simDM simulation for jonsson_3dm_01_01_20_25

Introduction

The accompanying code was written to provide simulation results to the IEEE 802.3dm Task Force. The results from this code are shared in jonsson_3dm_01_01_20_25 [1]. The code can also be used to run simulations for other channels/cables. The code is based on the simDM code introduced in jonsson_3dm_01_12_19_24 [2].

Simulation Details

- The simulation uses a 22.5GHz sampling rate to represent analog signals, and analog signal levels are represented in Volts
- No echo cancelation is used for either high or low data rate signals
- No equalization is used for the 100Mbps DME signal
- T/2-spaced equalizers are used for the high data rate signals, to minimize ambiguity due to sampling phase at the ADC
- No quantization is done at the ADC (only down-sampling), to minimize ambiguity due to signal quantization

- Equalizer coefficients for high data rate signals are calculated using line probing signals and closed form minimum mean square equalizer algorithm from [3]

Test1 - How to Run

This code is written for MATLAB and has been verified with MATLAB R2012b.

To run the code the following command can be used:

```
>> Test1;
```

This will run ACT simulation for the default configuration for 100M+2.5GBASE-V1, with PAM4 modulation using the cable impulse response from the included "cable_jonsson_3dm_02_09_15_24_good.mat" file.

The code can run for other data rates in the high rate direction, for example to run for 10Gbps case the following can be used

```
Test1(10);
```

The function format for Test1.m is

```
Test1(hdr_rate,pam_levels,cable_name,pcb_cutoff,print_plot)
```

Where *hdr_rate* is the data rate in the high data rate direction, given in Gbps (default is 2.5, for 2.5Gbps). The *pam_levels* is the number of levels in the high data rate PAM modulation (default is 4, for PAM4). The *cable_name* parameter identifies the cable model to use in the simulation. The *pcb_cutoff* parameter gives the cutoff frequency, in MHz, for the high-pass filter used to model the high-pass nature of the PoC circuitry on the PCB. The unit for this parameter is MHz and the default value is 10, for 10MHz. The *print_plot* parameter controls if the the plots generated by the test code should be saved to an image file (default is 0, for not saving the image files).

If the value of *cable_name* is either 'good' or 'bad', then the simulation will be run with the included cable models in cable_jonsson_3dm_02_09_15_24_good.mat and cable_jonsson_3dm_02_09_15_24_bad.mat, respectively. Other cable models can be loaded by using the full name of the cable model file. For more information about the format of the cable model files, see the "Cable Models Files" section below.

Example 1

To simulate 100M+2.5GBASE-V1, with PAM2 , on bad cable, and saving the plots to file, the following command can be used

```
Test1(2.5,2,'bad',[],1)
```

Example 2

To simulate 100M+10GBASE-V1, with PAM4 , on new cable in cable_my.mat, and saving the plots to file, the following command can be used

```
Test1(10,4,'cable_my.mat',[],1)
```

Test3 - How to Run

This code is written for MATLAB and has been verified with MATLAB R2012b.

To run the code the following command can be used:

```
>> Test3;
```

This will run ACT simulation for the default configuration for 100M+2.5GBASE-V1, with PAM4 modulation comparing the "good" and "bad" cable files.

The code can run for other data rates in the high rate direction, for example to run for 10Gbps case the following can be used

```
Test3(10);
```

The function format for Test1.m is

```
Test3(hdr_rate,pam_levels,print_plot)
```

Where *hdr_rate* is the data rate in the high data rate direction, given in Gbps (default is 2.5, for 2.5Gbps). The *pam_levels* is the number of levels in the high data rate PAM modulation (default is 4, for PAM4). The *print_plot* parameter controls if the the plots generated by the test code should be saved to an image file (default is 0, for not saving the image files).

Example 3

To simulate 100M+2.5GBASE-V1, with PAM2 , on bad cable, and saving the plots to file, the following command can be used

```
Test3(2.5,2,1)
```

Cable Model Files

The cable model files are in MATLAB data format, that can be loaded into MATLAB using the "load" command. The files contain a single data structure named "cable".

The cable data structure must have the following fields:

- *h* - is 2x2 cell array with the channel impulse response h{1,1}, h{1,2}, h{2,1} and h{2,2}, corresponding to s11, s12, s21, and s22, respectively.
- *is_coax* - is 0 if the cable is not coax and 1 if it is coax.
- *F_s* - is the sampling frequency for the *h* impulse response in Hz.
  Other fields are optional, but may include
- *s* - is 2x2 cell array with the channel transfer function s{1,1}, s{1,2}, s{2,1} and s{2,2}, corresponding to s11, s12, s21, and s22, respectively.
- *f* - the frequency vector for S-parameters.
- *name* - the name of the cable.
  Including other fields is allowed and should be harmless for the simulation.

References

[3]: R. H. Jonsson, "DSL Channel Equalization" in Fundamentals of DSL Technology P. Golden, H. Dedieu, and K. S. Jacobsen, Eds. CRC Press, 2005, pp. 299-350.