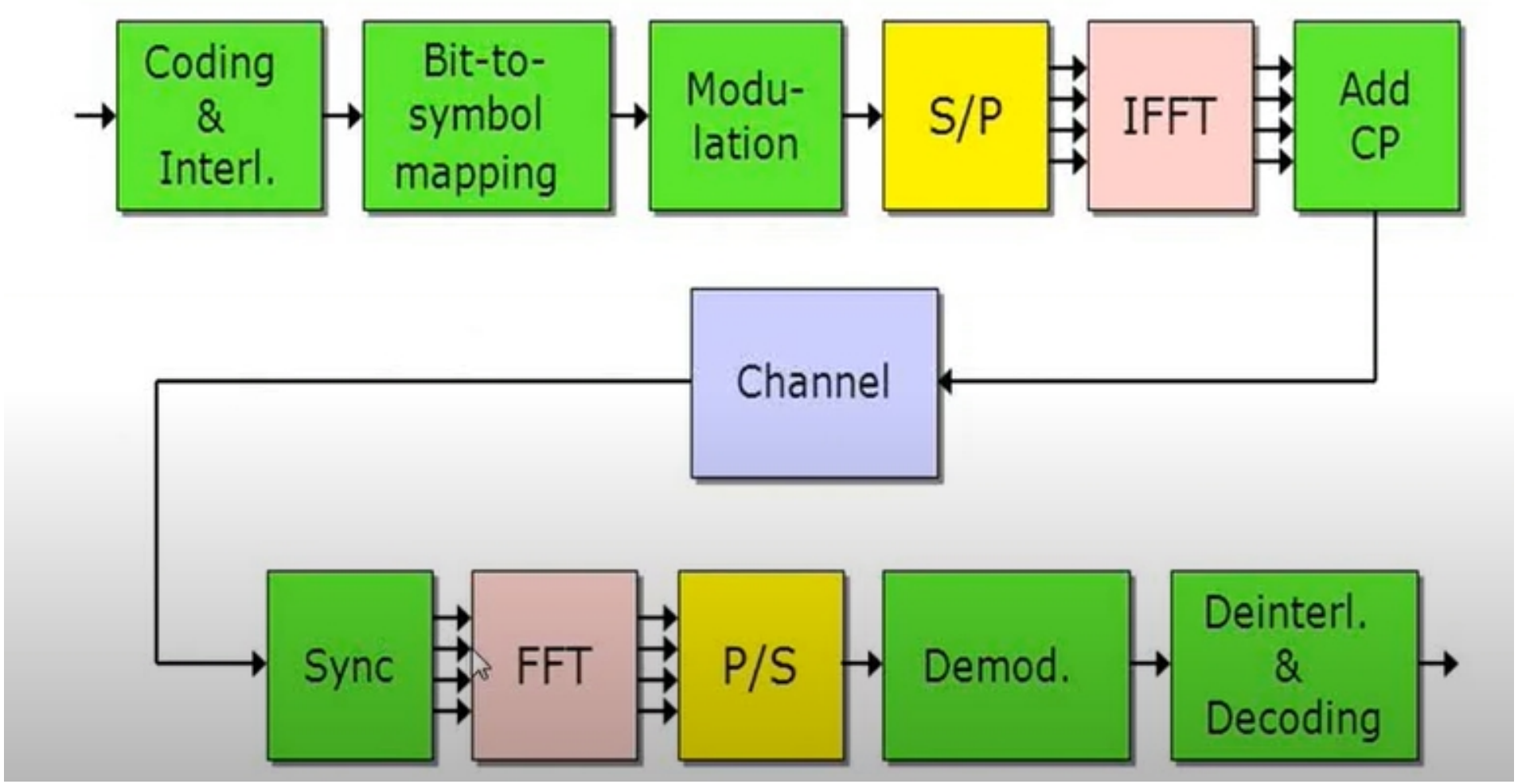
Experiment No.6

Study of OFDM system by using Simulink

What is OFDM:

- Orthogonal frequency-division multiplexing (OFDM) is a multi-carrier modulation system where data are transmitted as a combination of orthogonal narrowband signals known as subcarriers.
- OFDM builds upon single carrier modulation such as QAM and can transmit at similar data rates.
- However, OFDM is more robust to frequency selective fading and simplifies equalization at the receiver. OFDM is a foundational scheme found in many common wireless communications standards such as WIFI, LTE, and 5G. You can use MATLAB and Simulink to configure and generate OFDM waveforms, adhering to these standards to simulate and test a physical layer model of your wireless communications system.

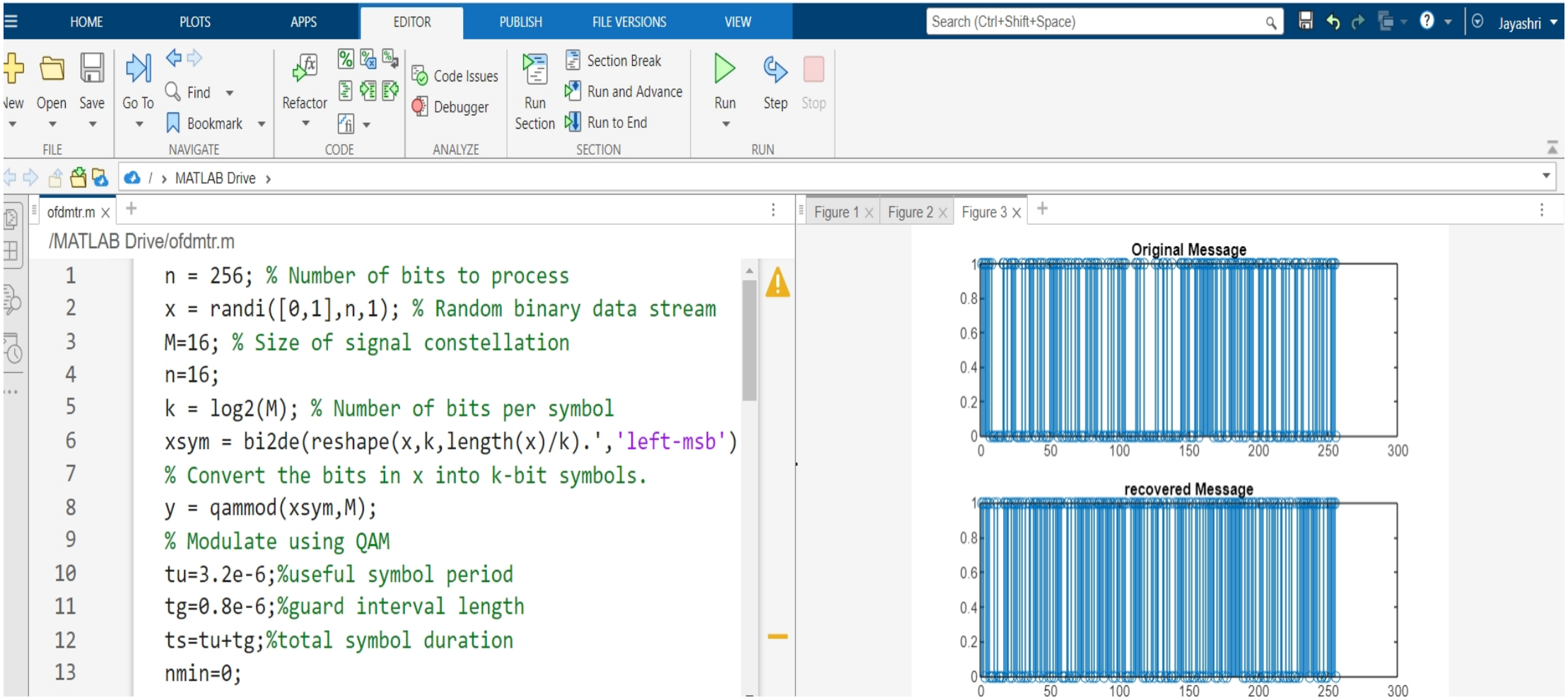
OFDM System Block diagram:



Converting Matrix to vector

- A = [1 2 3; 4 5 6; 7 8 9] % Example matrix
- reshape(A,[],1) % convert matrix to column vector
- reshape(A,1,[]) % convert matrix to row vector

MATLAB Code:


HOME
PLOTS
APPS
EDITOR
PUBLISH
FILE VERSIONS
VIEW
Search (Ctrl+Shift+Space)
Jayashri
New
Open
Save
FILE
Go To
Find
Bookmark
NAVIGATE
Refactor
CODE
Code Issues
Debugger
ANALYZE
Run Section
Section Break
Run and Advance
Run to End
SECTION
Run
Step
Stop
RUN
MATLAB Drive
ofdmtr.m
/MATLAB Drive/ofdmtr.m
1 n = 256; % Number of bits to process
2 x = randi([0,1],n,1); % Random binary data stream
3 M=16; % Size of signal constellation
4 n=16;
5 k = log2(M); % Number of bits per symbol
6 xsym = bi2de(reshape(x,k,length(x)/k).','left-msb')
7 % Convert the bits in x into k-bit symbols.
8 y = qammod(xsym,M);
9 % Modulate using QAM
10 tu=3.2e-6;%useful symbol period
11 tg=0.8e-6;%guard interval length
12 ts=tu+tg;%total symbol duration
13 nmin=0;
Figure 1
Figure 2
Figure 3
Original Message
recovered Message
0
0.2
0.4
0.6
0.8
1
0
50
100
150
200
250
300

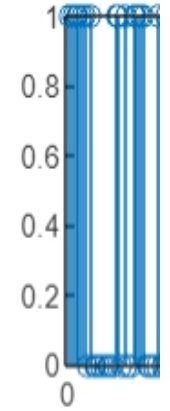
MATLAB Code:

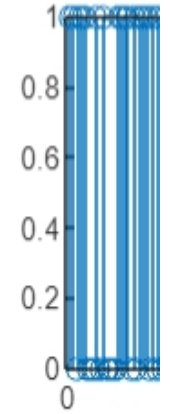
ofdmtr.m

/MATLAB Drive/ofdmtr.m

```
14    nmax=64;%total number of subcarriers
15    scb=312.5e3;%sub carrier spacing
16    fc=3.6e9;%carrier frequency
17    Rs=fc;
18    tt=0: 6.2500e-008:ts-6.2500e-008;
19    c=ifft(y,nmax);%IFFT
20    s=real(c'.*(exp(1j*2*pi*fc*tt)));%bandpass modulati
21    figure;
22    plot(real(s),'b');
23    title('OFDM signal transmitted');
24    figure;
25    plot(10*log10(abs(fft(s,nmax))));
26    title('OFDM spectrum');
27    xlabel('frequency')
```

Figure 1 | Figure 2 | Figure 3





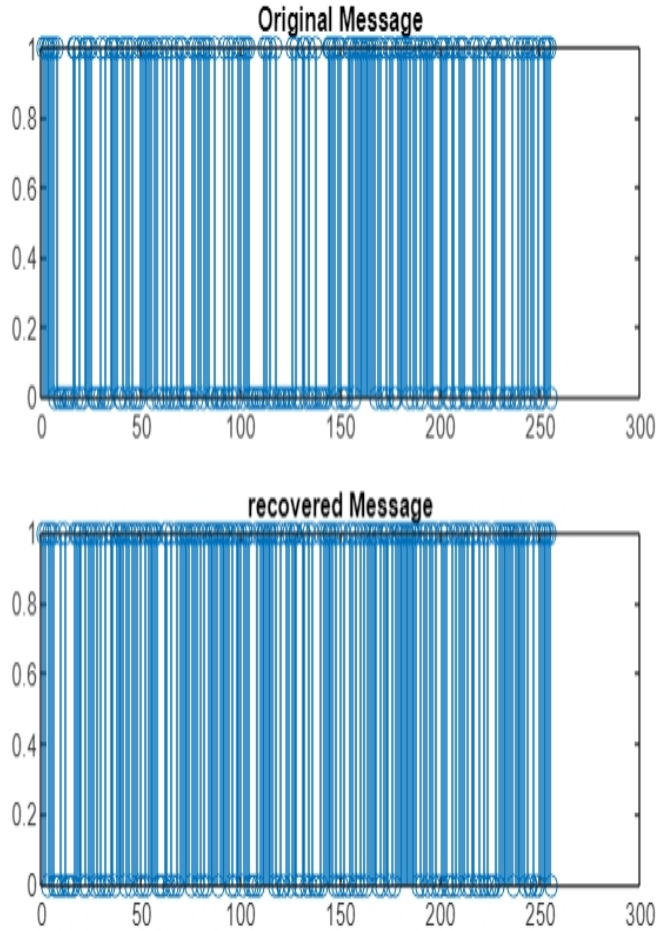
/ › MATLAB Drive ›

ofdmtr.m

/MATLAB Drive/ofdmtr.m

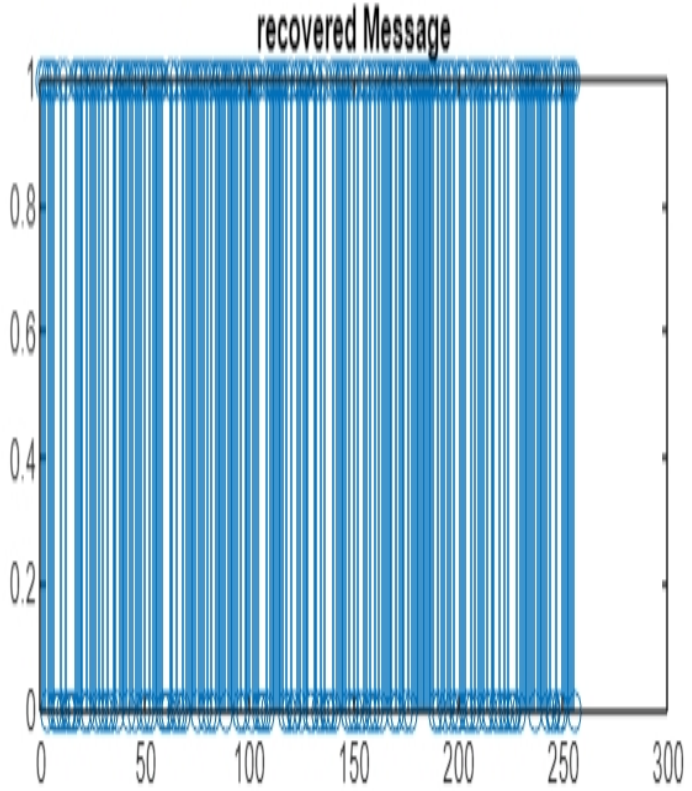
```
27      xlabel('frequency')
28      ylabel('power spectral density')
29      title('Transmit spectrum OFDM');
30      snr=10;%signal to noise ratio
31      ynoisy = awgn(s,snr,'measured');%awgn channel
32      figure;
33      plot(real(ynoisy),'b');
34      title('received OFDM signal with noise');
35      z=ynoisy.*exp(1i*2*pi*fc*tt);%Bandpass demodulation
36      z=fft(z,nmax);%FFT
37      zsym=qamdemod(z,(M));%demo dulation of bandpass dat
38      z = de2bi(zsym,'left-msb'); %Convert integers to bi
39      z = reshape(z.',prod(size(z)),1);%matrix to vector
```

Figure 1 | Figure 2 | Figure 3



MATLAB Code:

```
40  [noe,ber] = biterr(x,z) ;%BER calculation figure;
41  subplot(211);
42  stem(x(1:256));
43  title('Original Message');
44  subplot(212);
45  stem(z(1:256));
46  title('recovered Message');
```



Command Window

References:

[1] https://in.mathworks.com/discovery/ofdm.html

[2]https://matlab-code.org/ofdm-simulation-using-matlab-simulink/

[3] https://www.rfwireless-world.com/source-code/MATLAB/OFDM-matlab-code.html

[4] https://www.youtube.com/watch?v=C69JJEx6Jas