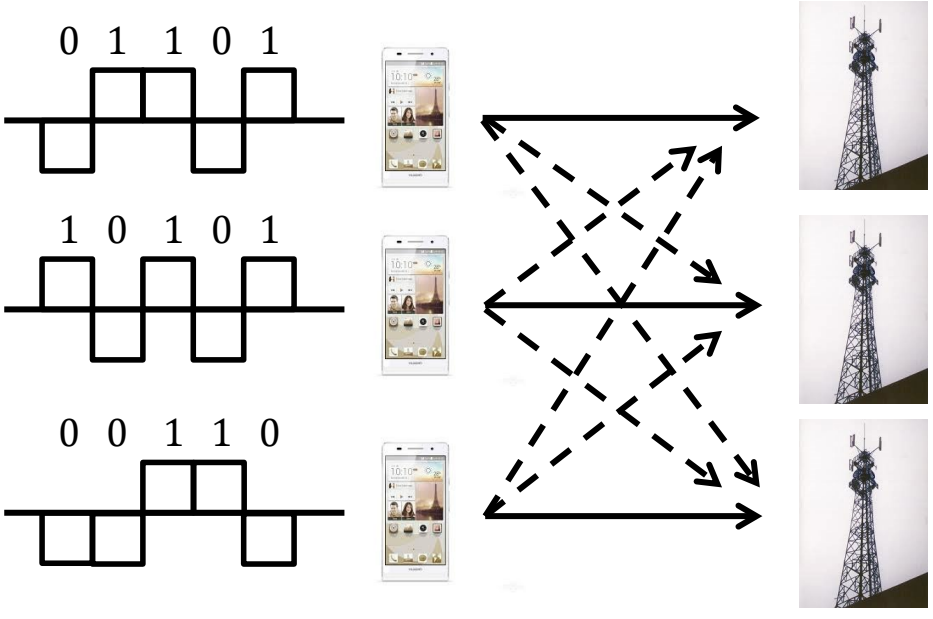
Application of CTFT

- Analysis of amplitude modulation (AM)

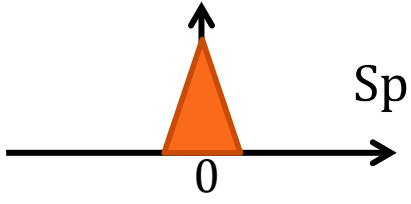
What's Modulation 调制



- Each phone wants to deliver information to its base station
- Therefore, there is cross-talk in the wireless channel
- How can we solve this issue?

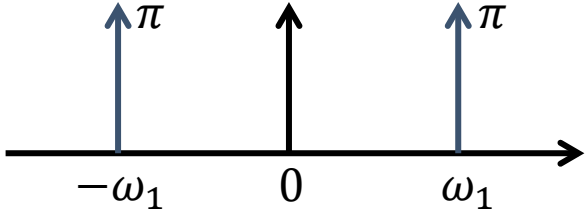
Amplitude Modulation

- Signal: $m(t)$



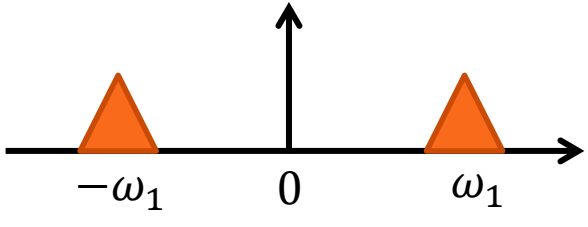
Spectrum of $m(t)$

- Carrier: $\cos(\omega_1 t) \Leftrightarrow \pi[\delta(\omega - \omega_1) + \delta(\omega + \omega_1)]$



Spectrum of carrier

- Amplitude Modulation: $y(t) = m(t) \times \cos(\omega_1 t)$

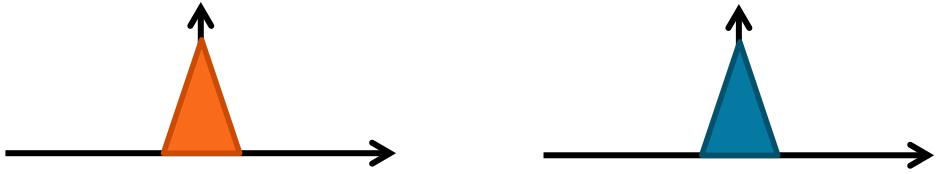


能量不变，复制变为原来的一半

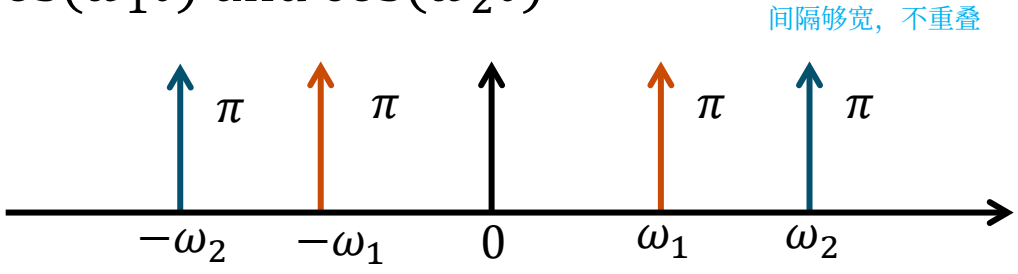
Shift by ω_1 and Scale by $1/2$

No information loss

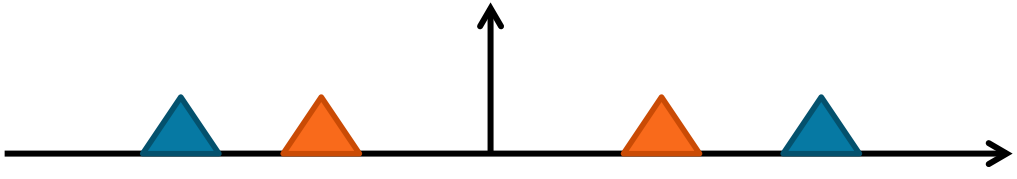
- Signals: $m_1(t)$ and $m_2(t)$



- Carriers: $\cos(\omega_1 t)$ and $\cos(\omega_2 t)$



- Amplitude Modulation: $y(t) = m_1(t) \times \cos(\omega_1 t) + m_2(t) \times \cos(\omega_2 t)$



Signals are distinguished in frequency domain

Demodulation 解调

- Lies in lab assignment 4.6……
- **When loading the file, you should have noticed that you have been transformed into Agent 008, the code-breaking sleuth.**
- **The last words of the aging Agent 007 were**

The Future Of Technology Lies In . . .

A ·-	H ····	O ---	V ···-
B -···	I ··	P ·--·	W ·--
C -·-·	J ·---	Q --·-	X -··-
D -··	K -·-	R ·-·	Y -·--
E ·	L ·-··	S ···	Z --··
F ··-·	M --	T -	
G --·	N -·	U ··-	

Correction and Tip

- A correction: Lab assignment 4.6, Eq. (4.17)

$$x(t) = m_1(t)\cos(2\pi f_1 t) + m_2(t)\,\mathbf{sin}(2\pi f_2 t) + m_3(t)\sin(2\pi f_1 t)$$

- A tip: In Part (e), have one more try:

$$m(t)\sin(2\pi f_1 t)\sin(2\pi f_1 t)$$

单选题 1分

设置

The correction for lab assignment in the last page is for assignment _____?

A 4.2

B 4.5

C 4.6

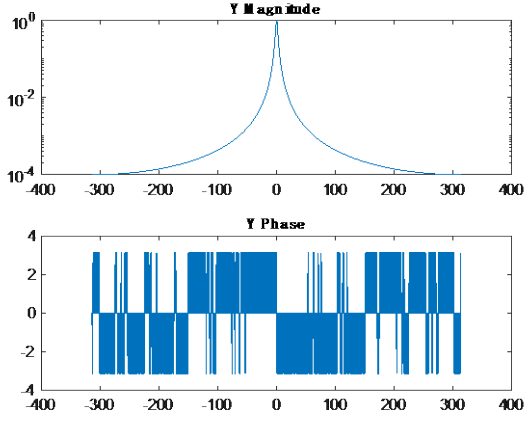
D 4.18

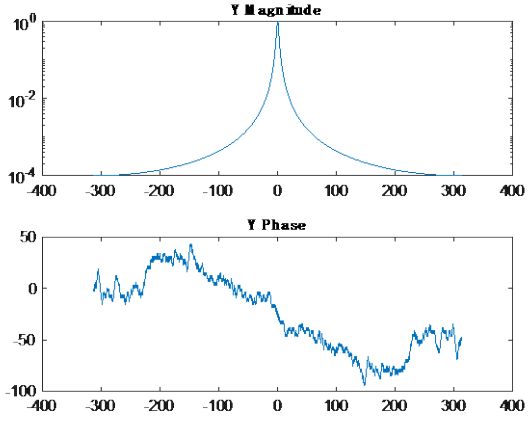
提交

Lab Assignment 4

- Read tutorial 4.1 by yourself
- 4.2, 4.5 & 4.6
  - You need to download ctftmod.mat for 4.6
- Submit your report + codes onto Blackboard before 10:00 am Nov. 18th

Wrapping vs. unwrapping

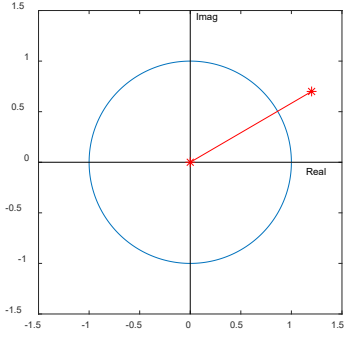




- unwrap(angle(X))
  - Correct phase angles to produce smoother phase plots
  - Find more details in MATLAB HELP DOCUMENT

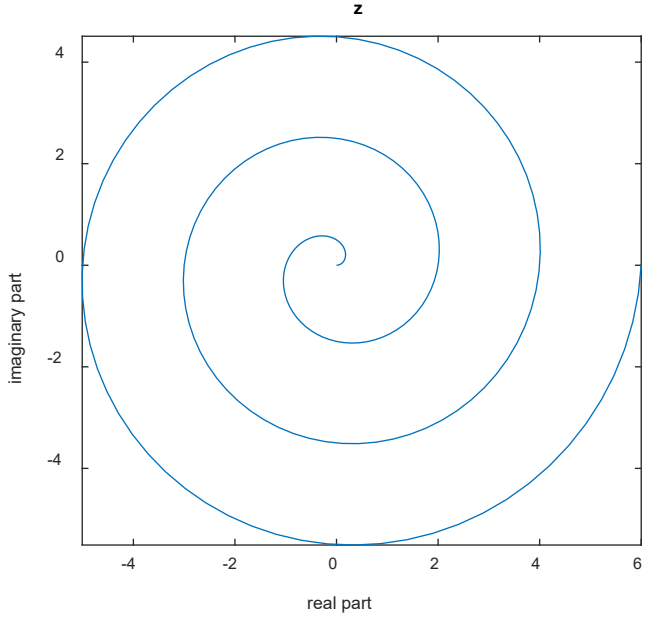
根据信号的变化趋势确定

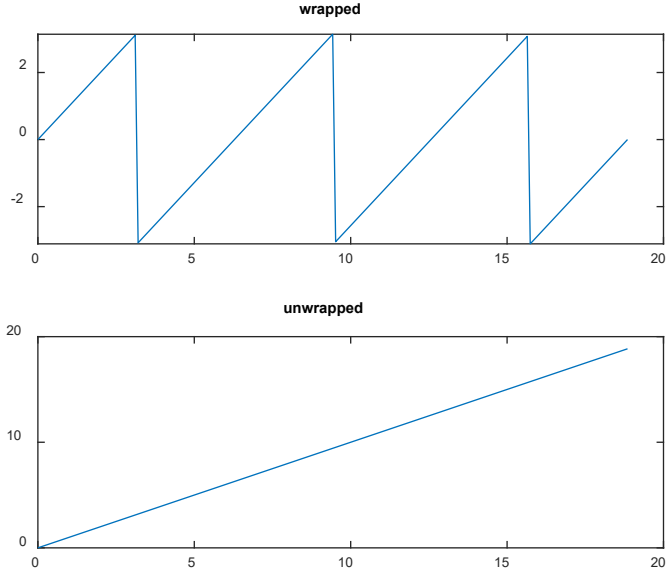
Q = unwrap(P) unwraps the radian phase angles in a vector P. Whenever the jump between consecutive angles is greater than or equal to π radians, unwrap shifts the angles by adding multiples of $\pm 2\pi$ until the jump is less than π.



'angle' takes a complex number $z = x + iy$ and uses the 'atan2' function to compute the angle between the positive x-axis and a ray from the origin to the point (x,y) in the xy-plane

```
t = linspace(0,6*pi,201);
x = t/pi.*cos(t);
y = t/pi.*sin(t);
z = x + 1i*y;  % magnitude=t/pi, phase=t
figure; plot(z); title('z'); axis image;
xlabel('real part') ; ylabel('imaginary part');
figure;subplot(211);plot(t, angle(z)); title('wrapped')
subplot(212);plot(t, unwrap(angle(z))); title('unwrapped')
```


z
imaginary part
real part
4
2
0
-2
-4
-4
-2
0
2
4
6


wrapped
2
0
-2
0
5
10
15
20
unwrapped
20
10
0
0
5
10
15
20

单选题 1分

设置

What is the function of ‘unwrap’ just mentioned?

A To get the angle of complex 求复数的角度

B To correct phase angles to produce smoother phase plot
纠正连续变化的相位由于角度计算问题引起的跳变

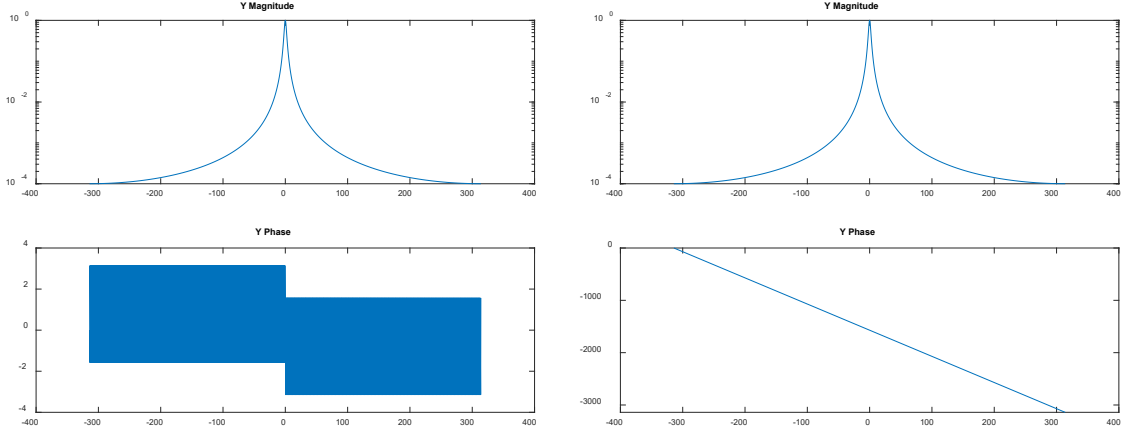
C To unwrap your packages 拆快递

D It doesn’t matter 这不重要

提交

- Lab assignment 4.2
  - `T = 10`
  - `w = -(pi/tau)+(0:N-1)*(2*pi/(N*tau));`
- Step of w:
  - `dw=2*pi/(N*tau)=2*pi/T= pi/5`
- Step of phase:
  - `dph=-5*dw=-pi`

When T = 20, √



- Any questions?