Matlab Simulation Example 1: PHY abstraction under 11ax OFDM SISO system

Matlab code part is colored in orange.

Setup:
MCS = 0
num of transmit antenna = 1, num of receive antenna = 1
Channel: Model-D, bandwidth = 20MHz
APEP length = 1000
Channel coding = LDPC

Step 1: running full PHY simulation
1.1 Set the above parameters in 1 full PHY/fullPHY.m:

```
mcs = [0]; % Vector of MCS to simulate between 0 and 9
numTxRx = [1 1]; % Matrix of MIMO schemes, each row is [numTx numRx]
chan = "Model-D"; % String array of delay profiles to simulate
maxnumberrors = 40*1e3;  % The maximum number of packet errors at an SNR point
maxNumPackets = 40*1e3; % The maximum number of packets at an SNR point
% maxnumberrors = 1e1;  % The maximum number of packet errors at an SNR point
% maxNumPackets = 1e2; % The maximum number of packets at an SNR point

% Fixed PHY configuration for all simulations
cfgHE = wlanHESUConfig;
cfgHE.ChannelBandwidth = 'CBW20'; % Channel bandwidth
bandwidth = cfgHE.ChannelBandwidth;
cfgHE.APEPLength = 1000;          % Payload length in bytes
cfgHE.ChannelCoding = 'LDPC';     % Channel coding
```

1.2 run fullPHY.m. This takes a long time (around a few hours).

1.3 You can see the output:
snrPer_CBW20_Model-D_1-by-1_MCS0.m
and a PER-VS-SNR figure in Figure 1.

The dotted line: simulated is the average PER- RXSNR curve under full PHY simulation.

Step 2: optimize EESM parameter beta
2.1 Copy snrPer_CBW20_Model-D_1-by-1_MCS0.m into the second folder: 2 EESM parameter optimization

2.2 Open eesmAbstractionPerVsEffSnr.m
Correctly load snrPer_CBW20_Model-D_1-by-1_MCS0.m in eesmAbstractionPerVsEffSnr.m:

```
load('snrPer_CBW20_Model-D_1-by-1_MCS0.mat');
```

Randomly choose an initial beta value (usually the larger MCS value, the larger initial beta value):

```
% Initialize EESM parameters
beta = 5;
```

2.3 run eesmAbstractionPerVsEffSnr.m

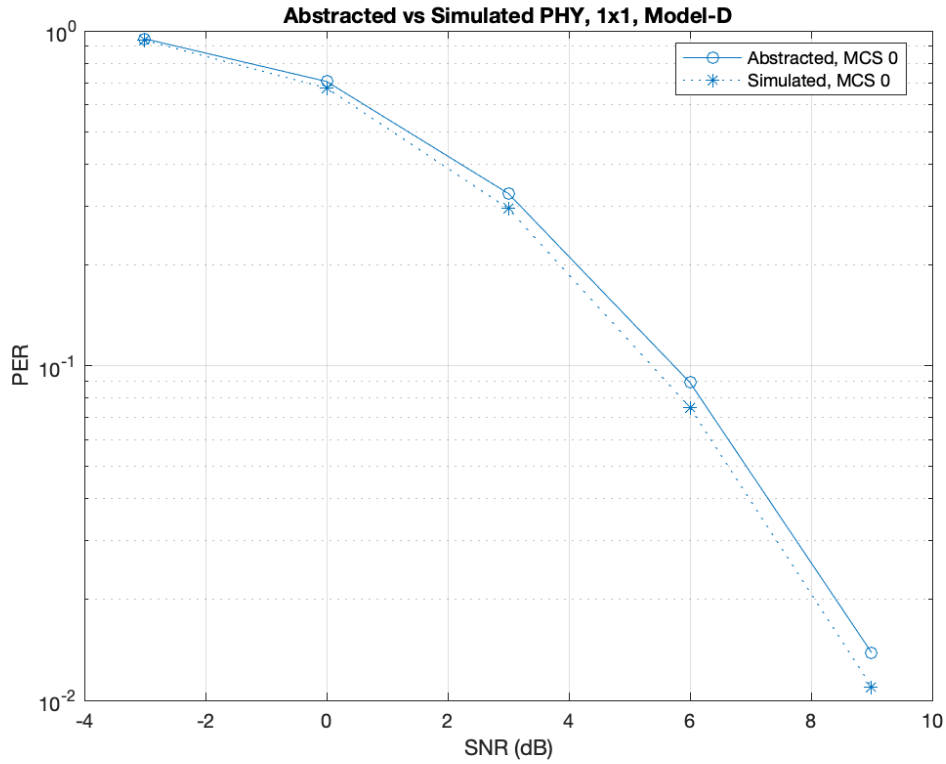

Figure 1. Average PER versus RX SNR

2.4 You can see output
eesmEffSnr_CBW20_Model-D_1-by-1_MCS0.m
This file includes optimized eesm parameter beta

Step 3: EESM-log-SGN PHY abstraction
3.1 Copy snrPer_CBW20_Model-D_1-by-1_MCS0.m and eesmEffSnr_CBW20_Model-D_1-by-1_MCS0.m into the third folder: 3 log-SGN method

3.2 Open skewGeneralizedNormalApp.m
Correctly load snrPer_CBW20_Model-D_1-by-1_MCS0.m and eesmEffSnr_CBW20_Model-D_1-by-1_MCS0.m in skewGeneralizedNormalApp.m:

```
load(‘snrPer_CBW20_Model-D_1-by-1_MCS0.mat');
load('eesmEffSnr_CBW20_Model-D_1-by-1_MCS0.mat')
```

There are 5 SNR values, stored in the variable snrs.
Set for example:

```
snrIdx = 1;
```

This means choose the 2nd SNR value:

```
snrs(1) = 0
```

This value means the currently tested SNR is 0dB.

3.3 Run skewGeneralizedNormalApp.m. You'll quickly see Figure 2:

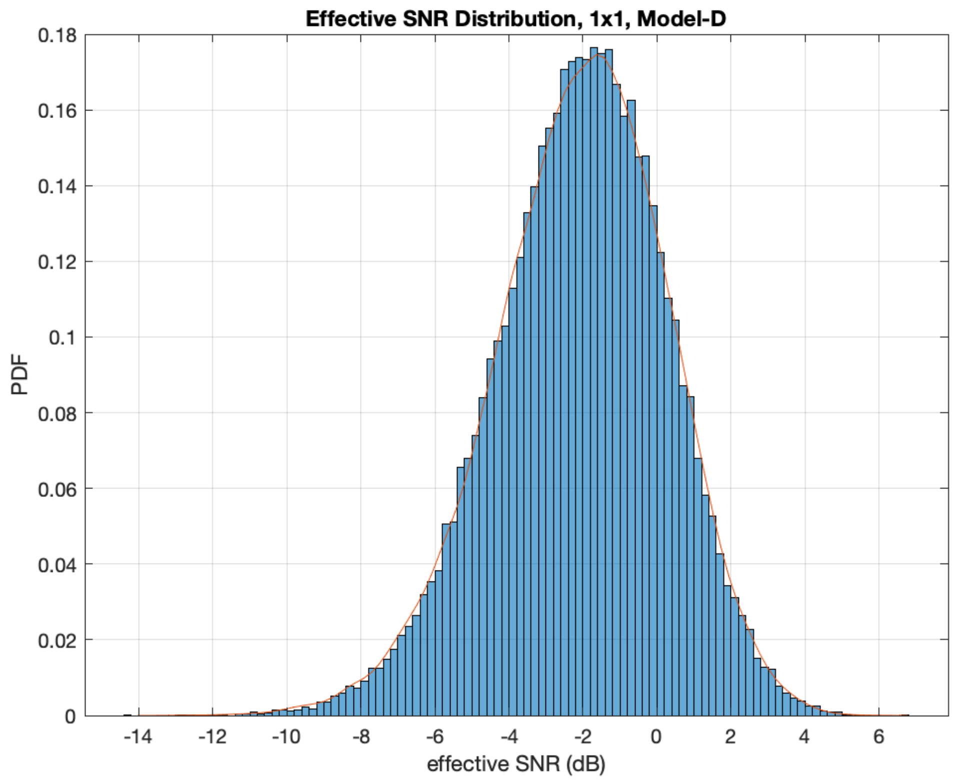

Figure 2. Effective SNR distribution under MCS0, RX SNR = 0dB

If the red curve fits with the blue histogram, then record the log-SGN parameters in the vector xBest in a table in your document (for example, Table A below)

xBest = [5.45859353529112e-09 0.712056954779706 -1.52830915570878 0.0139401007142386]

These values are the average PER under SNR = 0dB.
Also, record the value in perFastAbs

perFastAbs = 0.6608

into perFastAbsVec in the file absAvgPerVsTxSnr.m.
This value is the average PER under SNR = 0dB.

3.4 Repeat the process in step 3.2 to 3.3 for different SNR indices.
Fill in the table that records the log-SGN parameters, as exemplified in Table A.
Finish recording average PER under each SNR in the file absAvgPerVsTxSnr.m.

3.5 Run the file absAvgPerVsTxSnr.m

Copy the curve into figure 1, see whether it matches the full PHY simulation result (the dotted line) well.

You can reproduce the result in Table A, and see the curve in step 3.5 matches with the full PHY simulation result in figure 1.

Table A. Log-SGN parameters under 11ax 20MHz OFDM SU-SISO, **Model-D, MCS0**. The parameters are obtained by running 40000 packet simulations. Under such setup, the optimized EESM parameter beta = 0.9542.

Rx SNR	mu	sigma	lambda 1	lambda 2
0dB	0	0.7121	-1.5283	0.0139
3dB	0	0.4940	0.3618	4.7790
6dB	0.1793	0.5559	1.1009	0.3257
9dB	0.4136	0.6389	1.9375	0.4792