EE3107
COMMUNICATION
SYSTEMS

भारतीय प्रौद्योगिकी संस्थान तिरुपति
TIRUPATI

LINE CODING TECHNIQUES

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LINE CODING Explained

Binary digits
010010110110

Baseband Digital Signal

Source
(Sends the digital data)

Modulator
(Converts data for Tx)

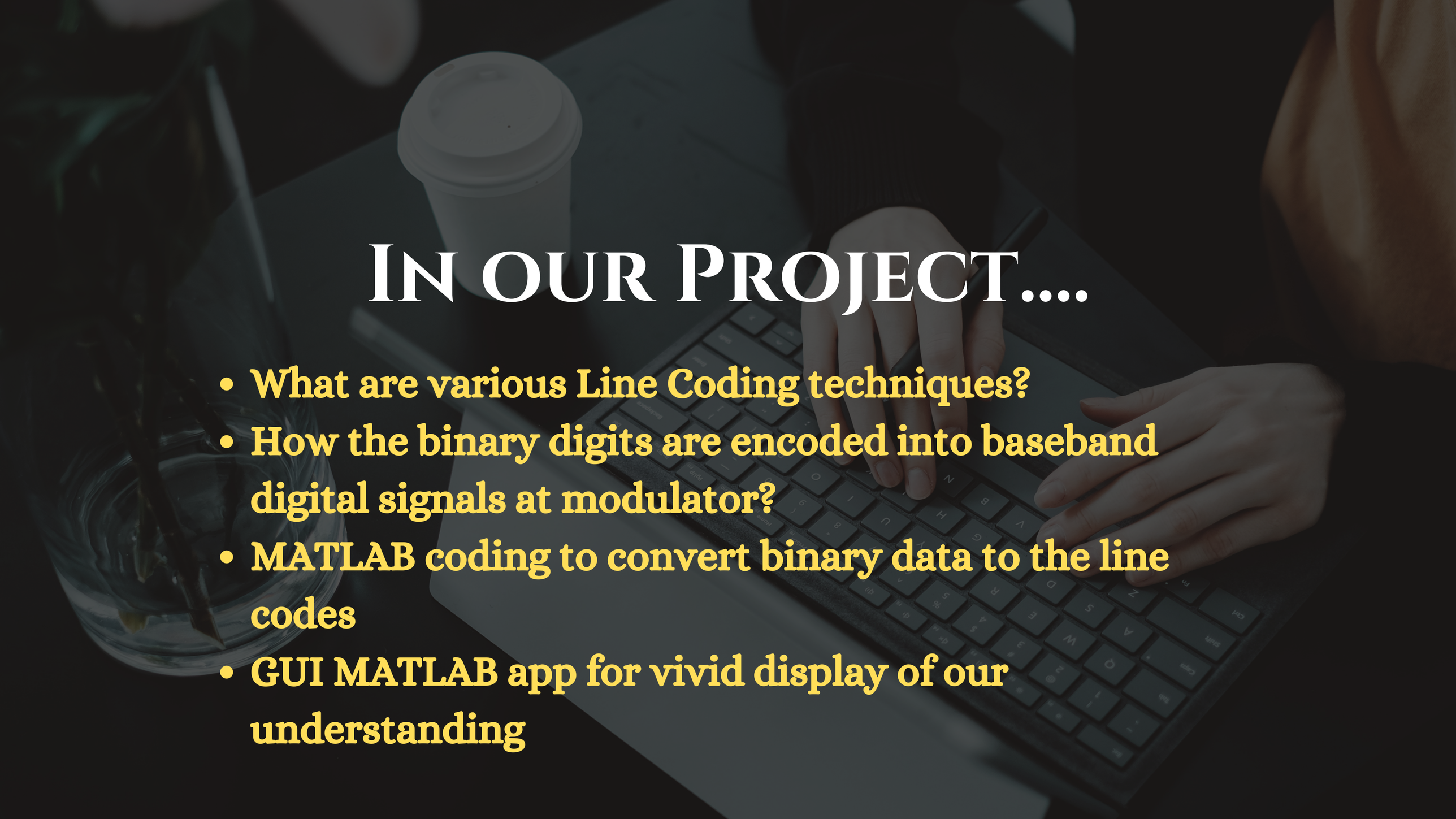
Channel
(Link b/w CN)

Digital Signal transmitted

DeModulator
(Decodes back the signal)

Binary digits
010010110110

Destination
(Recieves the message)



In our Project....

- What are various Line Coding techniques?
- How the binary digits are encoded into baseband digital signals at modulator?
- MATLAB coding to convert binary data to the line codes
- GUI MATLAB app for vivid display of our understanding

Types

We have explored the following line coding techniques in our project-

Unipolar

- **Unipolar NRZ**
- **Unipolar RZ**

Polar

- **Polar NRZ**
- **Polar RZ**

Bipolar

- **AMI**

Manchester

Unipolar Line coding

In a unipolar signaling scheme, all non-zero signalling elements have the same polarity - either they are all positive or they are all negative. It is analogous to a simple on-off keying scheme (OOK)

Unipolar NRZ

Unipolar RZ

Unipolar NRZ

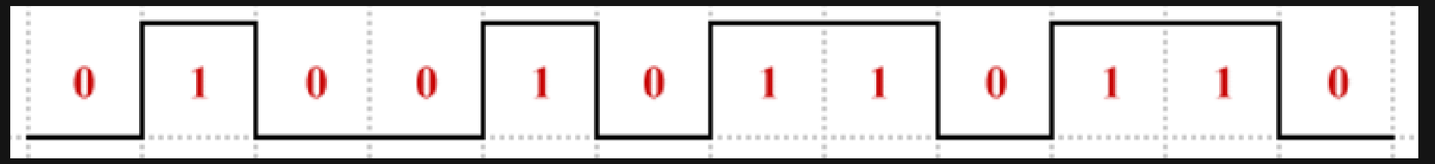
UNIPOLAR NON-RETURN-TO-ZERO

In this type of unipolar signaling, a High in data is represented by a positive pulse called as Mark, which has a duration To equal to the symbol bit duration. A Low in data input has no pulse.

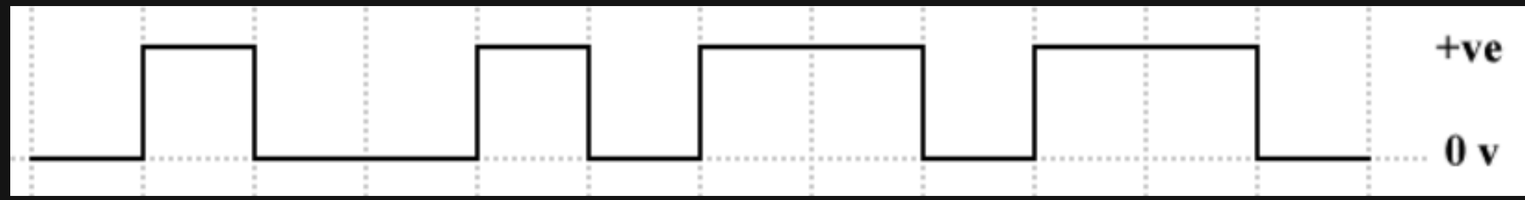
Simple and requires lesser bandwidth

BINARY MESSAGE: 010010110110

DATA



ENCODED MESSAGE



Unipolar RZ

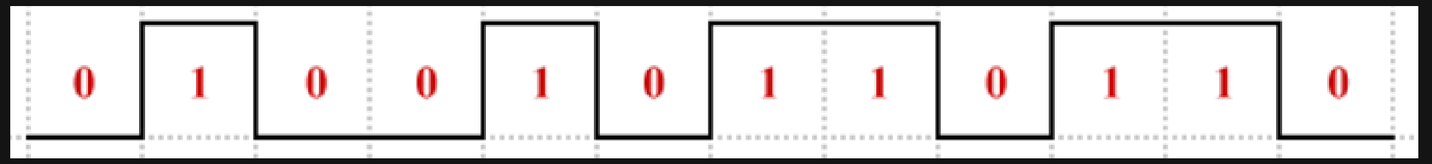
UNIPOLAR RETURN-TO-ZERO

In this type of unipolar signaling, a High in data, though represented by a Mark pulse. Half of the bit duration remains high but it immediately returns to zero and shows the absence of pulse during the remaining half of the bit duration.

Simple and requires lesser bandwidth

BINARY MESSAGE: 010010110110

DATA



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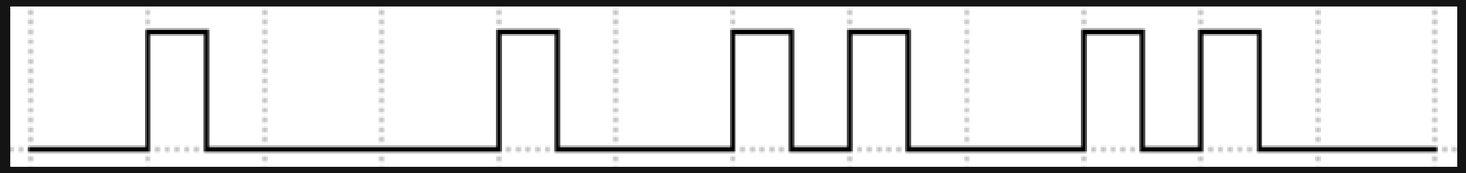


POLAR LINE CODING

Polar line coding schemes use both positive and negative voltage levels to represent binary values.

POLAR NRZ

POLAR RZ

Polar NRZ

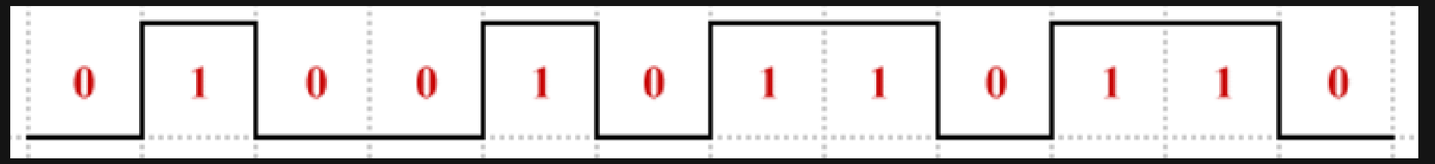
POLAR NON-RETURN-TO-ZERO

In this type of Polar signaling, Typically, logic low (binary zero) is represented by a positive voltage while logic high (binary one) is represented by a negative voltage.

Simple and no low frequency components are present.

BINARY MESSAGE: 010010110110

DATA



ENCODED MESSAGE

Polar RZ

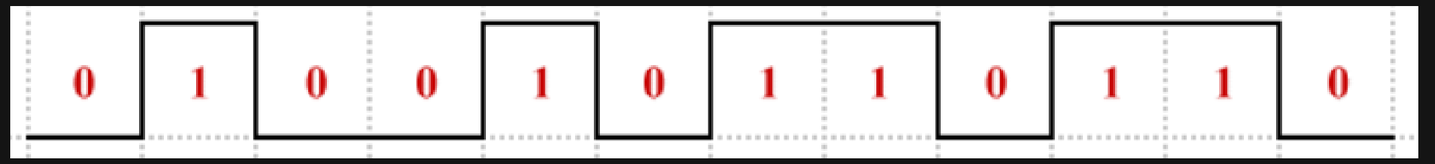
POLAR RETURN-TO-ZERO

In this type of polar signaling, logic low is represented by a positive voltage and logic high is represented by a positive voltage, but in both cases the signal level returns to zero half way through the bit time and stays there until the next bit is transmitted

Simple and no low frequency components are present.

BINARY MESSAGE: 010010110110

DATA



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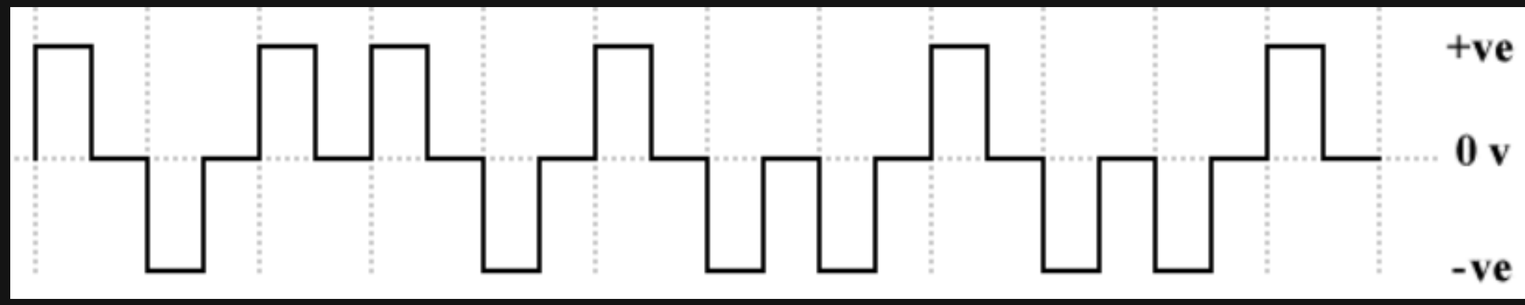


Bipolar Line coding

Like polar RZ, bipolar line coding schemes (sometimes called multi-level binary or duo-binary) use three voltage levels - positive, negative and zero.

Alternate Mark Inversion

AMI

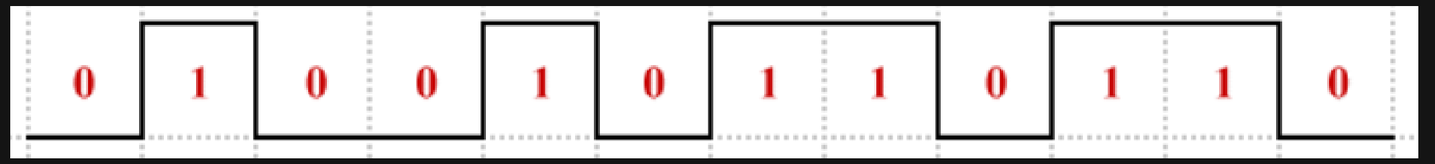
BIPOLAR ALTERNATE MARK INVERSION(AMI)

Bipolar alternate mark inversion (AMI) uses alternate positive and negative voltages to represent logic high (binary one), and a zero voltage to represent logic low (binary zero).

Simple and same signalling rate as other NRZ schemes. Uses less power than polar NRZ line coding schemes.

BINARY MESSAGE: 010010110110

DATA



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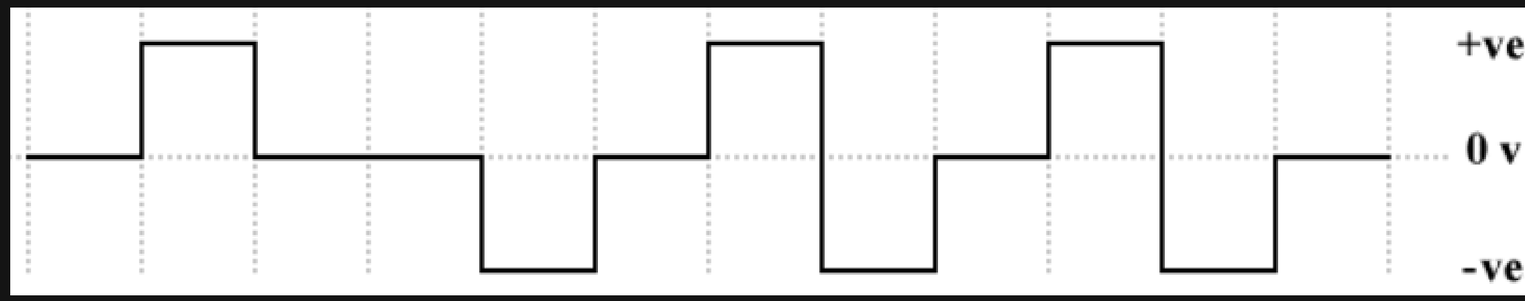


Manchester coding

Manchester encoding is a widely used line coding scheme that embeds timing information in the transmitted signal. It does this by ensuring that there is a transition (high-to-low or low-to-high) in the middle of every bit time, making it easy for the receiver to retrieve a clock signal from the incoming bit stream and maintain synchronisation with the transmitted signal.

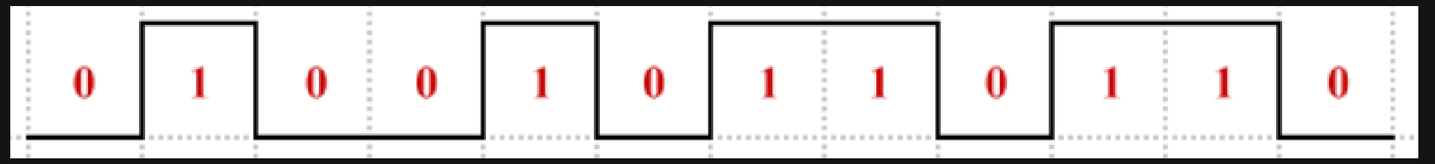
Manchester

A logic high (binary one) is represented by a positive pulse with a period of half a bit time followed by a negative pulse of the same duration. Similarly, A logic low (binary zero) consists of a negative pulse followed by a positive pulse, each with a period of half a bit time.

Ensure that there is sufficient embedded timing information in the transmitted signal. Eliminates the possibility of a DC component developing

BINARY MESSAGE: 010010110110

DATA



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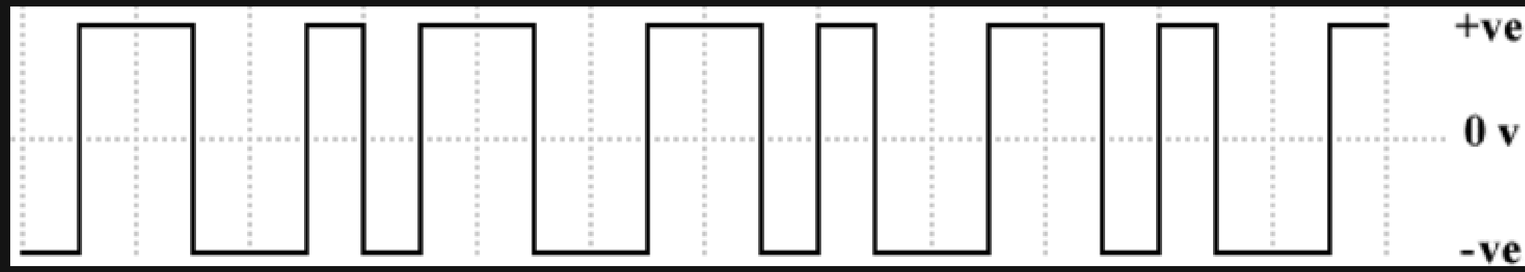
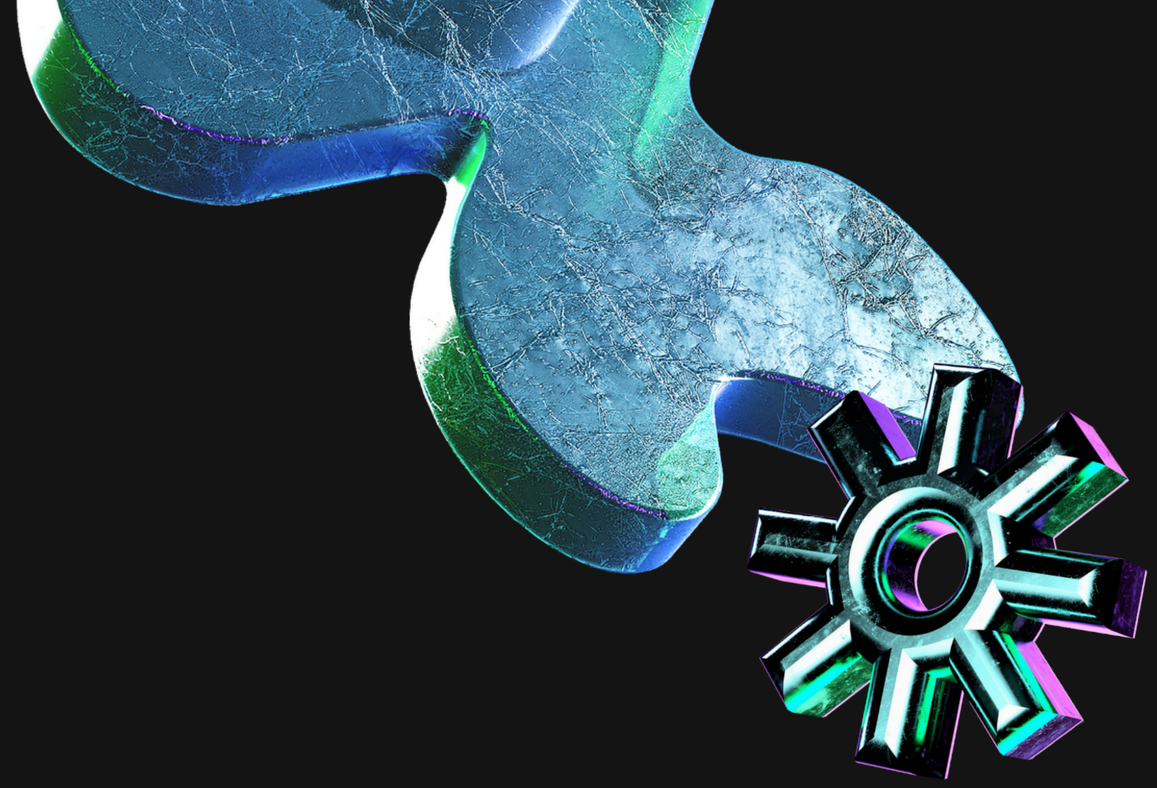


References

- https://www.technologyuk.net/telecommunications/telecom-principles/line-coding-techniques.shtml
- https://www.tutorialspoint.com/digital_communication/digital_communication_line_codes.htm

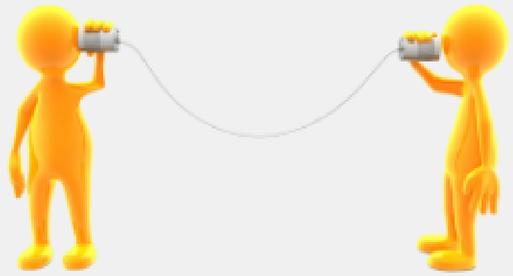


Codes and Simulations.....

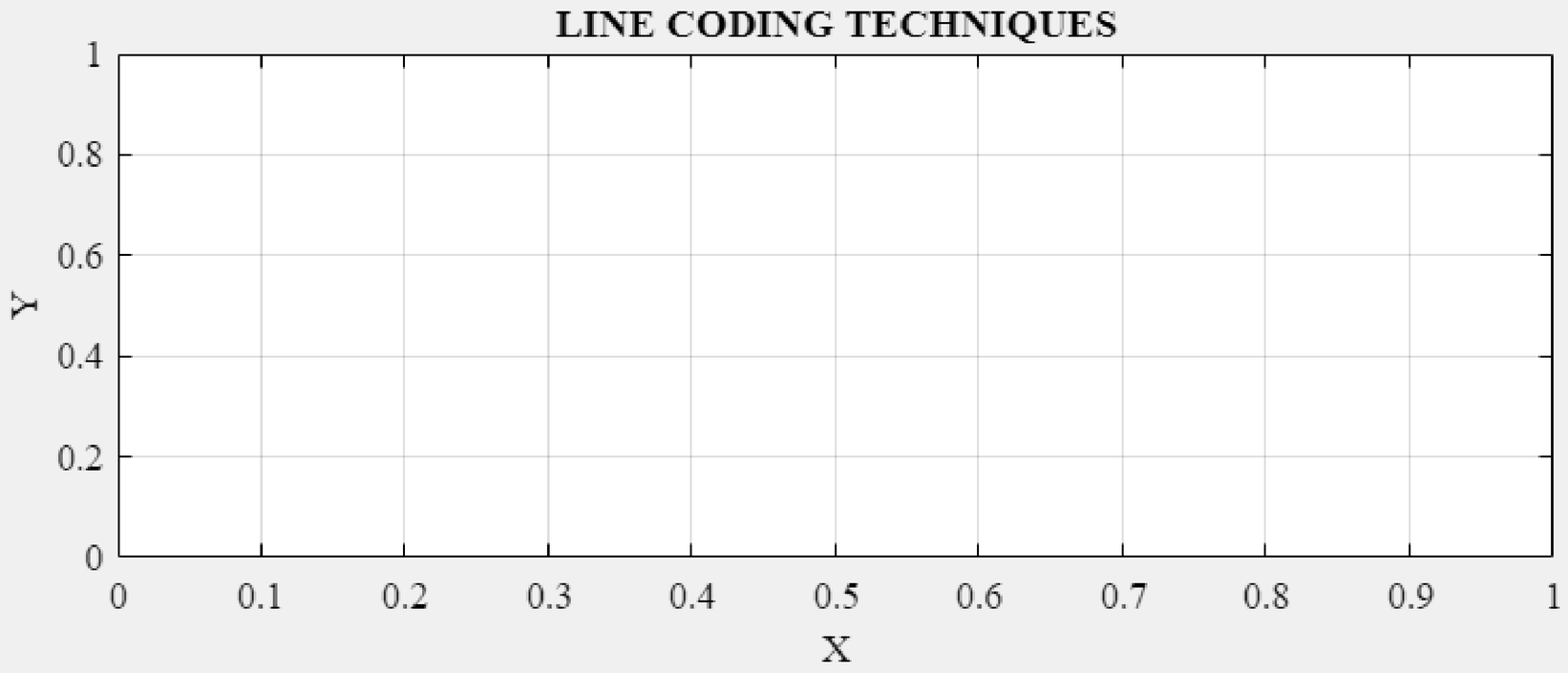
Our APP

EE3107-Communication System

(EE19B045 Abhimenyu, EE19B047 M. Suchitra)



INPUT



UniNRZ | PolarNRZ | AMI

UniRZ | PolarRZ | Manchester

Our APP

Unipolar NRZ

MATLAB App

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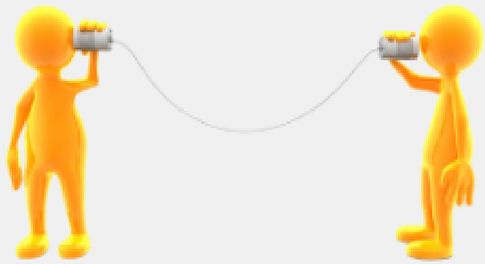
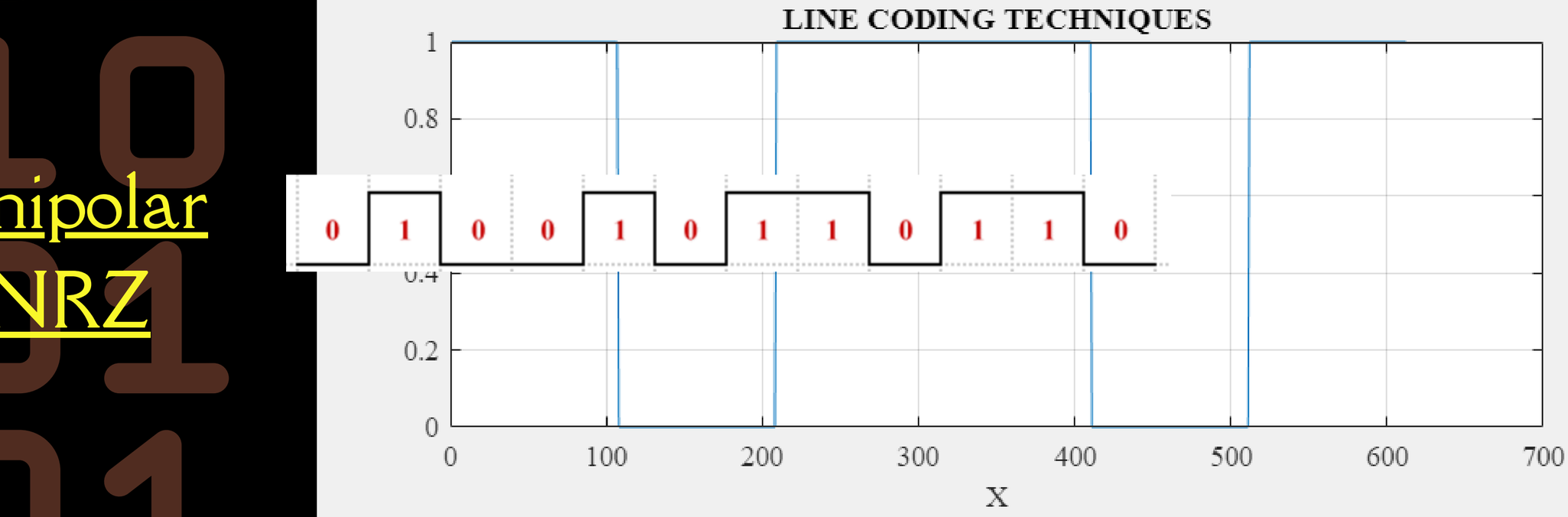


INPUT 1,0,1,1,0,1

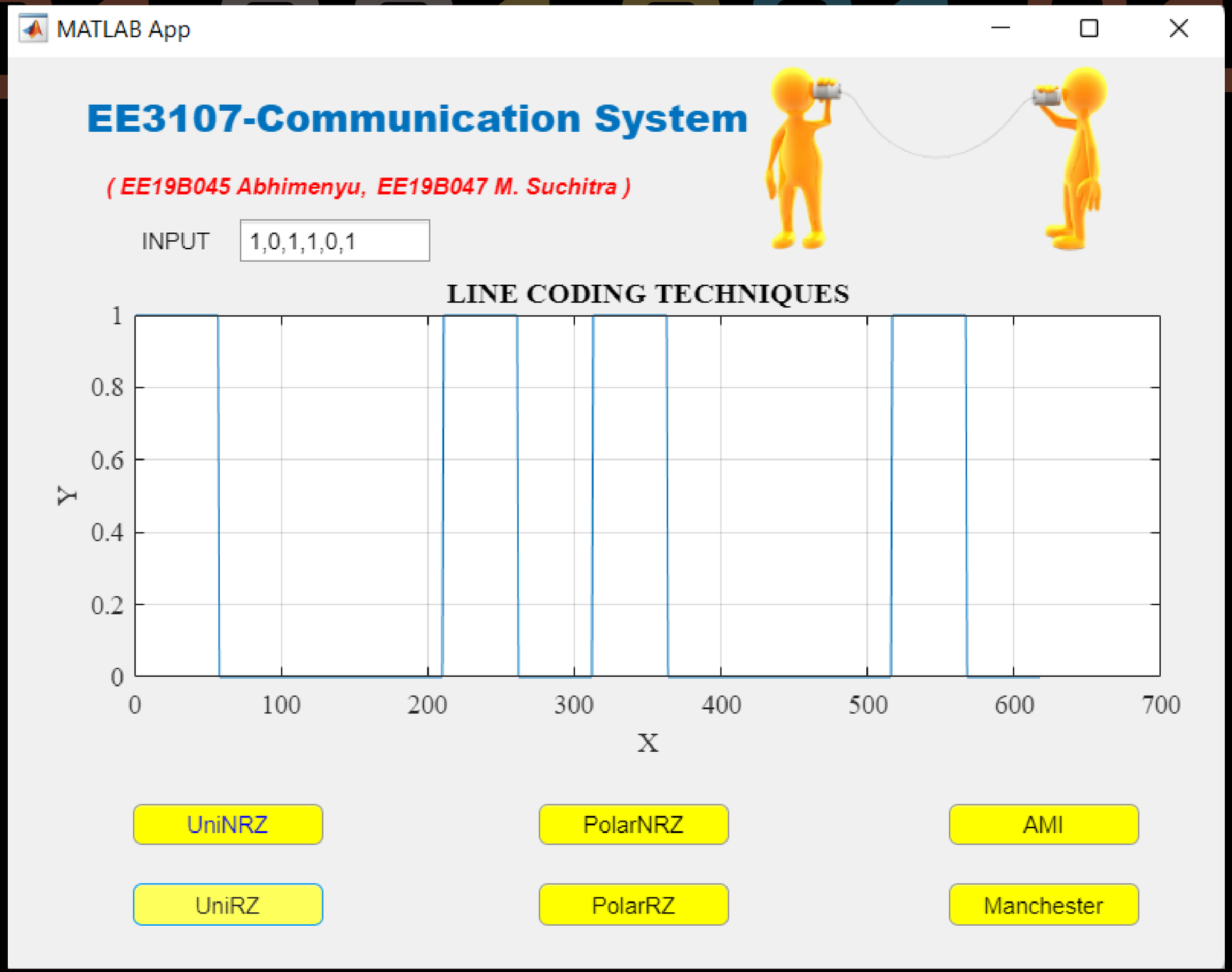


UniNRZ | PolarNRZ | AMI

UniRZ | PolarRZ | Manchester

Our APP

Unipolar RZ



Our APP

Polar NRZ

MATLAB App

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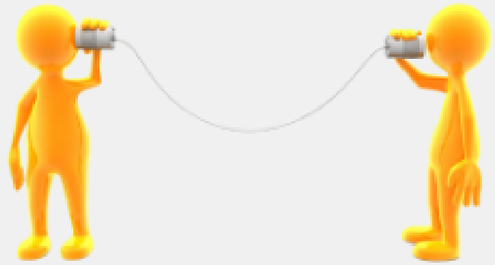
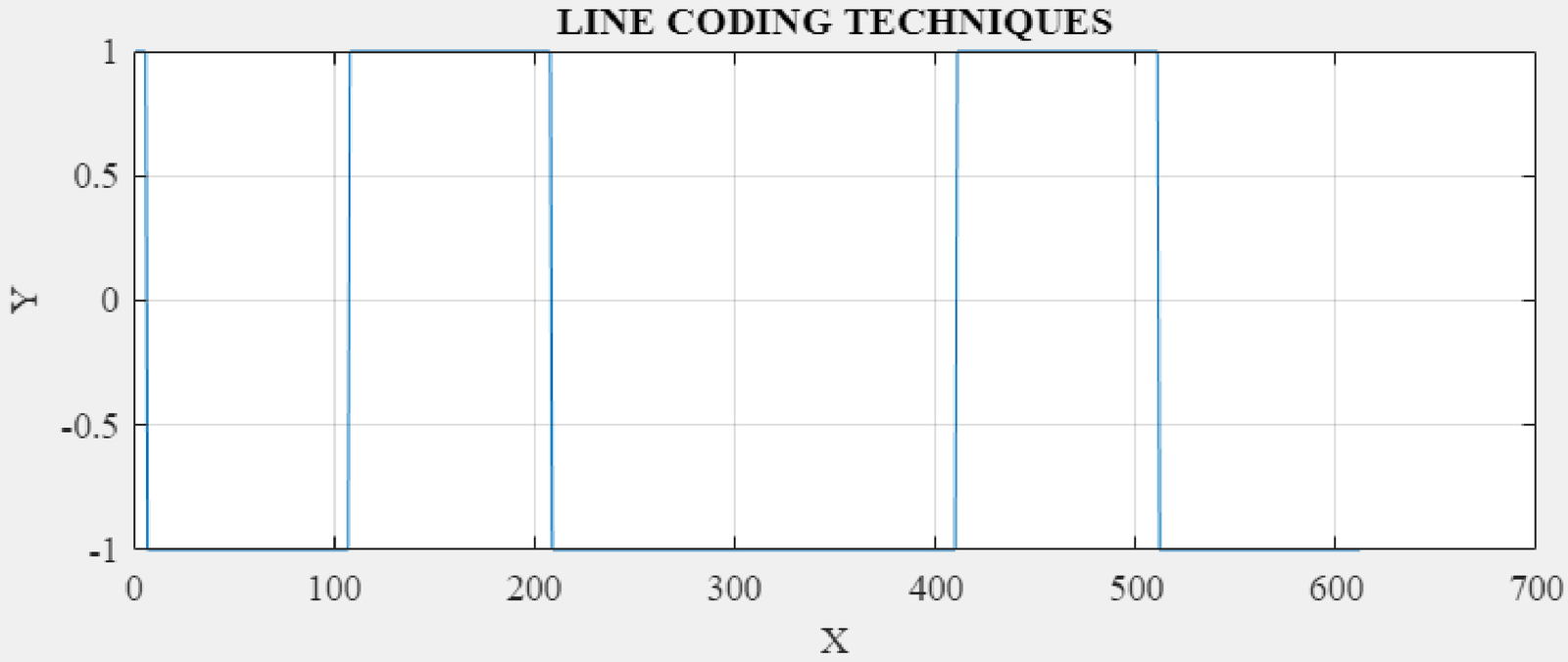


INPUT 1,0,1,1,0,1



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Polar RZ

MATLAB App

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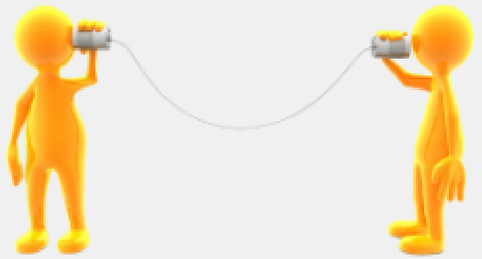

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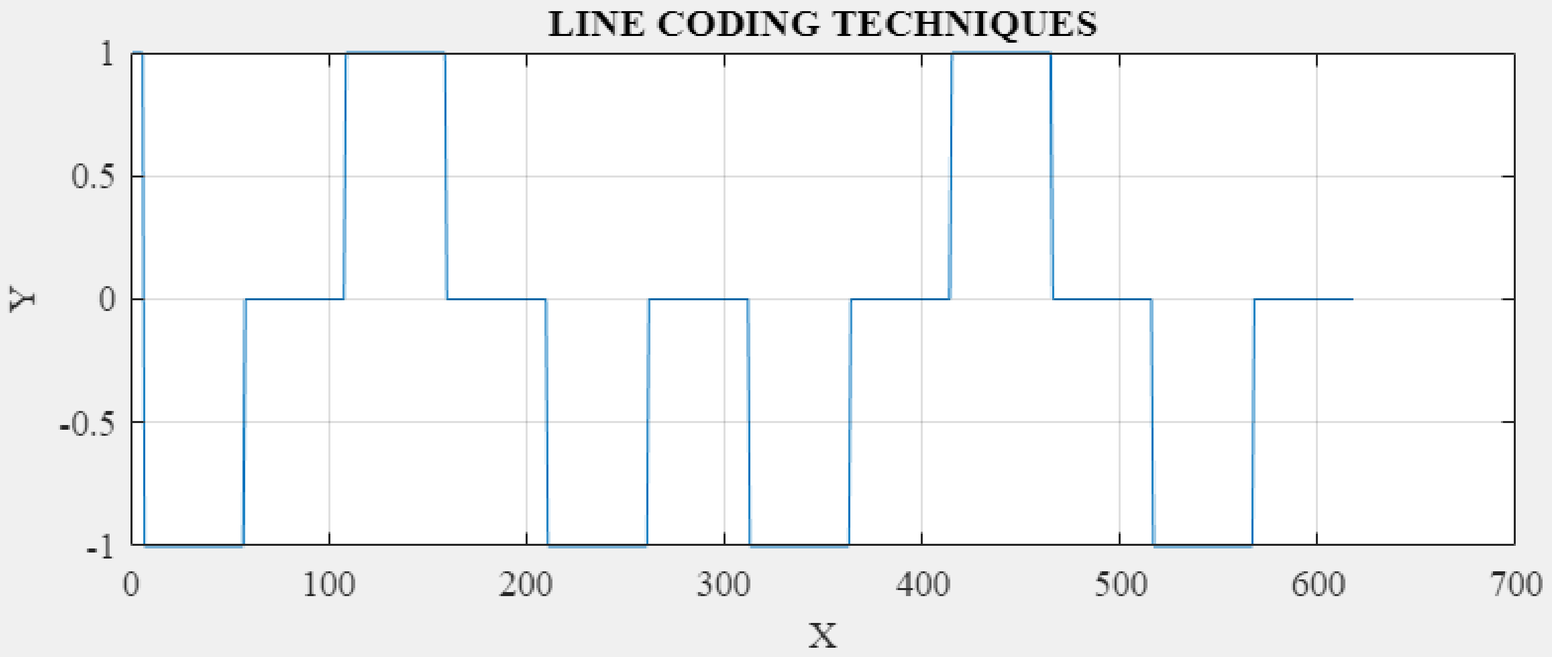

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Our APP

AMI

MATLAB App

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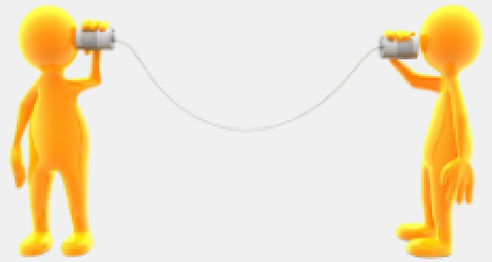

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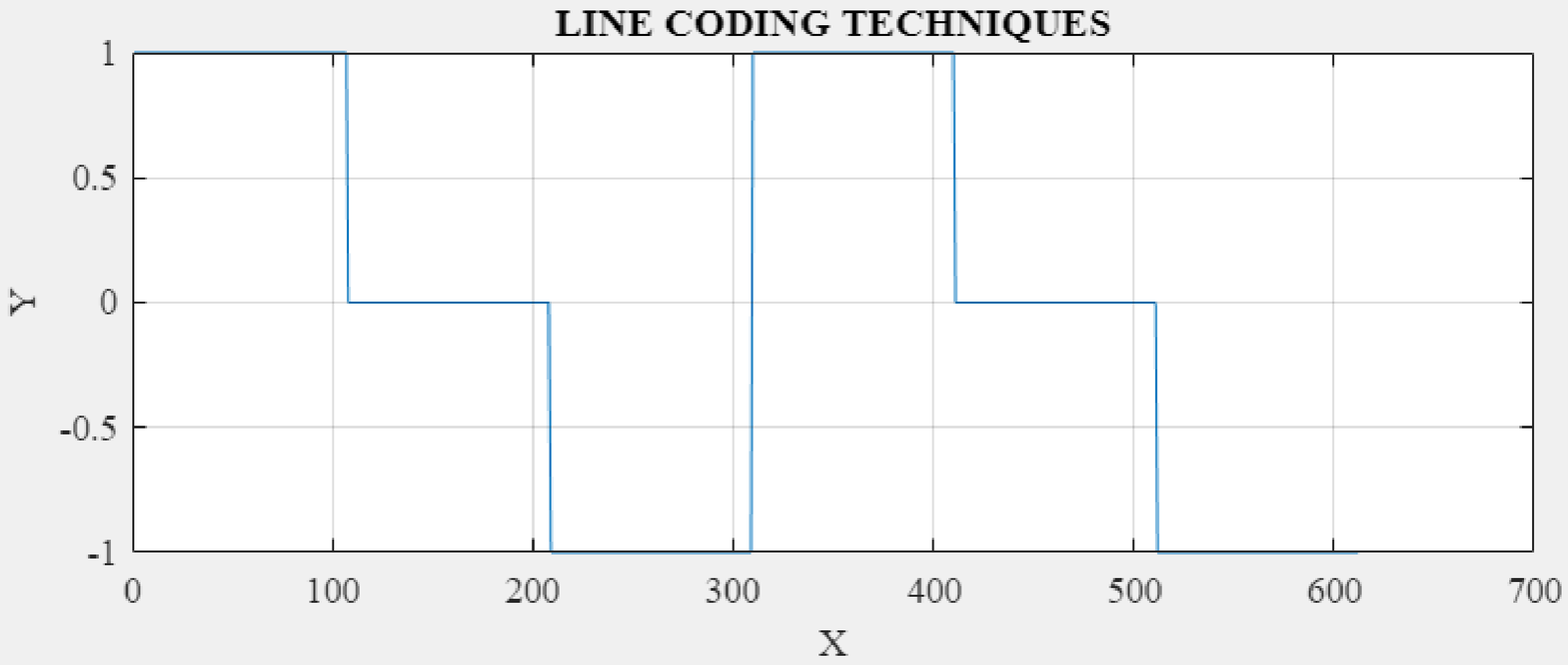

UniNRZ | PolarNRZ | AMI

UniRZ | PolarRZ | Manchester

Our APP

Manchester

MATLAB App

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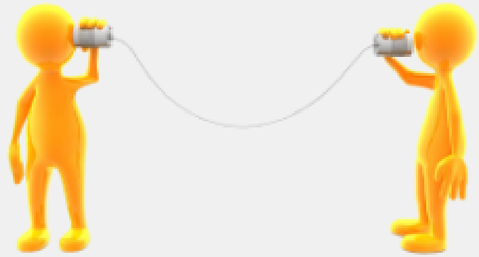

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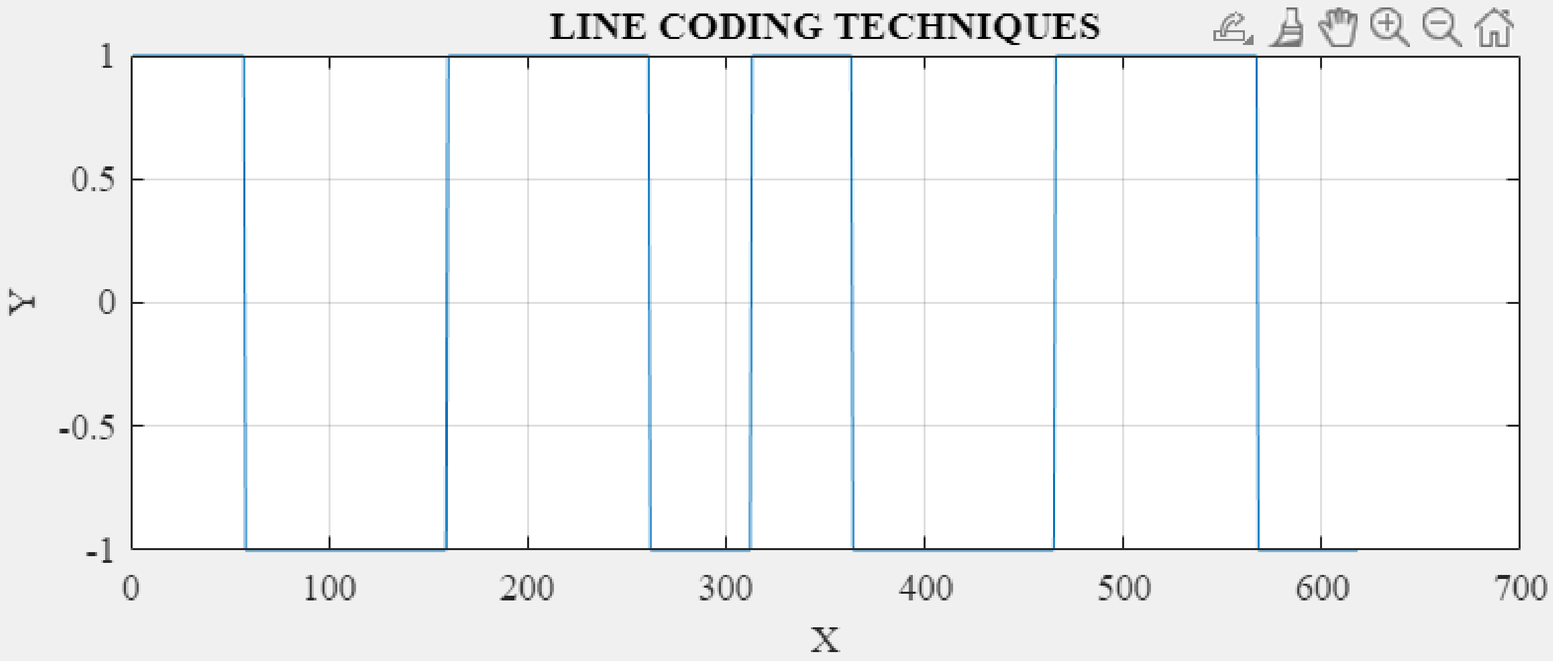

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Thank you