Sardar Patel Institute of Technology

Bhavan's Campus, Munshi Nagar, Andheri (West), Mumbai-400058-India Academic Year: 2024-2025

TE EXTC B Sem V ADC RUSHIKESH KHEDEKAR (2022200069) SOYAL NIRANJANE (2022200084) KRISHNA KUMAVAT (2022200075)

DUOBINARY ENCODER DECODER AND PRECODED DUOBINARY ENCODER DECODER

Abstract

- **Design and Simulation of Duobinary and Precoded Systems:** This project involves creating and simulating duobinary and precoded duobinary encoding-decoding systems to efficiently manage inter-symbol interference (ISI) in communication networks.
- **Performance Analysis and Impulse Response Evaluation:** By simulating various input sequences, the project analyzes the systems' accuracy and efficiency. It also examines their impulse response to understand their signal processing characteristics and practical applications.
- **Bandwidth Optimization and Error Mitigation:** Duobinary signaling optimizes bandwidth by introducing controlled ISI, making it suitable for modern networks. Precoding enhances reliability by preventing error propagation, ensuring robust communication.

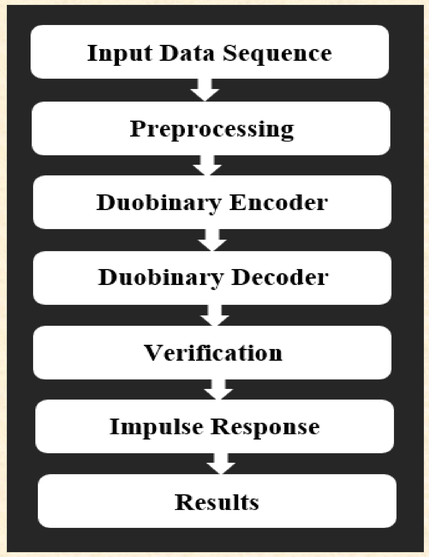
Introduction

1) Duobinary Encoder-Decoder:A duobinary encoder introduces controlled inter-symbol interference (ISI) by combining adjacent bits into a single waveform. This reduces the signal's bandwidth, allowing more efficient use of the communication channel. The duobinary decoder reconstructs the original binary sequence from the received signal, compensating for the introduced ISI.

2) Precoded Duobinary Encoder-Decoder:
A precoded duobinary system applies a preprocessing step (precoding) to the input binary sequence before encoding. This step ensures that errors introduced during transmission do noy propagate across multiple symbols. The decoder then recovers the original data with increased robustness against errors.

Purpose:
•**Duobinary Systems**: Optimize bandwidth usage and reduce channel noise sensitivity.
•**Precoding**: Prevent error propagation, enhancing system reliability. Together, these techniques improve signal quality and efficiency in digital communication systems.

Flowchart



•**Input Data Sequence**: Generate random or user-defined binary sequences.
•**Preprocessing**: Perform precoding for precoded duobinary systems.
•**Duobinary Encoder**: Encode the data using a filter that introduces controlled ISI.
•**Duobinary Decoder**: Decode the received signal to reconstruct the original data.
•**Verification**: Compare the decoded data with the input sequence.
•**Impulse Response**: Simulate and analyze the system's impulse response.
•**Results**: Document and evaluate performance metrics.

Result and Analysis

Duobinary and Precoded Duobinary

Duobinary: Maps binary data to three levels (+1, 0, 1), improving bandwidth efficiency. Encoder adds the current bit to the previous output, while the decoder subtracts consecutive outputs.

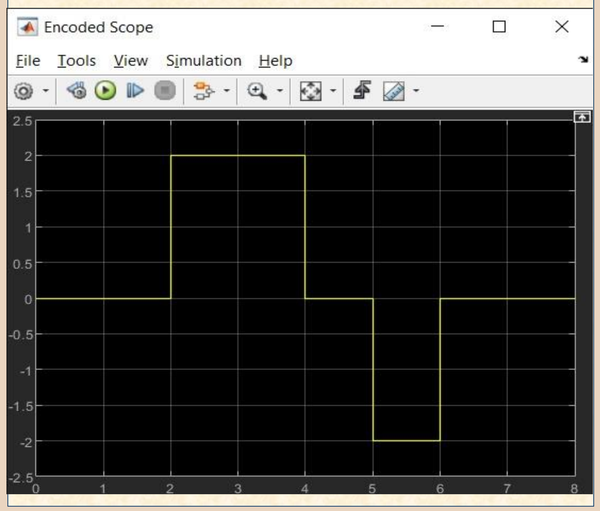
Precoded Duobinary: Adds a precoder before the duobinary encoder to eliminate DC component and improve spectral efficiency. Precoder inverts every other bit of the input data.

Key Points:
▪Both techniques increase bandwidth efficiency.
▪ Precoded duobinary offers better spectral efficiency and DC component reduction.
▪Both require careful synchronization and noise reduction techniques for reliable decoding.

Output :

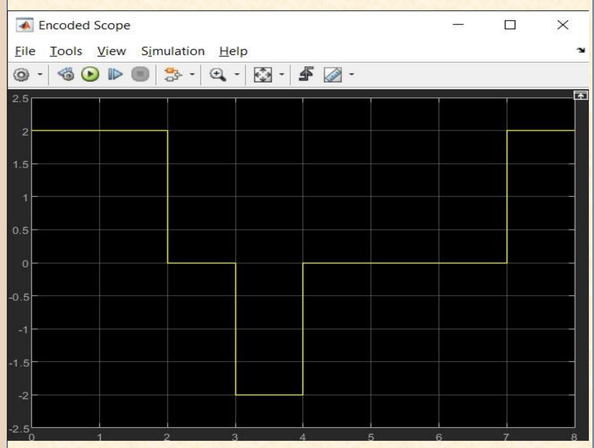
With Precoder

Precoded Signal ------- {0,1,1,1,0,0,1,0}
Input Signal ----- { 1,1,0,0,1,0,1,1}
Encoded Message ----- {0,0,2,2,0, -2 ,0,0}
Decoded Message ------ { 1,1,0,0,1,0,1,1}



Without Precoder

Input Signal ------ { 1,1,0,0,1,0,1,1}
Encoded Message ------ { 2,2,0,-2,0,0,0,1}
Decoded Message ------- {1,1,0,0,1,0,1,1}



Conclusion

The project confirms the effectiveness of duobinary and precoded encoding-decoding techniques, highlighting their efficiency and reliability for digital communication. The impulse response obtained from simulations validates the system's correct operation and practical feasibility. These methods are highly relevant for bandwidth-limited channels and can be applied in fields like optical communication, wireless systems, and high-speed data transmission.

References

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[3] X. Gu, S.J. Dodds et al, "Duobinary Technique for Dispersion Reduction in High Capacity Optical Systems Modelling, Experiment and Field Trial," IEEE Proc. Optoelectron, vol. 143, no. 4, August 1996.