

DSP AND COMS

by Alexander Gravatt

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Digital Signal Processing and Communications (ACDA5008)

By Alexander Gravatt

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Contents

- Contents
- Abstract
- Introduction
- Simulation models
- Results
- Discussion
- Conclusion
- References

Table of figures

Table of Figures

Table of Figures

- Figure 1: [3] 5
- Figure 2: [1] 6
- Figure 3: filter desing 7
- Figure 4: ASK System Block diagram 8
- Figure 5: PSK system Block Diagram 8
- Figure 6: QPSK system block Digram 9
- Figure 7: QAM System block Diagram 9
- Figure 8: ASK Bit Error Rate graph 10
- Figure 9: PSK bit error rate graph 11
- Figure 10: QPSK bit error rate graph 12
- Figure 11: QAM bit error rate graph 13
- Figure 12: all data bit error rate graph 14

Abstract

In this report I describe four models, their modulation scheme and demonstrate a modulator and demodulator. I will demonstrate this using MATLAB simulink. And show the bit error rate of the models. With graphs.

Introduction

I created a MATLAB script that performed 10 tests of each signal to noise value with 15 values the data starts at 10 moving to -60 in increments of 5 this enabled me to enable me plot the data onto an error bar plot shown below individually and as one.

ASK is a function of increasing the size of a single sine wave in relation to data a simple way of producing this is to multiply the signal by the data in and this will produce a sine wave that is active when the data is 1 and inactive when the data is 0.

PSK is a method of switching between two out of phase sine waves to transmit data. To perform this, play a sine wave by 90 degrees and then switch if its active by using the data if data is 0 in phase if data 1 out of phase. This gives it its second name binary phase shift keying.

QPSK is an iteration on PSK as it uses two more phase. This enables it to transmit more bits of data than PSK. This is because each phase can be mapped as a bit. This allows it to in theory match PSK in error rate but outperform it in data transmission. As such that is one of the things this report will look to characterise.

QAM is a further iteration on PSK implementing amplitude into its modulation scheme. It adds amplitude to the already existent phase changes, allowing a larger number of symbols. These with similar error rejection to QPSK and PSK in theory at the least.

Usage

ASK is used in short range radio communications as they allow the user to

PSK is used in GSM (global system for mobile communication). It's used in the form of GMSK [2], a different slightly altered implementation of PSK but as PSK has limited benefits over the other modulation techniques, it's reasonable that a user will need to alter the technique to allow it to perform as needed by that standard. GMSK or Gaussian minimum shift keying uses the MSK alteration of PSK to further improve the error rejection of PSK. It does this by changing phase at the zero point, reducing if not outright removing the amplitude change that can come with an alteration. The main reason for its use was its spectral efficiency [2].

Acronym caps

QPSK is used in WiFi as a backup to QAM as it has less symbols on its constellation but uses very similar modulation. QPSK can often be interpreted when QAM cannot. QPSK is commonly used when the higher standards from WiFi such as 802.11ax as the area becomes more cluttered with signals and symbols, the device will drop down its modulation type until it reaches a QPSK form that allows for basic data transfer and maintaining of communication. This is demonstrated in the MCS Table from semfiornetworks [3] shown below.

First use

MCS Index	Spatial Stream	Modulation	Coding	OFDM (802.11ax)											
				20MHz			40MHz			80MHz			160MHz		
				0.8µs GI	1.6µs GI	3.2µs GI	0.8µs GI	1.6µs GI	3.2µs GI	0.8µs GI	1.6µs GI	3.2µs GI	0.8µs GI	1.6µs GI	3.2µs GI
0	1	BPSK	1/2	8.6	8.1	7.3	17.2	16.3	14.6	34.0	30.6	27.1	68.1	61.3	51.3
1	1	QPSK	1/2	17.2	16.3	14.6	34.4	32.5	29.3	72.1	68.1	61.3	136.1	122.5	102.5
2	1	QPSK	3/4	25.8	24.4	21.9	51.6	48.8	43.9	108.1	102.1	91.9	216.2	204.2	183.8
3	1	16-QAM	1/2	34.4	32.5	29.3	68.8	65.0	58.5	144.1	136.1	122.5	288.2	272.2	245.0
4	1	16-QAM	3/4	51.6	48.8	43.9	103.2	97.5	87.8	216.2	204.2	183.8	432.4	408.3	367.5
5	1	64-QAM	2/3	68.8	65.0	58.5	137.6	130.0	117.0	288.2	272.2	245.0	576.5	544.4	490.0
6	1	64-QAM	3/4	77.4	73.1	65.8	154.9	146.3	131.6	324.3	306.3	275.6	648.5	612.5	551.3
7	1	64-QAM	5/6	86.0	81.3	73.1	172.1	162.5	146.3	360.3	340.3	306.3	720.6	680.6	612.5
8	1	256-QAM	3/4	103.2	97.5	87.8	206.5	195.0	175.5	432.4	408.3	367.5	864.7	816.7	735.0
9	1	256-QAM	5/6	114.7	108.3	97.5	229.4	216.7	195.0	480.4	453.7	408.3	960.8	907.4	816.7
10	1	1024-QAM	3/4	129.0	121.9	109.7	258.1	243.8	219.4	540.4	510.4	459.4	1080.9	1020.8	918.8
11	1	1024-QAM	5/6	143.4	135.4	121.9	286.8	270.8	243.8	600.4	567.1	510.4	1201.0	1134.3	1020.8
0	2	BPSK	1/2	17.2	16.3	14.6	34.4	32.5	29.3	72.1	68.1	61.3	144.1	136.1	122.5
1	2	QPSK	1/2	34.4	32.5	29.3	68.8	65.0	58.5	144.1	136.1	122.5	288.2	272.2	245.0
2	2	QPSK	3/4	51.6	48.8	43.9	103.2	97.5	87.8	216.2	204.2	183.8	432.4	408.3	367.5
3	2	16-QAM	1/2	68.8	65.0	58.5	137.6	130.0	117.0	288.2	272.2	245.0	576.5	544.4	490.0
4	2	16-QAM	3/4	103.2	97.5	87.8	206.5	195.0	175.5	432.4	408.3	367.5	864.7	816.7	735.0
5	2	64-QAM	2/3	137.6	130.0	117.0	275.3	260.0	234.0	576.5	544.4	490.0	1152.9	1088.9	980.0
6	2	64-QAM	3/4	154.9	146.3	131.6	309.7	292.5	263.3	648.5	612.5	551.3	1297.1	1225.0	1102.5
7	2	64-QAM	5/6	172.1	162.5	146.3	344.1	325.0	292.5	720.6	680.6	612.5	1441.2	1361.1	1225.0
8	2	256-QAM	3/4	206.5	195.0	175.5	412.9	390.0	351.0	864.7	816.7	735.0	1729.4	1633.3	1470.0
9	2	256-QAM	5/6	229.4	216.7	195.0	458.8	433.3	390.0	960.8	907.4	816.7	1921.6	1814.8	1633.3
10	2	1024-QAM	3/4	258.1	243.8	219.4	516.2	487.5	438.8	1080.9	1020.8	918.8	2161.8	2041.7	1837.5
11	2	1024-QAM	5/6	286.8	270.8	243.8	573.5	541.7	487.5	1201.0	1134.3	1020.8	2402.0	2268.5	2041.7
0	3	BPSK	1/2	25.8	24.4	21.9	51.6	48.8	43.9	108.1	102.1	91.9	216.2	204.2	183.8
1	3	QPSK	1/2	51.6	48.8	43.9	103.2	97.5	87.8	216.2	204.2	183.8	432.4	408.3	367.5
2	3	QPSK	3/4	77.4	73.1	65.8	154.9	146.3	131.6	324.3	306.3	275.6	648.5	612.5	551.3
3	3	16-QAM	1/2	103.2	97.5	87.8	206.5	195.0	175.5	432.4	408.3	367.5	864.7	816.7	735.0
4	3	16-QAM	3/4	154.9	146.3	131.6	309.7	292.5	263.3	648.5	612.5	551.3	1297.1	1225.0	1102.5
5	3	64-QAM	2/3	206.5	195.0	175.5	412.9	390.0	351.0	864.7	816.7	735.0	1729.4	1633.3	1470.0
6	3	64-QAM	3/4	232.3	219.4	197.4	464.6	438.8	394.9	972.8	918.8	826.9	1945.6	1837.5	1653.8
7	3	64-QAM	5/6	258.1	243.8	219.4	516.2	487.5	438.8	1080.9	1020.8	918.8	2161.8	2041.7	1837.5
8	3	256-QAM	3/4	309.7	292.5	263.3	619.4	585.0	526.5	1297.1	1225.0	1102.5	2594.1	2450.0	2205.0
9	3	256-QAM	5/6	344.1	325.0	292.5	688.2	650.0	585.0	1441.2	1361.1	1225.0	2882.4	2722.2	2450.0
10	3	1024-QAM	3/4	387.1	365.6	329.1	774.3	731.3	658.1	1621.3	1531.3	1378.1	3242.6	3062.5	2756.3
11	3	1024-QAM	5/6	430.1	406.3	365.6	860.3	812.5	731.3	1801.5	1701.4	1531.3	3602.9	3402.8	3062.5

Figure 1: MCS Index table [3]

Acronym caps

Qam (Quadrature amplitude modulation) is a further step from qpsk to allow amplitude modulation at its phases this scheme is used from 16 to 4096 the larger the constellation the more data points can be demonstrated. 16 qam produces 16 points of 4 binary bits the scheme for how these bits are matched to points is dependent on the governing body. A common version of this is the image below provided by huawei for their explanation of qam

26

Acronym caps

Acronym caps

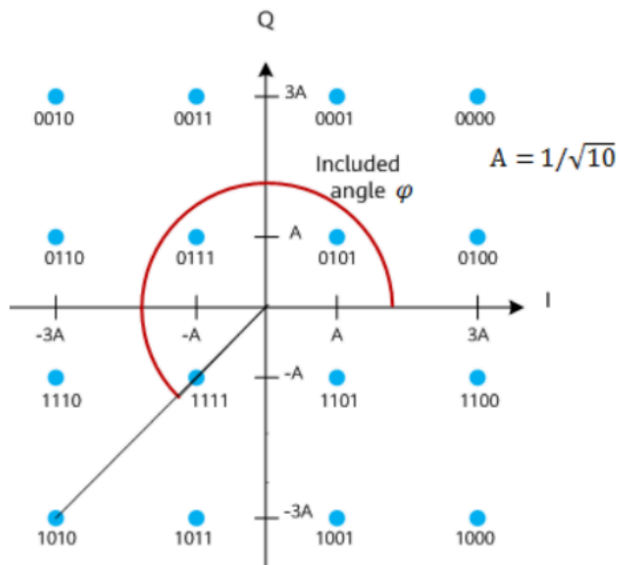


Figure 2: QAM constellation diagram from Huawei [1]

This is used by wifi alliance and many other wireless standard agencies to produce high data rate wireless communications. Wi-Fi 6 or 802.11ax is one of many of the Wi-Fi alliance standards and it uses a 1024 QAM so 1024-point QAM model [3]. This allows them to match low-grade cable speeds with a over the air link.

Use of 1st Person Voice Acronym caps

Throughout my test I use SNR. This is signal to noise and is a ratio of how much signal there is to noise. The higher the number the more signal the lower the number the more noise.

This report will look at the modulation techniques and prove if the technique has the same or similar error rate with a margin of error for pseudo-randomised data and white Gaussian noise. From their tests will be plotted on an error bar graph to show how the error rate corresponds to noise and how well the demodulator can reject data errors. This will demonstrate the differences in the techniques, the capabilities of each, and I will indicate the different use cases of each modulator.

Use of 1st Person Voice

Simulation models

Use of 1st Person Voice

Use of 1st Person Voice

Use of 1st Person Voice

passing the same filter through all the models to allow me to compare the techniques rather than the filter performance as such below is the filter I used its of order 47 keep it low enough to minimise delay but high enough to work as a filter.

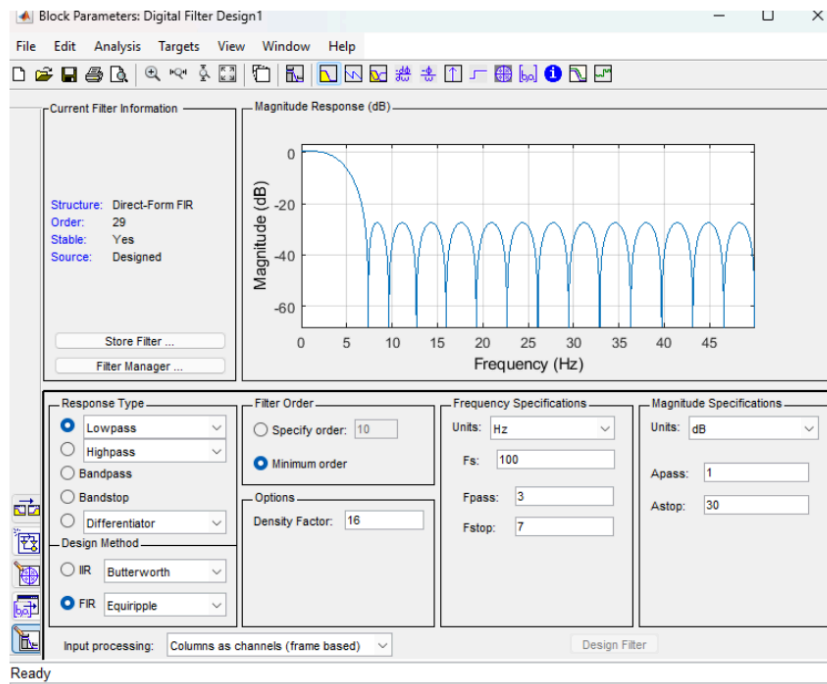


Figure 3: filter design

Acronym caps

Ask

amplitude shift keying it increases the amplitude in relation to the signal. This is performed in this model by multiplying the sine wave with the random data Bernoulli generator. This creates a signal that is higher in amplitude when the data is 1 and lower in amplitude when the data is 0.

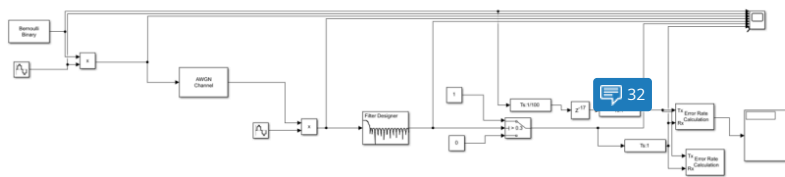


Figure 4: ASK System Block diagram

Acronym caps

Phase shift keying is a method of changing the phase of a signal to indicate a change in the data normally produced by delaying the signal by 90 degrees and flipping the switch between either in or out of phase in relation to the signal.

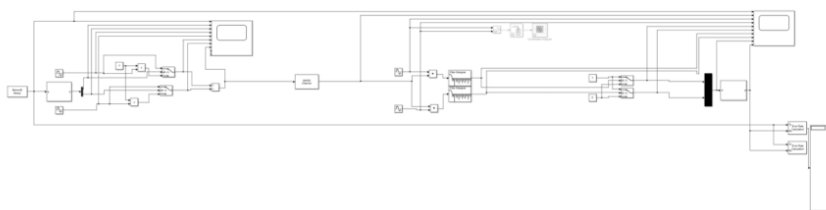


Figure 5: PSK system Block Diagram

Acronym caps

Quadrature phase shift keying is similar to psk but it shifts it in 4 phases it does this in practice by using two signals that then the data is off sets the data to move the phase of the signal into 4 phases.

The data is normally at 0,90,180,270 degrees in phase; this gives 4 easily distinguishable signals to map.

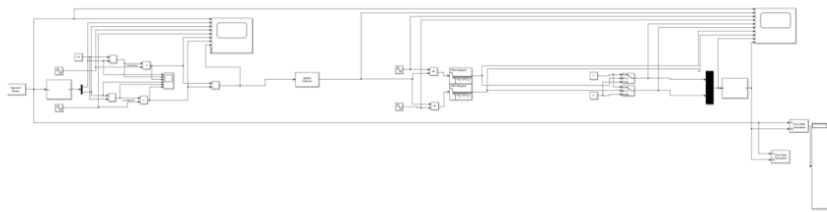


Figure 6: QPSK system block Diagram

Acronym caps

QAM

Acronym caps

The picture below is the qam block diagram from modulator to de modulator

36

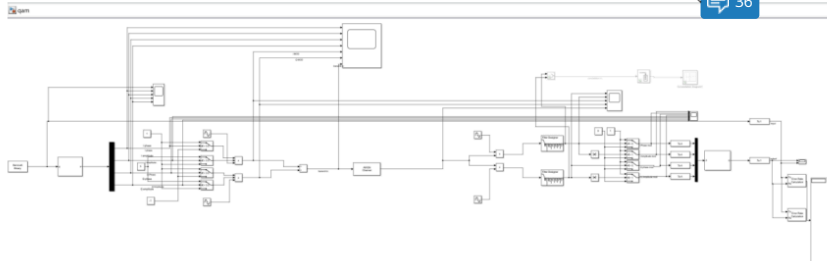


Figure 7: QAM System block Diagram

Modulation Their There They're data into 4 bits in you use that data as 4 holds for your switches from their the switches perform the phase amplitude phase and amplitude this is done by taking 3 different constants in to get 4 distinct signals but the signals are then combined in products with their carrier frequency the phase of the frequency depending on if its i or q part and is again finally combined into a single signal that could be put through an antenna.

Demodulation works much the same in reverse it takes the same sine wave and multiplies the transmission signal by it and then directs it into the filter which gets rid of any unwanted noise. the best of its ability it then enters the switches and is converted to a binary data stream again where it is combined in a mux and then serialised before being put into the bit error rate calculator.

This data is delayed at the start by 4 as it splits the data and then its held again for 4 seconds as it serialises the data in the modulator requiring a signal spec of 4 seconds before the mux and 1 second before the bit error rate calculator to bring them back into line.

Results

Use of 1st Person Voice

I will be declaring the signal failed with the bit error rate above 0.5 because this is the equivalent of guessing but it should be noted that most standards fail the signal at 0.4 or 0.3 as this is much better than guessing. I simply want to compare and contrast as such 0.5 fits my needs

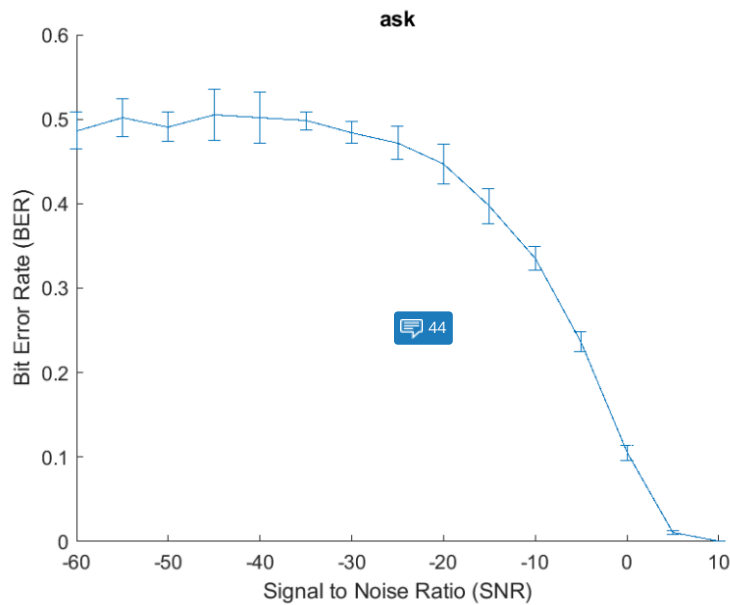


Figure 8: ASK Bit Error Rate graph

analogue shift keying fails completely at -40 but can error at -30 as shown by the error bars this as this is part of the error bars i will noted it buy it indicates that the signal could still get below 0.5 ber regularly.

Acronym caps

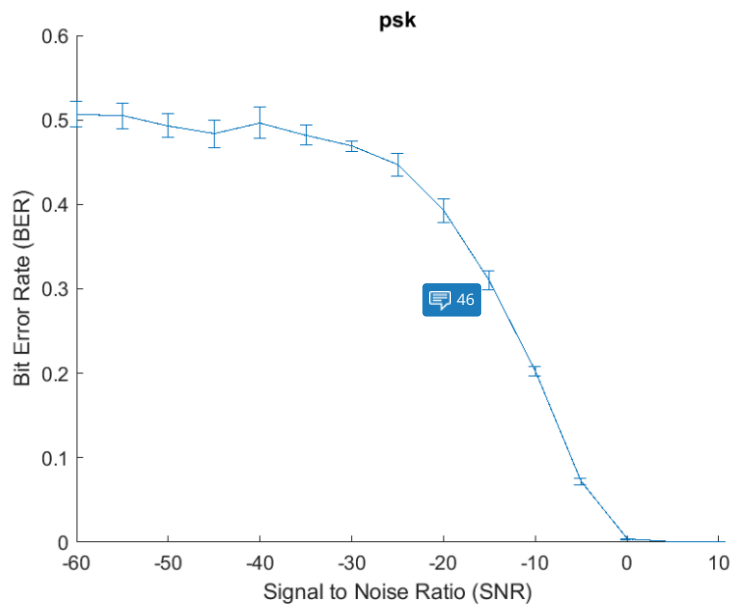


Figure 9: PSK bit error rate graph

Acronym caps

Missing Units

Missing Units

PSK climbs from -5 SNR steadily until it reaches -30 when it starts to level out at 0.45 or so it first fails at -40 then it returns below at -45 returning to a fail at -50.

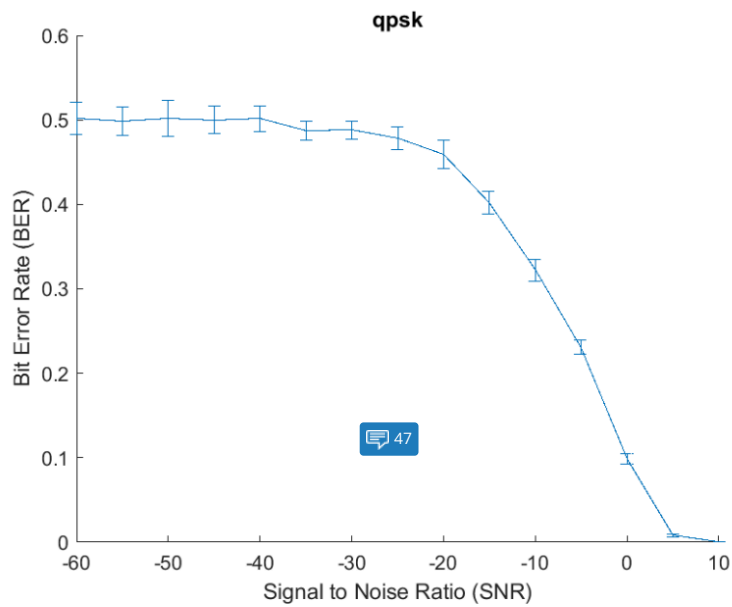


Figure 10: QPSK bit error rate graph

Acronym caps

Missing Units

qpsk take a single climb from -60 to -20 snr then it slowly increases until it fails at -40 and stays static at that point.

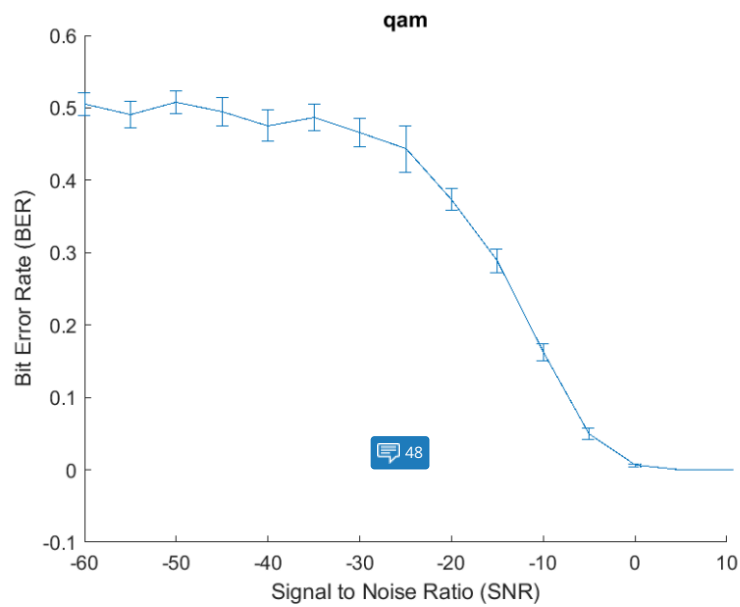


Figure 11: QAM bit error rate graph

Acronym caps The BER starts at 0.5 for SNR = -60 dB and then it bounces between fail and barely pass until it reaches -40 where it fails completely Missing Units

Acronym caps This combined data shows that they all roughly stay close to each other. It also shows that the BER for all is similar with models such as QAM having similar variances in BER the higher the SNR

Acronym caps WC Acronym caps

noise value becomes.

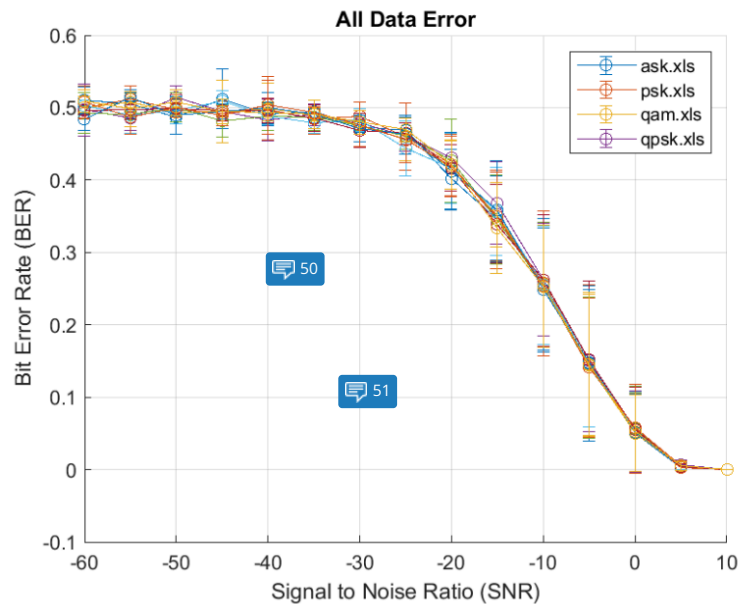


Figure 12: all data bit error rate graph

Discussion

These test results were produced using the average of 10 simulations at each snr value, this is a limited number of samples as such if I were to produce this data another time I would look to increase the number of runs as currently there are indications that some data is far away from the average.

These tests use the digital filter design block from simulink which while being nearly the same as a filter it implemented the same as such for future models it would be advisable to use a filter realised from this block to keep the filter response to what the demodulator would likely see. On the other side they were all using this filter as such it wont have provide more benefits to one than the other.

I demonstrated these models with low frequency sine waves in practice these sine wave would have been much higher frequency but again they all used the same sine wave so this wouldn't

skew results it just makes the results less representative of what could be performed in the real world as most systems are not running at 62.8318531 Hz frequency.

As much as this was a test of the modulation schemes not changing the filters and initial sine waves does actually make these test less respective of their real world uses as ASK QAM QPSK and PSK do not all run at the same rate or through identical filters the filters and carrier waves are designed for each modulation technique to better provide an actual output.

54

Conclusion

These tests indicate that the models perform similarly in terms of response with but the Contraction tell the whole truth as models such as qam and qpsk can transmit much more data than ask in a single symbol as such with all staying in close proximity to each other.

Cap. Error

55

In conclusion QAM is best for data transmission a similar response to all the other models but has a higher data throughput with qpsk following the second highest data throughput. This matches the real world situation where Qam is used for the high data rate communication and QPSK is used for the more contested areas where QAM symbols may be harder to map against symbols.

For simple systems such as point to point radios, ASK will outperform both due to its simple implementation and similar error rate. But the limitation on data rate from symbols used makes it less capable when compared to QPSK or Qam.

Acronym caps

PSK in its base form provides limited advantages over the other signals this matches the real world case where most PSK systems are actually using MSK or GMSK an alteration to improve PSK's response.

56

Finally if I was to perform these tests again I would alterations to the sine waves and filters to better match a real world used filter and sine wave used. This would make them more representative but make the test more problematic to perform producing a much larger data set than would be ideal as such these tests would take substantially longer.

57

58

References

[1]

Z. Xia, "What Is QAM? How Does QAM Work? - Huawei," *info.support.huawei.com*, Jul. 01, 2021. <https://info.support.huawei.com/info-finder/encyclopedia/en/QAM.html>

[2]

"What is GMSK Modulation: Gaussian Minimum Shift Keying» Electronics Notes," *www.electronics-notes.com*. <https://www.electronics-notes.com/articles/radio/modulation/what-is-gmsk-gaussian-minimum-shift-keying.php> (accessed Nov. 22, 2024). [Ref Qual](#)

[3]

F. Verges, "MCS Table (Updated with 802.11ax Data Rates) – SemFio Networks," *semfionetworks.com*, Apr. 11AD. <https://semfionetworks.com/blog/mcs-table-updated-with-80211ax-data-rates/> (accessed Nov. 22, 2024).

[4]

Biology For Life, "Interpreting Error Bars," *Biology For Life*. <https://www.biologyforlife.com/interpreting-error-bars.html> (accessed Nov. 22, 2024).

[5]

ever, "Phase Shift Keying: Is it ever actually used?," *Electrical Engineering Stack Exchange*, Aug. 07, 2018. <https://electronics.stackexchange.com/questions/389756/phase-shift-keying-is-it-ever-actually-used> (accessed Nov. 22, 2024). [Ref Qual](#)

41

/100

PAGE 1

PAGE 2

PAGE 3

QM

Use of 1st Person Voice

When writing technical reports, do not use first person voice. Instead, use the third person passive voice.

You should not use words like "I", "you", "we" etc..



Comment 1

You should never start a sentence with "And", it should only be used to join two parts of a sentence together.



Comment 2

Your abstract is lacking a lot of detail. You should include what you did, how you did it, and what you found.

QM

Use of 1st Person Voice

When writing technical reports, do not use first person voice. Instead, use the third person passive voice.

You should not use words like "I", "you", "we" etc..



Comment 3

The script would have made an appropriate appendix to this report.

QM

Missing Units

What units is this in?

You should always include the units for all quantities you describe in your text. Some quantities have more than one unit. Frequency, for example, can be measured in Hertz (Hz) or radians per sec (rad/s).

Make it clear for your reader and remove any ambiguity.

QM

Use of 1st Person Voice

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You should not use words like "I", "you", "we" etc..



Comment 4

Do you mean a line graph with error bars?



Missing Units

What units is this in?

You should always include the units for all quantities you describe in your text. Some quantities have more than one unit. Frequency, for example, can be measured in Hertz (Hz) or radians per sec (rad/s).

Make it clear for your reader and remove any ambiguity.



Comment 5

Is this a heading?



Comment 6

You should be using correct terms. Amplitude, Phase or Frequency, not size.



Comment 7

Should be all caps for acronyms.

ASK not Ask



Comment 8

"there" not "their"

there - not here

their - belonging to them

they're - they are

PAGE 4



Comment 9

180 degrees



Comment 10

You should avoid using pronouns like "I" "you" "we" etc.

To perform this, a sine wave is delayed by 180 degrees....



Comment 11

I assume you are describing BPSK here. BPSK doesn't use I and Q channels, it only transmits 0 degrees phase or 180 degrees phase signals for binary 0 and 1 respectively. I think you may be getting confused with QPSK and QAM, these both have I and Q channels.



Comment 12

adds



Comment 13

phases



Comment 14

All caps for acronyms



Comment 15

All caps for acronyms



Comment 16

Why?

You should state that the separation between points is the same between BPSK and QPSK but QPSK has more points.



Comment 17

All caps for acronyms



Comment 18

all caps for acronyms



Comment 19

incomplete sentence



Comment 20

your first reference should always be [1]



Comment 21

What does GMSK stand for?

Introduce the acronym when you use it first.



QM

Acronym caps

Acronyms should be written using all capital letters.



Comment 22

This does not make sense. You should proofread your work before submission.



QM

Acronym caps

Acronyms should be written using all capital letters.



Comment 23

Why? what are the benefits?



QM

Acronym caps

Acronyms should be written using all capital letters.



Comment 24

reduce the number of symbols used?

QM

First use

You should introduce acronyms and symbols the first time you use them so the reader understands what you are talking about.

PAGE 5



Comment 25

Why is this relevant to this report? What does it show?

QM

Acronym caps

Acronyms should be written using all capital letters.

QM

Acronym caps

Acronyms should be written using all capital letters.

QM

Acronym caps

Acronyms should be written using all capital letters.



Comment 26

Huawei is a name, therefore it should start with a capital letter.

PAGE 6

QM

Use of 1st Person Voice

When writing technical reports, do not use first person voice. Instead, use the third person passive voice.

You should not use words like "I", "you", "we" etc..

QM

Acronym caps

Acronyms should be written using all capital letters.



Comment 27

within

QM

Use of 1st Person Voice

When writing technical reports, do not use first person voice. Instead, use the third person passive voice.

You should not use words like "I", "you", "we" etc..

PAGE 7

QM

Use of 1st Person Voice

When writing technical reports, do not use first person voice. Instead, use the third person passive voice.

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QM

Use of 1st Person Voice

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QM

Use of 1st Person Voice

When writing technical reports, do not use first person voice. Instead, use the third person passive voice.

You should not use words like "I", "you", "we" etc..



Comment 28

The filter shown below has an order of 29, not 47.



Comment 29

Filter

QM

Acronym caps

Acronyms should be written using all capital letters.



Comment 30

Should this be "In"?



Comment 31

from, not in

PAGE 8



Comment 32

Why are you delaying by 17 samples when your filter length is 47?

Surely you should be delaying by 24 samples (half the filter length)?

QM

Acronym caps

Acronyms should be written using all capital letters.



Comment 33

BPSK uses 180 degrees phase shifts, not 90 degrees.

QM

Acronym caps

Acronyms should be written using all capital letters.



Comment 34

four not 4

QM

Acronym caps

Acronyms should be written using all capital letters.



Comment 35

This should be 45, 135, 225, 315 degrees

QM

Acronym caps

Acronyms should be written using all capital letters.

QM

Acronym caps

Acronyms should be written using all capital letters.

**Comment 36**

demodulator is one word

QM

Pronouns

Do not use pronouns like "you" "we" "they" "I" etc.

**Comment 37**

"deserialise" is the British spelling, "deserialize" is the American spelling.

QM

Pronouns

Do not use pronouns like "you" "we" "they" "I" etc.

QM

Their There They're

There - opposite of here

Their - belonging to them

They're - They are

QM

Cap. Error

Capitalization

QM

Pronouns

Do not use pronouns like "you" "we" "they" "I" etc.

QM

Cap. Error

Capitalization

**Comment 38**

Careful to use the right tense.

This should be "created" not "create"

QM

Cap. Error

Capitalization

**Comment 39**

Both the I and Q components are always present in the modulated output signal.

**Comment 40**

Do you mean:

...I or Q phase of the carrier, depending...

QM

Cap. Error

Capitalization



Comment 41

This should be the "received signal" as you are now talking about the demodulator.



Comment 42

The filter is there to remove the carrier wave and leave the data, not to remove noise.



Comment 43

"...as it splits.." what are you referring to as "it"?

You need to be clearer in your descriptions.

PAGE 10

QM

Use of 1st Person Voice

When writing technical reports, do not use first person voice. Instead, use the third person passive voice.

You should not use words like "I", "you", "we" etc..



Comment 44

You should include units to your graphs.

Although BER has no units, there are several that could be used for SNR.



Comment 45

grammatical issue.

"..but could fail.."

QM

Missing Units

What units is this in?

You should always include the units for all quantities you describe in your text. Some quantities have more than one unit. Frequency, for example, can be measured in Hertz (Hz) or radians per sec (rad/s).

Make it clear for your reader and remove any ambiguity.

QM

Missing Units

What units is this in?

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Make it clear for your reader and remove any ambiguity.

QM

Acronym caps

Acronyms should be written using all capital letters.

PAGE 11



Comment 46

See fig 8 comment

QM

Missing Units

What units is this in?

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QM

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QM

Acronym caps

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PAGE 12



Comment 47

See fig 8 comment

QM

Acronym caps

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QM

Missing Units

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Make it clear for your reader and remove any ambiguity.

PAGE 13



Comment 48

See fig 8 comment

QM

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QM

Missing Units

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Make it clear for your reader and remove any ambiguity.

QM

Acronym caps

Acronyms should be written using all capital letters.

QM

WC

Word choice error:

Sometimes choosing the correct word to express exactly what you have to say is very difficult to do. Word choice errors can be the result of not paying attention to the word or trying too hard to come up with a fancier word when a simple one is appropriate. A thesaurus can be a handy tool when you're trying to find a word that's similar to, but more accurate than, the one you're looking up. However, it can often introduce more problems if you use a word thinking it has exactly the same meaning.



Comment 49

incomplete sentence.

QM

Acronym caps

Acronyms should be written using all capital letters.

QM

Acronym caps

Acronyms should be written using all capital letters.

PAGE 14



Comment 50

I am very surprised that they all came out so close. This makes me suspicious that there may have been a data handling error here and the same model was called from your script instead of the different modulation techniques.

Usually QAM is worst, then ASK, followed by QPSK and PSK which are about the same. This is due to the closeness of the points in the constellation diagrams for each modulation technique.



Comment 51

See fig 8 comment

QM

Use of 1st Person Voice

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You should not use words like "I", "you", "we" etc..

QM

Acronym caps

Acronyms should be written using all capital letters.

QM

Cap. Error

Capitalization



Comment 52

You should refer to the results by the figure number in each caption. Otherwise 1) how can you tell the reader what to look at, 2) what's the point of putting them in?



Comment 53

The digital filter design block in Simulink isn't "nearly the same as a filter", it *is* a filter, but it has a nice GUI to help you design it.



Sp.

Spelling error

PAGE 15



Comment 54

The filter is designed with knowledge of the data rate and carrier frequency, the modulation technique doesn't matter to the filter.



Cap. Error

Capitalization



Comment 55

Very good point.



Contraction

In formal academic writing, you should avoid using contractions like "aren't" "can't" "don't" etc. instead you should use the full form of the words. "Are not" "Can not", "Do not".



Acronym caps

Acronyms should be written using all capital letters.



Acronym caps

Acronyms should be written using all capital letters.



Acronym caps

Acronyms should be written using all capital letters.



Comment 56

Conclusions are ok, but only descriptive. You need to look deeper. You need to explain *why* the results are the way they are.

No mention of the relationship of the closeness of the points in the constellation diagram to the system's susceptibility to noise.



Comment 57

That would mean there were other differences between the experiments, rather than just modulation type. This would make comparison between them more difficult as you would not be able to determine if a characteristic is due to the modulation type or the difference in the filter or carriers chosen.



Comment 58

QM

Ref Qual

You should try to use more high quality reference sources, such as textbooks from reputable academic publishers and articles from peer reviewed journals.

QM

Ref Qual

You should try to use more high quality reference sources, such as textbooks from reputable academic publishers and articles from peer reviewed journals.

GRADING FORM: SMU GENERIC_SMOSEY

ALEXANDER GRAVATT

41

ENGAGEMENT WITH LITERATURE

including reading, referencing, academic conventions and academic honesty



References to a limited range of mostly relevant sources. Some omissions and minor errors. Referencing conventions evident though not always applied consistently.

4.5

KNOWLEDGE & UNDERSTANDING

Knowledge of the basic underlying concepts and principles of a subject.



There is evidence of basic knowledge, but your description of the concepts is weak and sometimes incorrect. Please see my comments on your text

9

COGNITIVE & INTELLECTUAL

Evaluate underlying concepts and principles of a subject and interpret qualitative and quantitative data in order to develop lines of argument and make sound judgements.



Some evidence of analytical intellectual skills, but for the most part descriptive. Generalised

statements made with scant evidence.

10.5

PRACTICAL APPLICATION SKILLS

Different approaches to solving problems in particular contexts.



Model descriptions were lacking details.
You mention a script you wrote to automate the testing, but have not included it - this would have been a useful addition to the work.

14

TRANSFERABLE SKILLS

Communicate the results of their study/work accurately and reliably, and with structured and coherent arguments; the qualities needed for employment requiring the exercise of some personal responsibility within a structured and managed environment.



Please read the comments throughout your report. Most of these relate to transferrable skills.
You MUST write in the third person.

3