NETW310 Wired, Optical and Wired Communication with Lab

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Introduction

This project introduces you to modulation mechanisms, encoding schemes, characteristics of wireline and wireless transmission media that make digital transmission possible. The implementation and analysis of simulations involve baseband signals, AM/FM signals, Pulse Code Modulation (PCM), line codes, antenna gain, free space path loss, and fading channels.

The presentation concludes with Challenges, Career Skills obtained, a Conclusion, and References.

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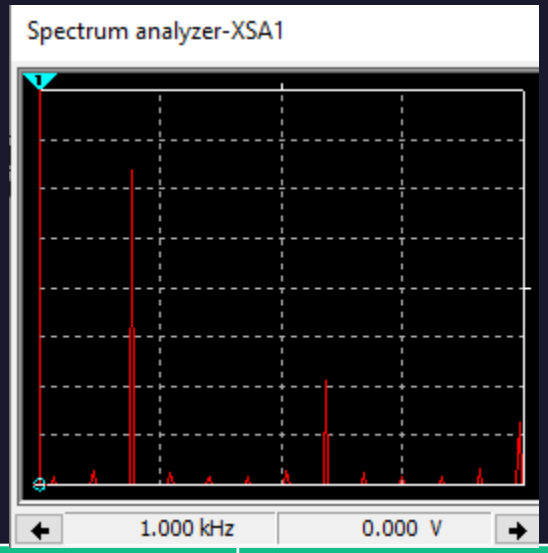
Module's 1 & 2

Baseband Signals and AM/FM Signals Analysis

The next three slides show:
1) Baseband Signals,
2) AM Signals; and,
3) AM/FM Signals.

Baseband Signals

The screenshot shows the spectrum analyzer displaying the signal's harmonic spectrum and its panel settings. The signal voltage at each of the frequencies are recorded and shown in the table.

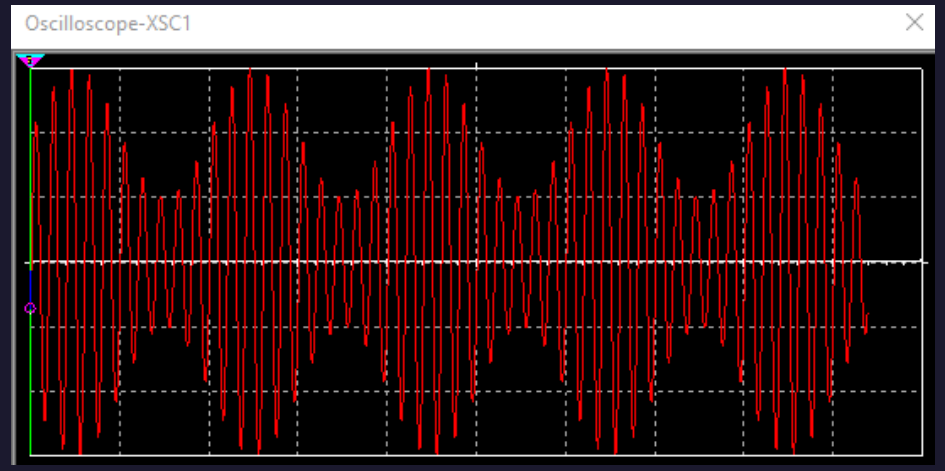


Harmonic Frequency	Signal (Volts)
20 kHz	3.13
40 kHz	0.0
60 kHz	377 mV
80 kHz	0.0
100 kHz	416 mV

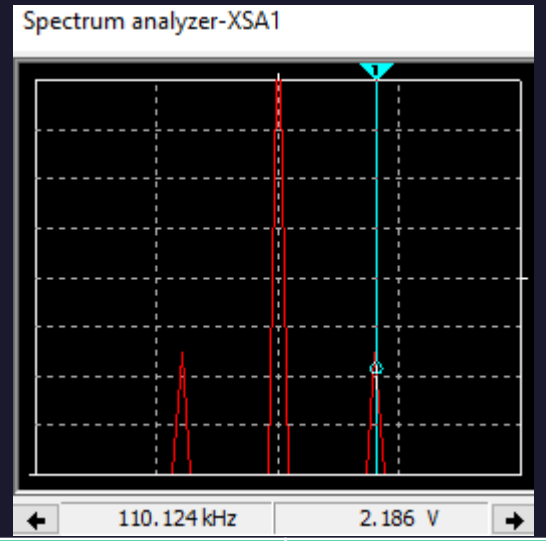
AM Signals

The screenshot of the Oscilloscope shows the signal and the panel settings of the oscilloscope. The screenshot of the Spectrum Analyzer shows the signal and the panel setting of the analyzer.

Oscilloscope



Spectrum Analyzer



The equation for the carrier signal is 10v = 100 KHz

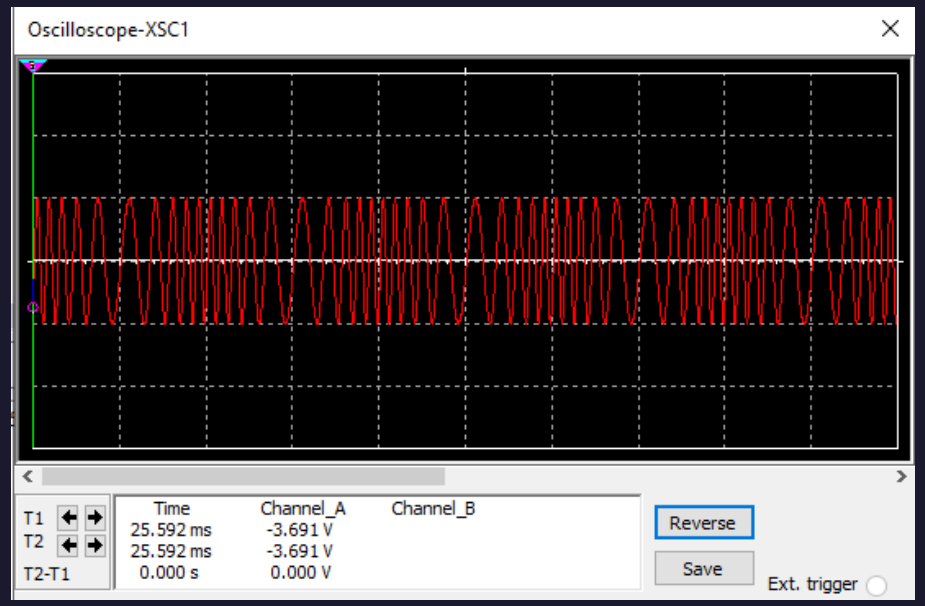
The Informational signal is 10 kHz with a peak value of 5v

AM Modulation	Frequency (kHz)
Lower side band	89.876
Carrier	100.207
Upper side band	80.124

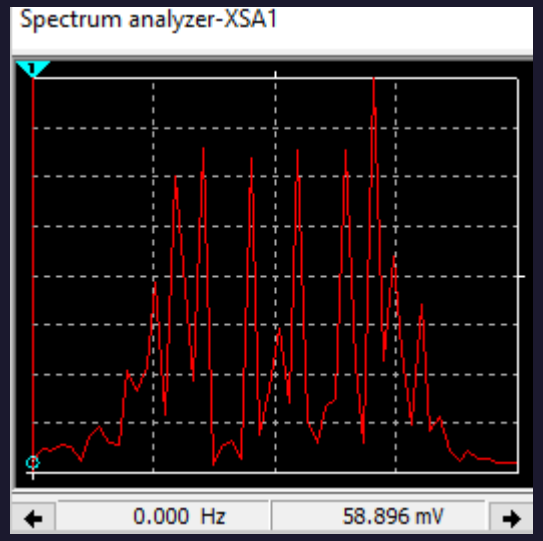
FM Signals

The screenshot of the Oscilloscope includes the signal and the panel settings of the oscilloscope. The screenshot of the Spectrum Analyzer includes the signal and the panel setting of the analyzer.

Oscilloscope



Spectrum Analyzer



The carrier frequency is 100 KHz

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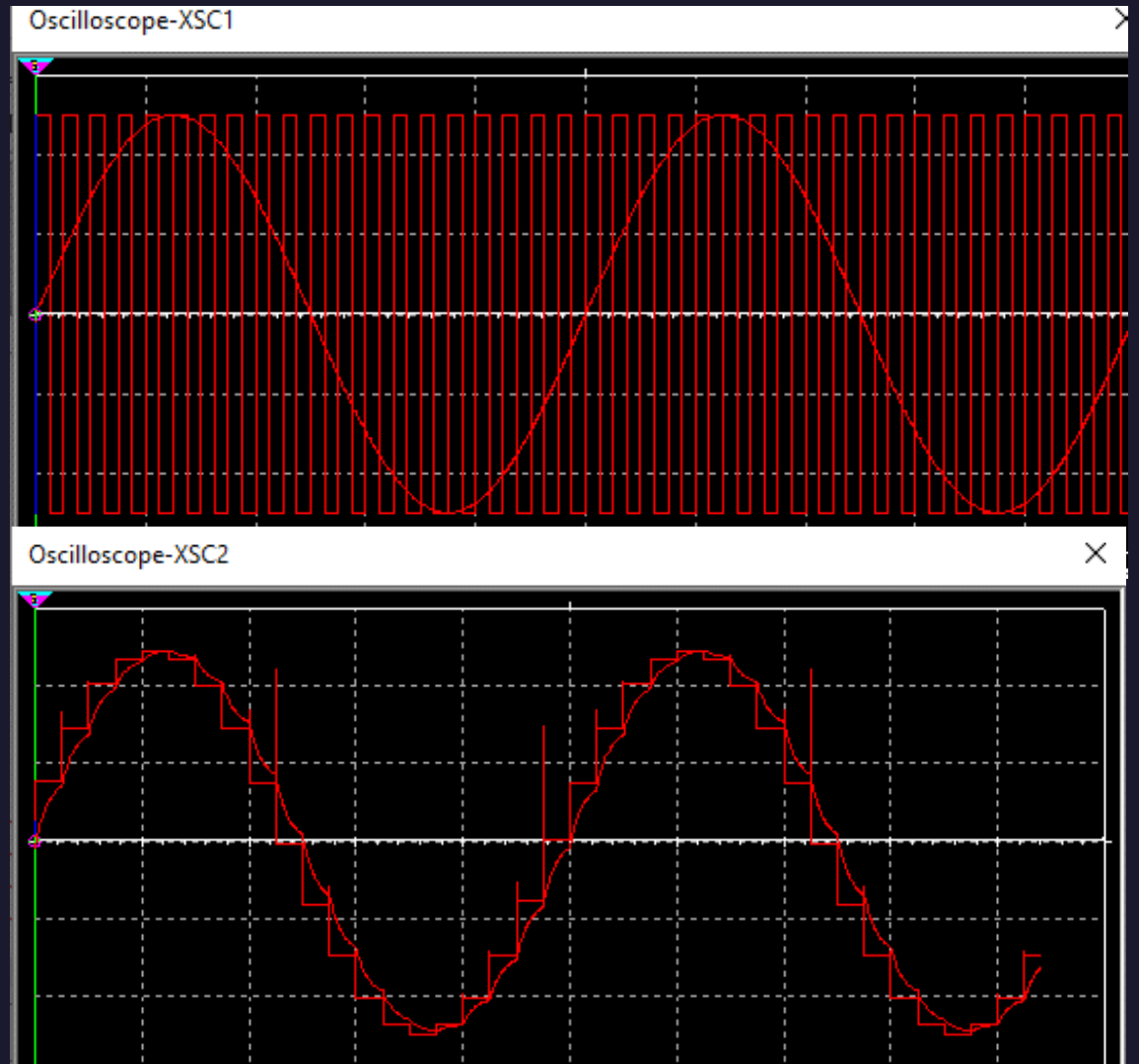
Module 3

Pulse Code Modulation (PCM) and Line Codes

The next three slides show: Oscilloscope-XSC1 display with the analog input signal and sampling clock at the input and output; and the Line Codes with a MATLAB diagram

Pulse Code Modulation (PCM)

The first screenshot shows the Oscilloscope-XSC1 display with the analog input signal and sampling clock at the input to the ADC. The second screenshot shows the Oscilloscope-XSC2 display with the output of the DAC.



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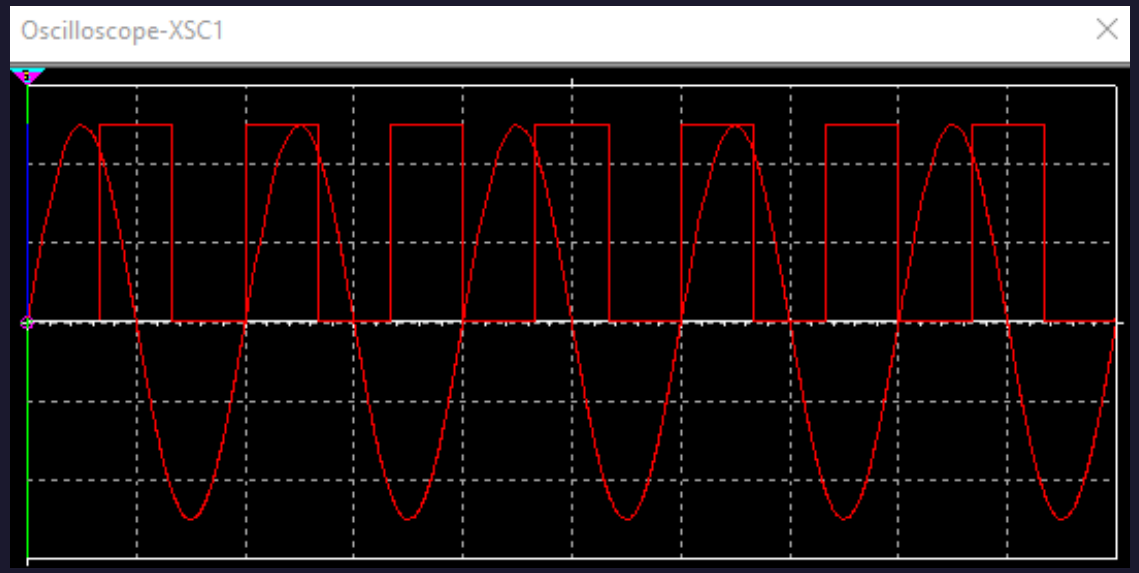
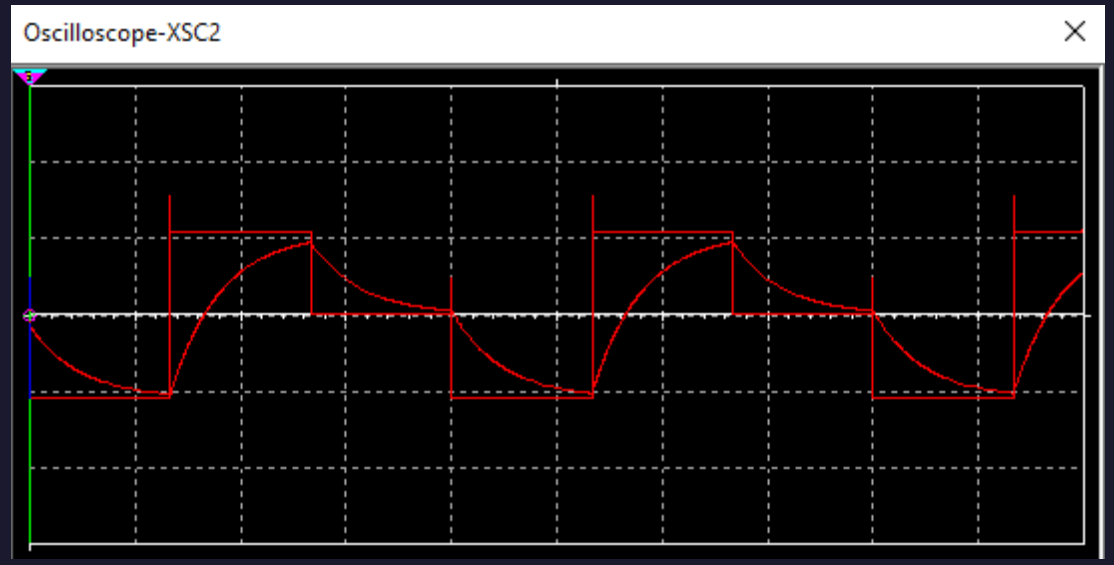




The effects of increasing or decreasing the sampling rate are:

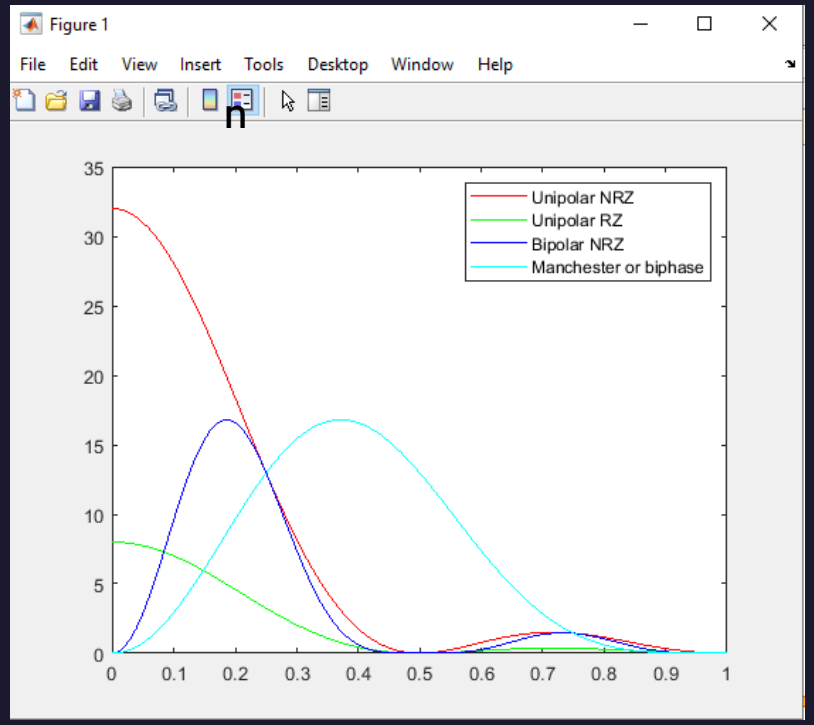
The first slide is better!

And the effects of increasing and decreasing the sampling rate causes spikes and eradication.

Line Codes

This screenshot shows the power spectral densities of four-line codes: NRZ-Polar, NRZ-Unipolar, NRZ-Bipolar, and Manchester-Polar.

MATLAB Diagram



When comparing the NRZ-Bipolar and Manchester polar codes in the diagram, you can see that the NRZ-Bipolar peaks sooner but overall, the Manchester polar requires more bandwidth.

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Module 4

Cables and Structured Cabling

The next two slides show informative questions and answers regarding Cables and Structured Cabling.

Questions and Answers

1. Why must the twisting in the individual wires be maintained in a UTP cable?

Answer: ***To protect the cable from EMI (Electro-magnetic Interference) as well as to prevent degrading the signal in the cable. Removing too much cover which leads to untwisting will result in crosstalk on the cable.***

2. How many inches should UTP cable be separated from 110 volts electrical cable?

Answer: ***Some recommend 6", but the NFPA recommends 2" or more.***

3. Horizontal cabling connects what areas to each other?

Answer: ***Horizontal cabling expands from a telecommunications room (TR) to the individual workstation outlets or a Work Area Outlet (WAO). It is typically installed in a star topology that connects each work area to the telecommunications room.***

Questions and Answers

4. What is a plenum rated cable?

Answer: ***A plenum cable can simply be referred to as an Ethernet networking electrical cable that is rated to be run in plenum spaces of buildings. A plenum space is the one between raised floors and dropped ceilings of a building.***

5. What is a riser tube used for?

Answer: ***This is used to open and close the riser. It provides a means of transfer of cables and wires between the pipeline and the platform.***

6. Is the grounding of equipment mostly a safety or a performance concern?

Answer: ***Safety-One of the most important reasons for grounding electrical currents is that it protects the equipment from ground faults, surges in the utility system, or nearby lightning strikes. These anomalies produce dangerously high voltages in the electrical system.***

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Module 5

Antenna Gain and Free Space Path Loss

The next three slides show informative questions and answers regarding Antenna Gain and Free Space Path Loss.

Antenna Gain

1. What is the maximum theoretical antenna gain of a common dish antenna at the 2.4 GHz band?

Answer: ***22.379***

2. What is the maximum theoretical antenna gain of a common dish antenna at the 5 GHz band?

Answer: ***29.079***

3. Given the same sized reflector, which signals, high-frequency, or low-frequency, can be more efficiently focused by a common dish antenna (i.e., result in a higher antenna gain)? **[5 points]**

Answer: ***5 GHz band and is more efficiently focused***

4. What is the maximum theoretical antenna gain of the dish antenna used in the VLA radio telescopes in New Mexico at the 5 GHz band?

Answer: ***63.059***

5. Given the same signal frequency, which dish antennas, large-sized or small-sized, are more efficient at focusing the signal (i.e., result in a higher antenna gain)?

Answer: ***5.15-5.85 GHz***

Free Space Path Loss

1. What is the free space path loss in dB at the 2.4 GHz band? [4 points] **Answer: *-80.4***

2. What is the free space path loss in dB at the 5 GHz band? [4 points] **Answer: *-87.2***

3. How does the free space path loss at a higher frequency (e.g., the 5 GHz band) compare with that at a lower frequency (e.g., the 2.4 GHz band)?
Answer: *the difference is 6.8 and/or the 5 GHz band decreases from -80.4 to -87.2*

4. What is the free space path loss in dB over 20 meters at the 2.4 GHz band?
Answer: *-66.421*

5. What is the free space path loss in dB over 40 meters at the 2.4 GHz band? [4 points]
Answer: *-72.441*

6. What is the free space path loss in dB over 80 meters at the 2.4 GHz band? [4 points]
Answer: *-78.462*

7. When the distance doubles, how does free space path loss in dB change approximately? [**5 points**]
Answer: *by 6 dB*

Free Space Path Loss (Continued)

8. Use a scientific calculator to calculate Delta L_{fS} for D1 = 20 meters and D2 = 40 meters.

Delta L_{fS} = -6.0205

9. Is your calculation approximately the same as the result from Part 1 Step 2?

Answer:

Yes, my calculation is approximately the same.

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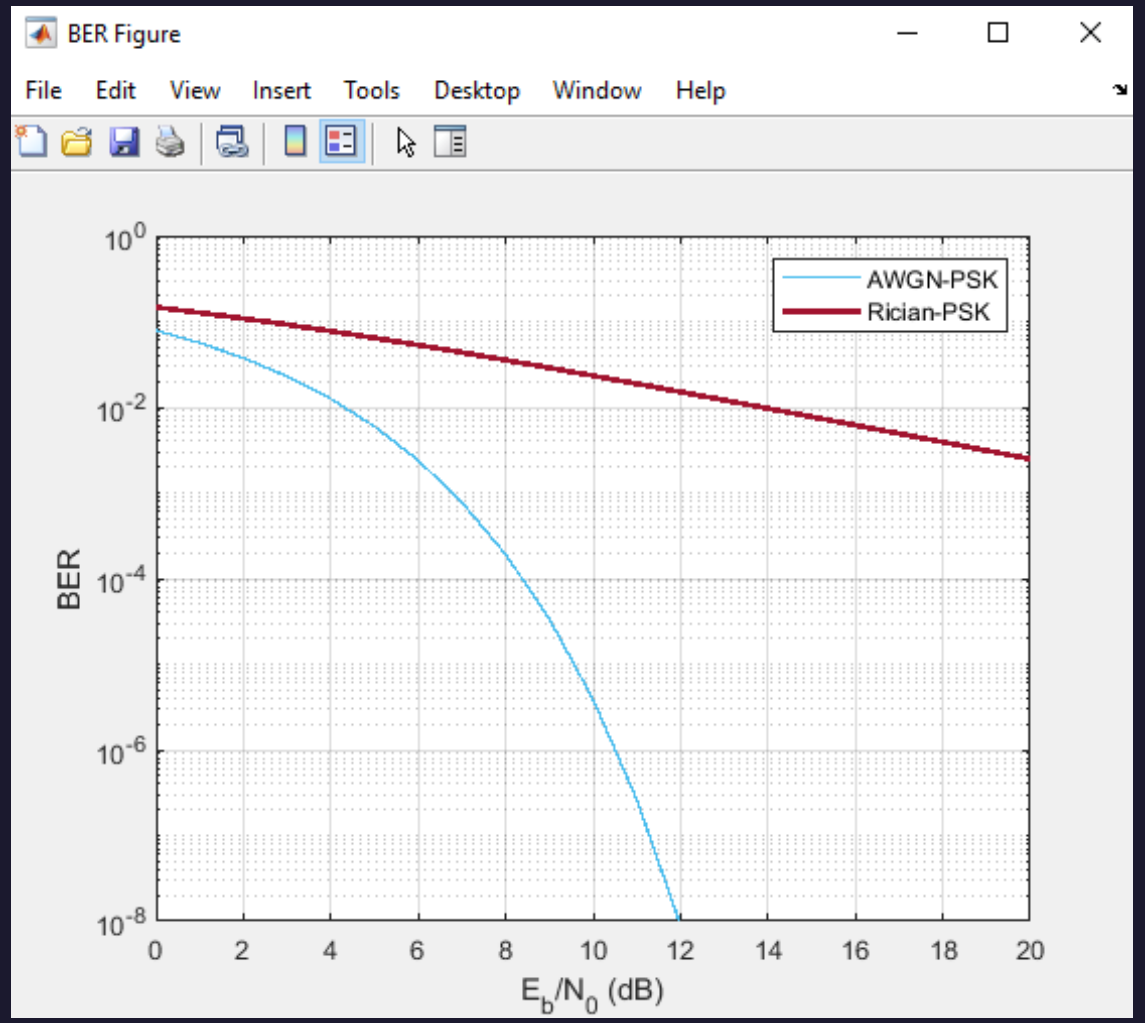
Module 6

Bit Error Rate of Fading Channels

The next slide shows the bit rate error performance of both AWGN and Rician fading channels.

AWGN Channel and Rician Channel

This screenshot shows the bit rate error performance of both AWGN and Rician fading channels. **You can see there is a significant difference and the AWGN-PSK is much better**



Challenges

- Identifying the proper login procedures.

Learning how to work with new programs and devices.

Testing the additions at each stage.

Learning how to discover and analyze new data.

Career Skills

Using, configuring, and reading an Oscilloscope.

Using, configuring, and reading a Spectrum Analyzer.

Understanding data and signals.

Further developed basic and advanced computer skills.

Conclusion

- Wired Optical, and Wired Communication is truly an exciting field.

I found learning about modulation mechanisms, encoding schemes, and characteristics of wireline and wireless transmission media - which makes digital transmission possible, to be very rewarding.

This project will be of tremendous benefit in the future.

References

Professor Messaoud Laddada at DeVry University

DeVry NETW 310 Course and Weekly WebEx Videos

Chapple, M., & Seidl, D. (2020). *CompTIA CySA+ study guide exam CS0-002* (2nd ed.). Wiley Sybex