Table of Contents

lab4.m

```
clear
delete(allchild(0));
w = linspace(-pi, pi, 11);
x = sequence([1 4 3 -2 6], -1);
%x = sequence([1 5 2 -1 4 1], -2);
```

Problem #1: Even, Odd

```
test_lab4('even(x)');
test_lab4('odd(x)');
test_lab4('trim(plus(even(x), odd(x)))');
```

```
_____________
even(x): sequence O.K.
Your answer:

z =

  sequence with properties:

      data: [3 -1 2 4 2 -1 3]
    offset: -3


_____________
odd(x): sequence O.K.
Your answer:

z =

  sequence with properties:

      data: [-3 1 -1 0 1 -1 3]
    offset: -3


_____________
trim(plus(even(x), odd(x))): sequence O.K.
Your answer:
```

```
z =

  struct with fields:

    offset: -1
      data: [1 4 3 -2 6]
```

Problem #2: DTFT

```
x = sequence([1 1 1], -1);
test_lab4('dtft(x, w)');

% Simple impulse Caution! check your answer for this.
% It should be a sequence.
x = sequence(1, 0);
test_lab4('dtft(x, w)');

%x = sequence([1 4 3 -2 6], -1)
x = sequence([1 3 -1 -4 1], -2);
test_lab4('dtft(x, w)');

%x = sequence([1 4 3 -2 6], -1)
x = sequence([1+j 0 1-j], -1);
test_lab4('dtft(x, w)-dtft(conj(flip(x)), w)');
```

```
_____________
dtft(x, w): data O.K.
Your answer:

z =

  Columns 1 through 7

   -1.0000   -0.6180    0.3820    1.6180    2.6180    3.0000    2.6180

  Columns 8 through 11

    1.6180    0.3820   -0.6180   -1.0000

_____________
dtft(x, w): data O.K.
Your answer:

z =

     1     1     1     1     1     1     1     1     1     1     1

_____________
dtft(x, w): data O.K.
Your answer:
```

```
z =

  Columns 1 through 4

   2.0000 - 0.0000i   0.4271 - 4.1145i  -2.3090 - 6.6574i  -2.9271 - 6.6574i

  Columns 5 through 8

  -1.1910 - 4.1145i   0.0000 + 0.0000i  -1.1910 + 4.1145i  -2.9271 + 6.6574i

  Columns 9 through 11

  -2.3090 + 6.6574i   0.4271 + 4.1145i   2.0000 + 0.0000i
```

```
dtft(x, w)-dtft(conj(flip(x)), w): data incorrect
Your answer:

z =

  Columns 1 through 4

  -2.0000 - 1.0000i   1.3209 + 0.3666i   4.1372 + 1.5931i   5.3733 + 2.2111i

  Columns 5 through 8

   4.5570 + 1.9846i   2.0000 + 1.0000i  -1.3209 - 0.3666i  -4.1372 - 1.5931i

  Columns 9 through 11

  -5.3733 - 2.2111i  -4.5570 - 1.9846i  -2.0000 - 1.0000i

Correct answer:
     0     0     0     0     0     0     0     0     0     0     0
```

Problem #3: Real and Imaginary

```
x = sequence([1 1 1 1 1], -1);
test_lab4('dtft2(x, w)');

%x = sequence([1 4 3 -2 6], -1);
x = sequence([1 2 2 -1 2 1], -2);
test_lab4('dtft2(x, w)');
```

```
dtft2(x, w): data O.K.
Your answer:

z =

  struct with fields:
```

```
    real: [-1 2.7756e-16 0.3820 1.1102e-16 2.6180 5 2.6180 1.1102e-16 … ]
    imag: [1.2246e-16 -1.1102e-16 -1.1756 2.2204e-16 1.9021 0 -1.9021 … ]


_____________
dtft2(x, w): data O.K.
Your answer:

z =

  struct with fields:

    real: [3 2.4271 0.0729 -0.9271 3.4271 7 3.4271 -0.9271 0.0729 2.4271 3]
    imag: [-2.4493e-16 -1.7634 -4.0287 -2.8532 0.1388 0 -0.1388 2.8532 … ]
```

Problem #4: Magnitude and Phase

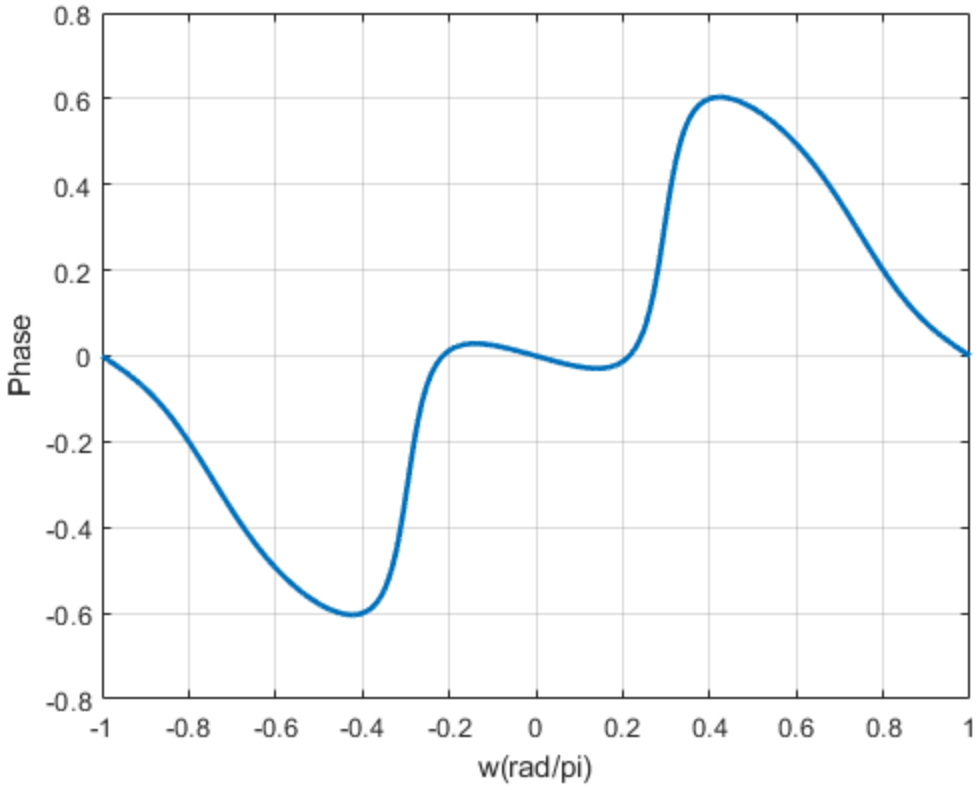
```
test_lab4('mag_phase(dtft2(x, w))');
```

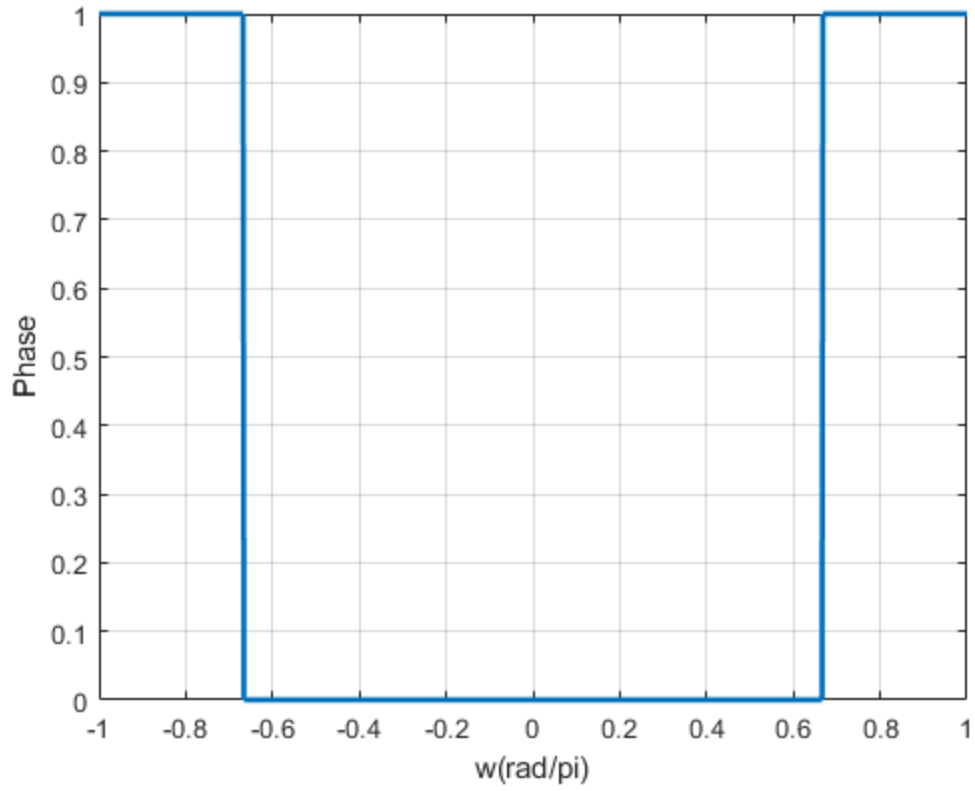
```
_____________
mag_phase(dtft2(x, w)): data O.K.
Your answer:

z =

  struct with fields:

      mag: [3 3.0000 4.0294 3.0000 3.4299 7 3.4299 3.0000 4.0294 3.0000 3]
    phase: [-8.1643e-17 -0.6283 -1.5527 -1.8850 0.0405 0 -0.0405 1.8850 … ]
```

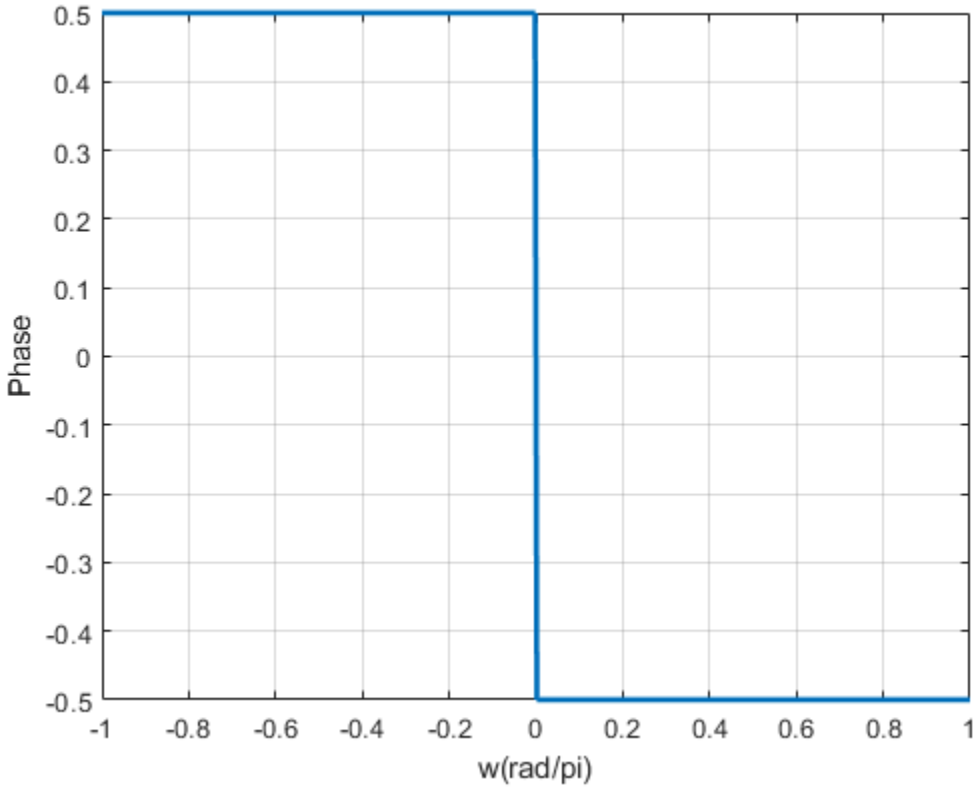
Problem #5 Plotting

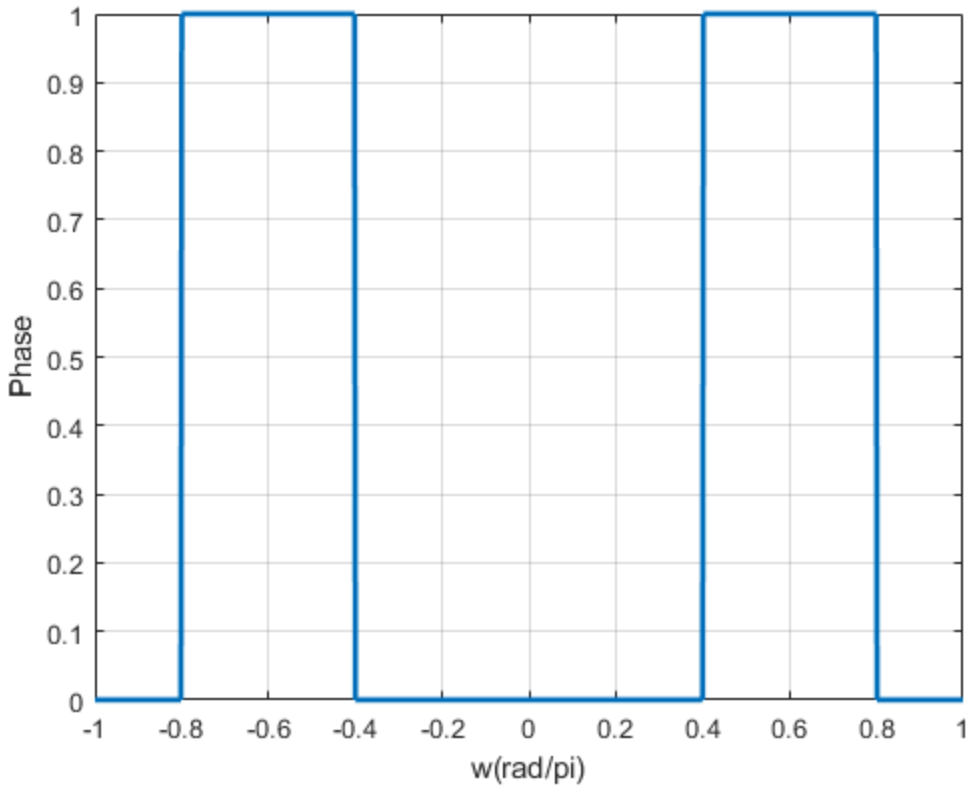
```
w = linspace(-pi, pi, 1001);
plot_magph(x, w);

% This is a purely real and even function.
% What can you say about the phase?
% Specifically why is it either 0 or pi?
x = sequence([1 1 1], -1);
set(figure, 'Color', 'w');
plot_magph(x, w);

% This is a purely real and odd function.
% What can you say about the phase?
% Specifically why is it either +pi/2 or -pi/2?
x = sequence([-1 0 1], -1);
set(figure, 'Color', 'w');
plot_magph(x, w);

% Here are a series of pulse functions.
% What happens to the magnitude of the transform as the pulse gets broader?
```

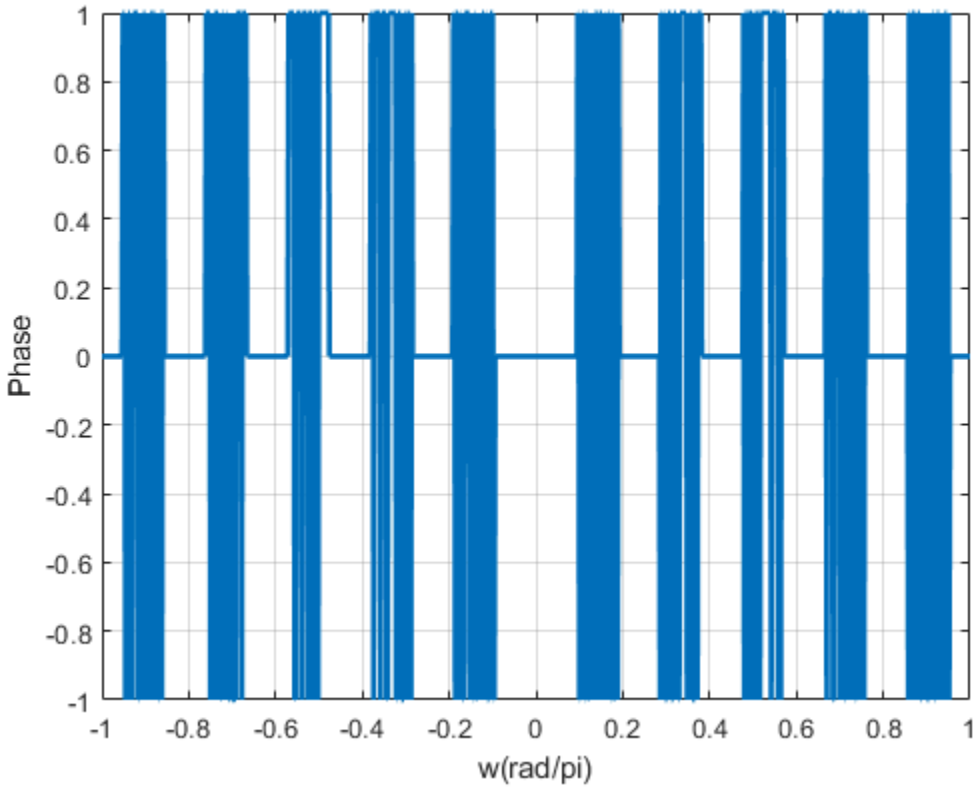
```
% You may note that the phase 'chatters' between +pi and -pi at some values of
 w.
% This doesn't look nice and it's confusing. How could you fix this in your
 plot_magph
% program so that the phase doesn't chatter? No biggie if you can't.
% (Hint: it has something to do with a very small imaginary part...).

x = sequence(ones(1, 5), -2);
set(figure, 'Color', 'w');
plot_magph(x, w)

x = sequence(ones(1, 21), -10);
set(figure, 'Color', 'w');
plot_magph(x, w)

x = sequence(ones(1, 101), -50);
set(figure, 'Color', 'w');
plot_magph(x, w)
```

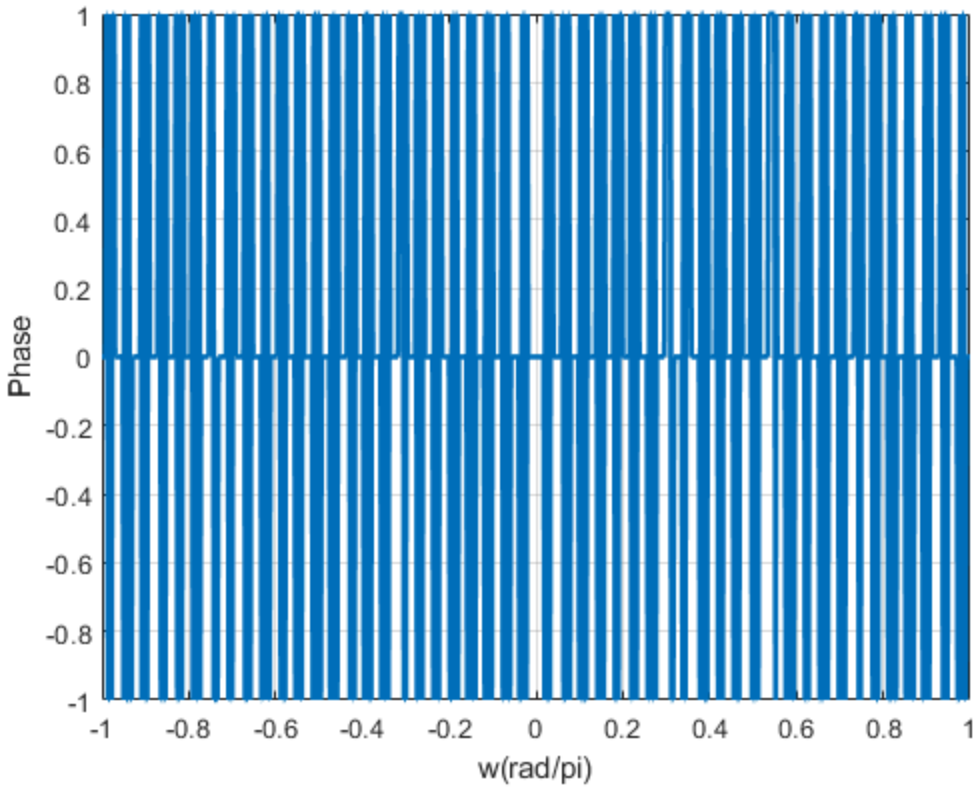



Phase
w(rad/pi)


Phase
w(rad/pi)


Phase
w(rad/pi)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
-1
-0.8
-0.6
-0.4
-0.2
0
0.2
0.4
0.6
0.8
1


Phase
w(rad/pi)
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
-1
-0.8
-0.6
-0.4
-0.2
0
0.2
0.4
0.6
0.8
1



Print programs

```
disp(' ')
disp('--- dtft.m --------------------------------')
type('dtft')
disp('--- dtft2.m -------------------------------')
type('dtft2')
disp('--- mag_phase.m ---------------------------')
type('mag_phase')
disp('--- plot_magph.m --------------------------')
type('plot_magph')
```

```
--- dtft.m --------------------------------

function y = dtft(x, w)

n = [x.offset: x.offset + length(x.data)-1];
Q = n'*w;
y = x.data*exp(-1i*Q);

end
--- dtft2.m -------------------------------

function y = dtft2(x,w)
n = (x.offset:x.offset + length(x.data)-1);
```

```
Q = n'*w;
dtft = x.data*exp(-1i*Q);

    for n=1:length(dtft)
        mag = abs(dtft(n));
        ang = angle(dtft(n));
        y.real(n) = mag*cos(ang);
        y.imag(n) = mag*sin(ang);
    end
end
--- mag_phase.m --------------------------

function y = mag_phase(x)
mag = sqrt(((x.real).*(x.real))+((x.imag).*(x.imag)));
P = zeros(1,length(x.real));

    for n=1:length(x.real)
        P(1,n) = atan2(x.imag(n), x.real(n));
        y.mag = mag;
        y.phase = P;
    end
end
--- plot_magph.m -------------------------

function plot_magph(x,w)

z = mag_phase(dtft2(x, w));
plot(w/pi,z.mag,'linewidth',2);
grid on;
ylabel('Magnitude');

plot(w/pi, z.phase/pi,'linewidth',2);
grid on;
ylabel('Phase');
xlabel('w(rad/pi)');

end
```

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