manually. If you do not know the intended sample rate of the video, let the block inherit the sample rate from the multimedia file.

Desired sample time:

Specify the block sample time. This parameter becomes available if you clear the Inherit sample time from file check box.

Number of times to play file:

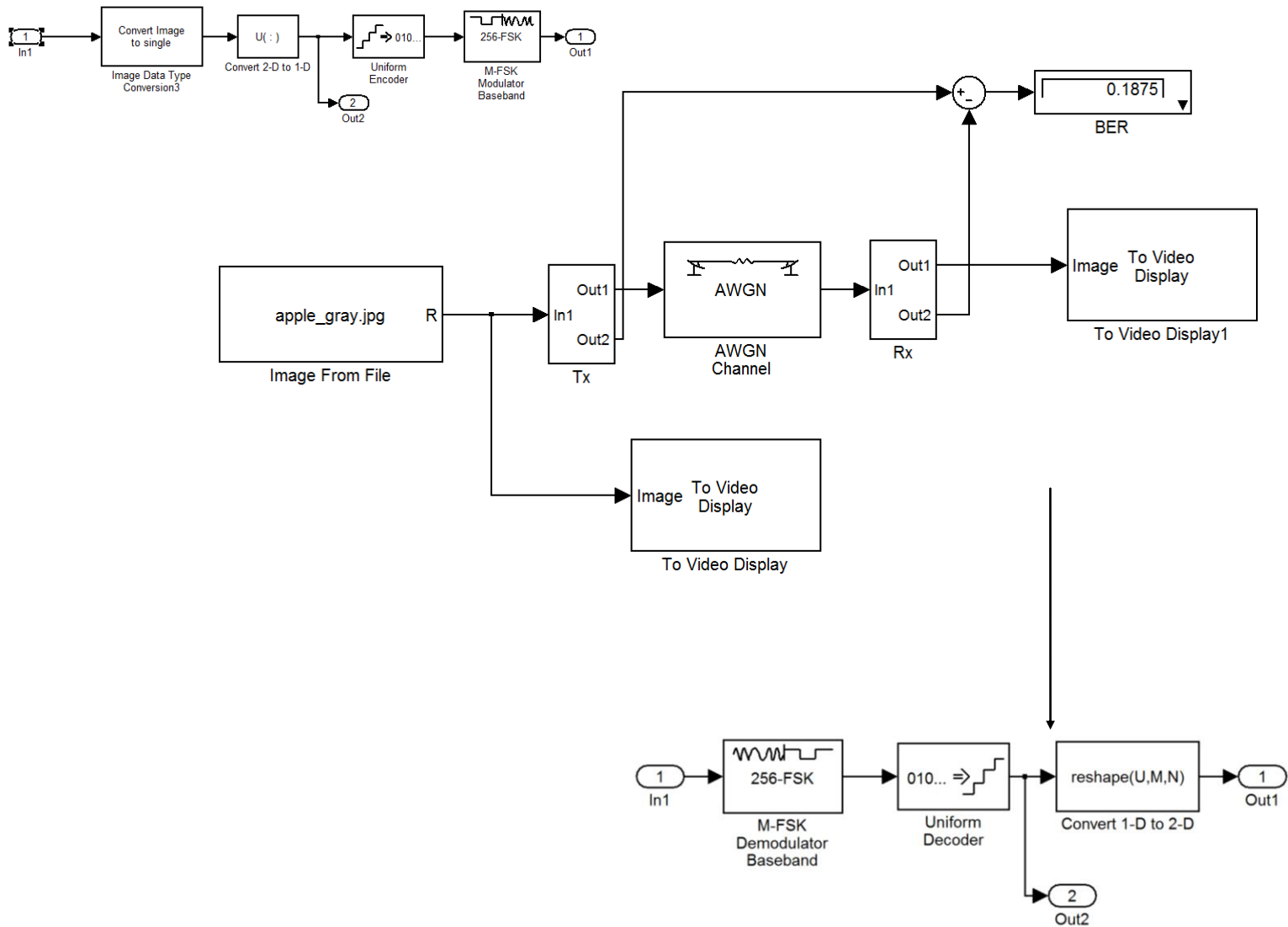Enter a positive integer or inf to represent the number of times to play the file.

Figure 4: SIMULINK Model for Video link

Output end-of-file indicator
Use this check box to determine whether the output is the last video frame or audio sample in the multimedia file. When you select this check box, a Boolean output port labeled EOF appears on the block. The output from the EOF port defaults to 1 when the last video frame or audio sample is output from the block. Otherwise, the output from the EOF port defaults to 0.

Multimedia outputs
Specify Video and audio, Video only, or Audio only output file type. This parameter becomes available only when a video signal has both audio and video.

Samples per audio channel
Specify number of samples per audio channel. This parameter becomes available for files containing

audio.

Convert image to double

The Image Data Type Conversion block changes the data type of the input to the user-specified data type and scales the values to the new data type's dynamic range. To convert between data types without scaling, use the Simulink Data Type Conversion block. When converting between floating-point data types, the block casts the input into the output data type and clips values outside the range to 0 or 1. When converting to the Boolean data type, the block maps 0 values to 0 and all other values to one. When converting to or between all other data types, the block casts the input into the output data type and scales the data type values into the dynamic range of the output data type. For double and single precision floating-point data types, the dynamic range is between 0 and 1. For fixed-point data types, the dynamic range is between the minimum and maximum values that can be represented by the data type.
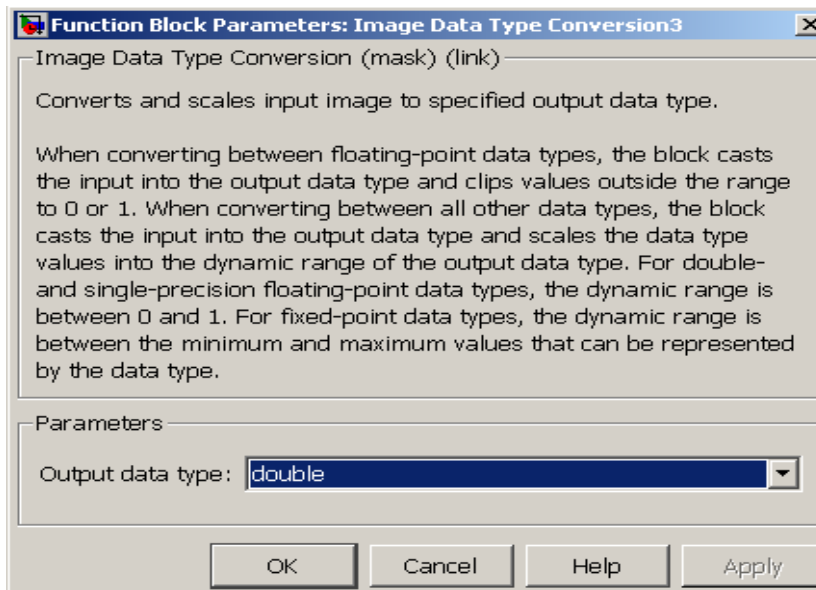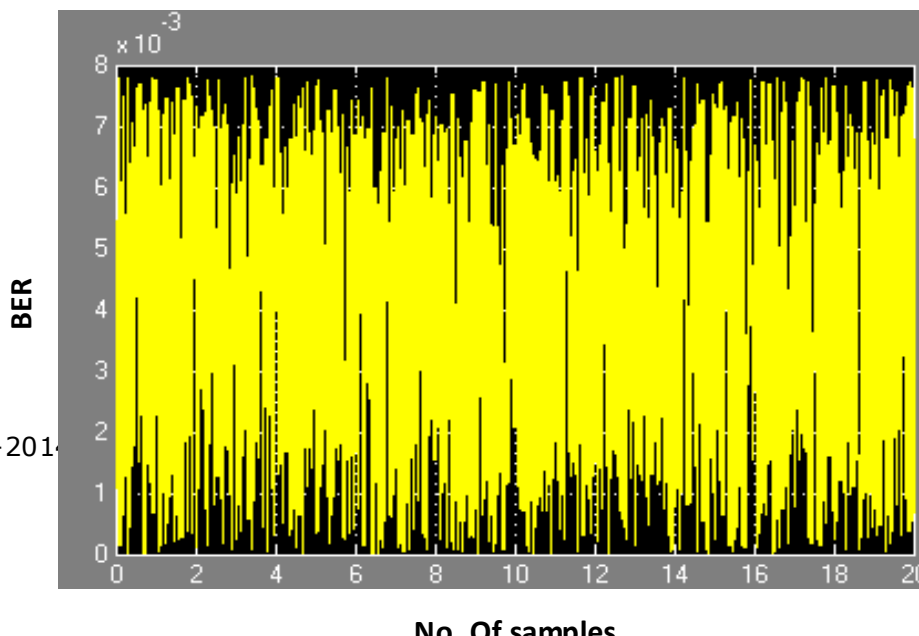

Figure 5 : Image data type conversion dialog box.

Output data type

Use this parameter to specify the data type of your output signal.
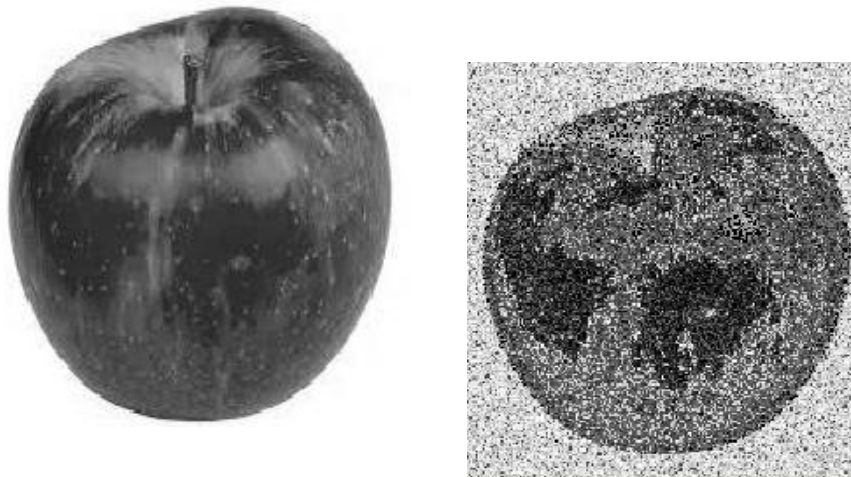
IV.RESULT

IV.A Data link

To evaluate the data link Bit Error Rate was the parameter. For an SNR of 25dB, the BER is plotted in the Figure 6.

No. Of samples

Figure

5: BER plot of data link

IV.B Image link

Figure 6 Tx and Rx images of video/image link

V.CONCLUSION AND FUTURE WORK

In this work, simple communication links to transmit data and Video were developed using MATLAB-SIMULINK development platform. The channel was modelled as a simple AWGN channel, which adds only noise to the information being transmitted. The link involved basic blocks like source and channel encoder/decoder and modulator/demodulator. The data transmission quality was quantified in-terms of BER.This work sets the platform for designing and evaluating the communication link. The model can be further expanded in terms of realistic channel modelling, appropriate modulation, encoder and equalizer blocks to simulate a realistic communication link leading to realistic link budget analysis.

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