Lab Handout # 4
CPP based based Simulation of M-QAM modulation over wired/wireless system

Design LAB II(Software)
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Time : 3:00 Hour Maximum Marks : 10

Instructions and information for students

- This Lab Handout consists of 2 pages. Please check that you have a complete copy.
- Simulate in matlab or any other Software.

Objective:

1) Simulate M-QAM modulator and Demodulator.

Itroduction:

1) $C++$ **based Qam modulator Demodulator.**

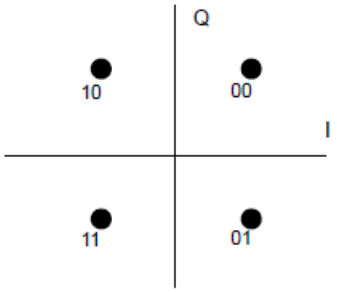

Figure - QPSK constellation

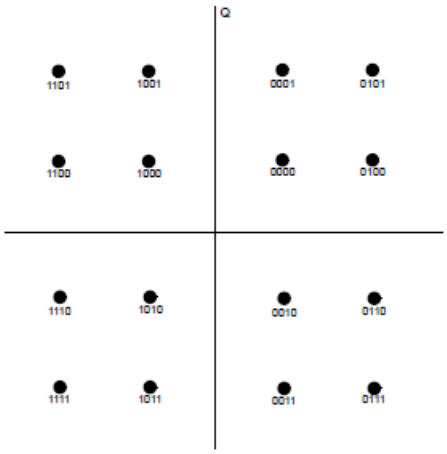

Table - QPSK bits to symbol mapping

B(1)	B(2)	I	Q
0	0	1	1
0	1	1	−1
1	0	−1	1
1	1	−1	−1

B(1)	B(2)	B(3)	B(4)	I	Q
0	1	0	1	3	3
0	1	0	0	3	1
0	1	1	0	3	−1
0	1	1	1	3	−3
0	0	0	1	1	3
0	0	0	0	1	1
0	0	1	0	1	−1
0	0	1	1	1	−3
1	0	0	1	−1	3
1	0	0	0	−1	1
1	0	1	0	−1	−1
1	0	1	1	−1	−3
1	1	0	1	−3	3
1	1	0	0	−3	1
1	1	1	0	−3	−1
1	1	1	1	−3	−3

Fig. 1. Modulator

a) **Simulating M-Qam modulator using C++:**

i) Generate a random binary sequence of 100-10000 values using rand function. Lets call it 'X' sequence.

ii) Map it to various QAM modulator given in the figure. For ex. for 16 QAM use combination of 1 and 3 to genrate constellation points.

iii) Use Normalization factor $\frac{1}{\sqrt{2}}$ for QPSK and $\frac{1}{\sqrt{10}}$ for 16-QAM.

iv) Use $DevC++$ to generate $C++$ code for the above modulator.

v) For comparison of simulated results use

i) Theoretical BER of QPSK:

$$QPSK_{BER} = erfc\left(\sqrt{\frac{snr}{2}}\right)$$

and

ii) Theoretical BER of 16-QAM:

$$16QAM_{BER} = 1.5erfc(\sqrt{snr/10})$$

2) **Observations and Results**.

a) Generate QPSK modulator in Dev C++ and using S-function Builder. [2]

b) Generate QPSK demodulator in Dev C++ and using S-function Builder. [2]

c) Generate Gaussian noise with mean zero and variance 1. [2]

d) Make an end-to-end simulink model for wired channel QPSK Transceiver. Plot Simulated BER. (Tuesday batch) [4]

e) Make an end-to-end simulink model for wired channel 16-QAM Transceiver. Plot Simulated BER. (Wednesday batch) [4]

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