

Experiment No.: 8

***Title: Simulation study of Performance of
M-ary PSK.***

Roll No.: _____ *Batch:* _____

Date of Performance: _____

Date of Assessment: _____

Particulars	Marks
Attendance (05)	
Journal (05)	
Performance (05)	
Understanding (05)	
Total (20)	
Signature of Staff Member	

Experiment No.: 8

Title: Simulation Study of Performance of M-ary PSK.

Aim: To simulate and analyze the performance of M-ary Phase Shift Keying (M-PSK) modulation in an Additive White Gaussian Noise (AWGN) channel by observing the Bit Error Rate (BER) versus Signal-to-Noise Ratio (SNR).

Apparatus / Software Required:

1. MATLAB software (with Communication Toolbox recommended).
2. Computer with MATLAB installed.

Theory:

M-ary PSK is a digital modulation scheme where M symbols are represented by different phases of a carrier signal equally spaced around a circle. The major parameters include:

1. M: Number of phase states (e.g., 2 for BPSK, 4 for QPSK, 8 for 8-PSK, etc.)
2. Symbol mapping assigns bits to phase shifts evenly distributed over $[0, 2\pi)$.
3. The modulated signal passes through a noise channel which adds Gaussian noise.
4. The receiver demodulates the received signal and calculates BER by comparing transmitted and received bits. BER performance curves are plotted against varying SNR in dB to analyze system reliability.

Procedure / Outline:

1. Generate random binary data symbol sequences.
2. Map binary data to M-PSK symbols using phase shifts.
3. Pass the symbols through an noise channel with varying SNR values.
4. Demodulate received noisy signals back to symbols.
5. Compare received data with transmitted data to calculate number of bit errors.
6. Compute and plot BER versus SNR curve.
7. Optionally plot the constellation diagrams of transmitted and received signals to visualize effects of noise.

Observation:

1. BER decreases as SNR increases, showing better performance at higher SNR.
2. For larger M (higher-order PSK), BER performance is generally worse for the same SNR due to closer constellation points.

3. Constellation diagram shows spread of received points around ideal constellation due to noise.

MATLAB Code Example:

```
clc;
clear all;
Close all;

M = input('Number of symbols (M) = ');
SNR_dB = input('SNR of M-ary PSK system in dB = ');

% Generate random symbols (0 to M-1)
x1 = randi([0 M-1], 1, M);

% PSK Modulation (manual)
theta = 2*pi*x1/M;      % phase for each symbol
y1 = exp(1j*theta);      % M-PSK signal

% Convert SNR from dB to linear
SNR_linear = 10^(SNR_dB/10);

% Compute signal power and noise power
signal_power = mean(abs(y1).^2);
noise_power = signal_power / SNR_linear;

% Generate complex Gaussian noise
noise = sqrt(noise_power/2) * (randn(size(y1)) + 1j*randn(size(y1)));

% Add noise to signal
y1n = y1 + noise;

% Plot constellation (basic)
figure;
plot(real(y1n), imag(y1n), 'o');
title([num2str(M), '-PSK Constellation with SNR = ', num2str(SNR_dB), ' dB']);
xlabel('In-phase');
ylabel('Quadrature');
axis equal; grid on;

% PSK Demodulation (manual)
```

```
y1r = mod(round((angle(y1n) / (2*pi)) * M), M);
```

```
% Error Calculation
```

```
num_error = sum(x1 ~= y1r);
```

```
er_rate = num_error / length(x1);
```

```
fprintf('Number of symbol errors = %d\n', num_error);
```

```
fprintf('Symbol error rate = %f\n', er_rate);
```

Output:

Number of symbols (M) = 32

SNR of M-ary PSK system in dB = 20

Number of symbol errors = 5

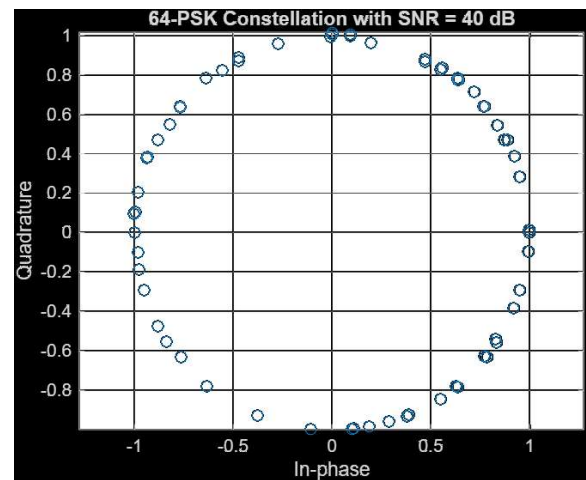
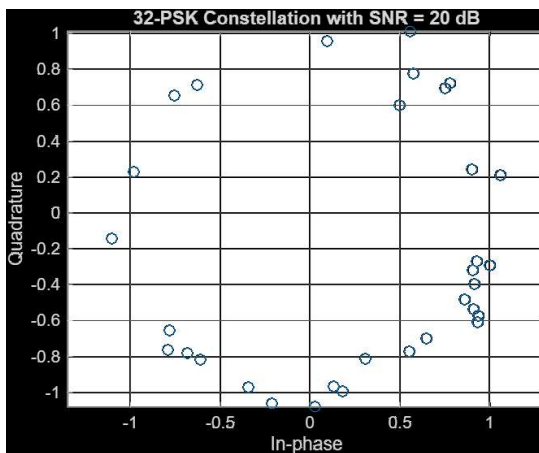
Symbol error rate = 0.156250

Number of symbols (M) = 64

SNR of M-ary PSK system in dB = 40

Number of symbol errors = 0

Symbol error rate = 0.000000

**Conclusion:**
