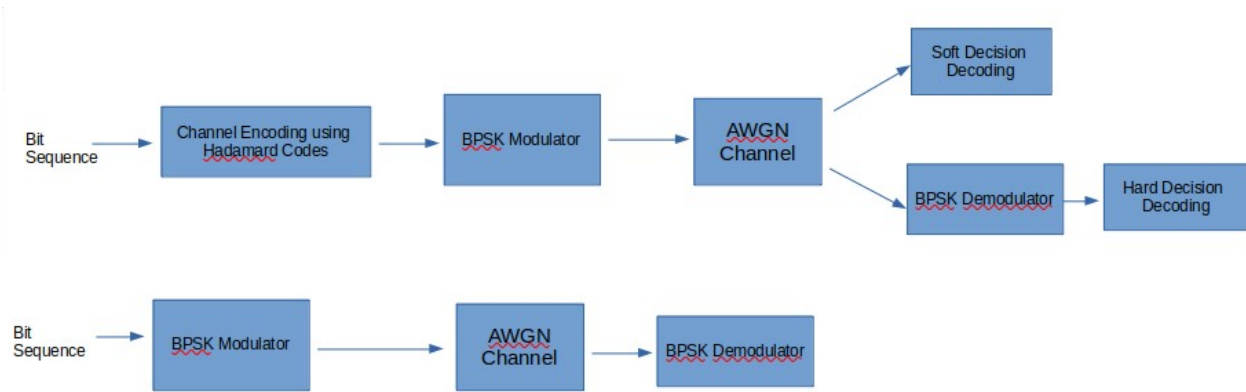


## Performance Comparison for Uncoded BPSK vs Coded BPSK using Hadamard Codes

In this work, BER vs SNR performances of uncoded BPSK modulated signal and channel coded BPSK modulated signal were compared. Hadamard codes were used to implement linear block coding.



**Block Diagram**

## System Equations

The uncoded transmitted sequence is,

$t_i = 2 \times I_i - 1$  where  $I_i$  represents data bit values. Each sequential three-tuple data bits are assigned to codewords from Hadamard matrix of order 8. Thus, code rate  $R_c = \frac{3}{8}$ .

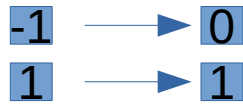
Hadamard matrix of order 8 is,

$$H_8 = \begin{pmatrix} 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ 1 & -1 & 1 & -1 & 1 & -1 & 1 & -1 \\ 1 & 1 & -1 & -1 & 1 & 1 & -1 & -1 \\ 1 & -1 & -1 & 1 & 1 & -1 & -1 & 1 \\ 1 & 1 & 1 & 1 & -1 & -1 & -1 & -1 \\ 1 & -1 & 1 & -1 & -1 & 1 & -1 & 1 \\ 1 & 1 & -1 & -1 & -1 & -1 & 1 & 1 \\ 1 & -1 & -1 & 1 & -1 & 1 & 1 & -1 \end{pmatrix}$$

Received signal is,

$$r_i = t_i + n_i \quad \text{where } t_i \text{ is transmitted sequence and } n_i \text{ is samples of additive white Gaussian noise.}$$

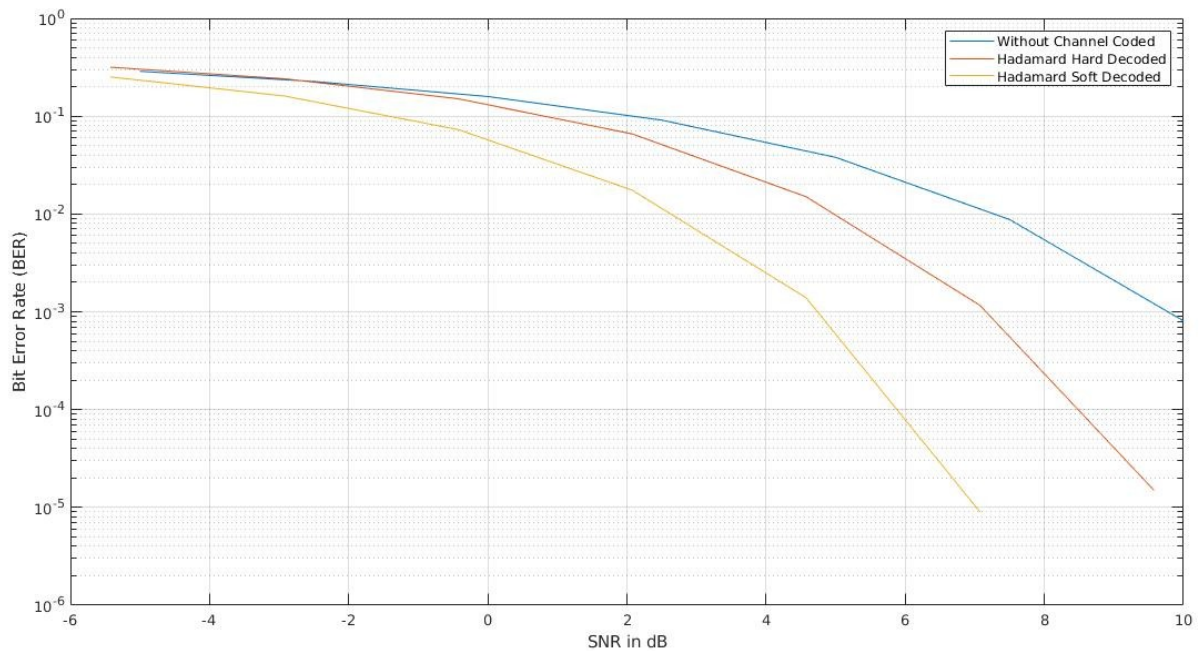
The uncoded BPSK modulated signal was directly demodulated according to their position in the constellation. The Hadamard Coded signals is decoding by first applying BPSK demodulation and then comparing Hamming distance between 8-tuple sequences and Hadamard codewords.



The soft decision was done by correlating each received 8-tuple sequence with Hadamard codewords. The received signal decoded to codeword that gives maximum correlator output.

## Simulation and Results

The transmitted bit sequence length is 999. BER vs SNR was simulated for different SNR values. The simulation was repeated 1000 times to get accurate results.



**BER vs SNR**

As shown in figure above, soft decision decoding using correlator gives best results.