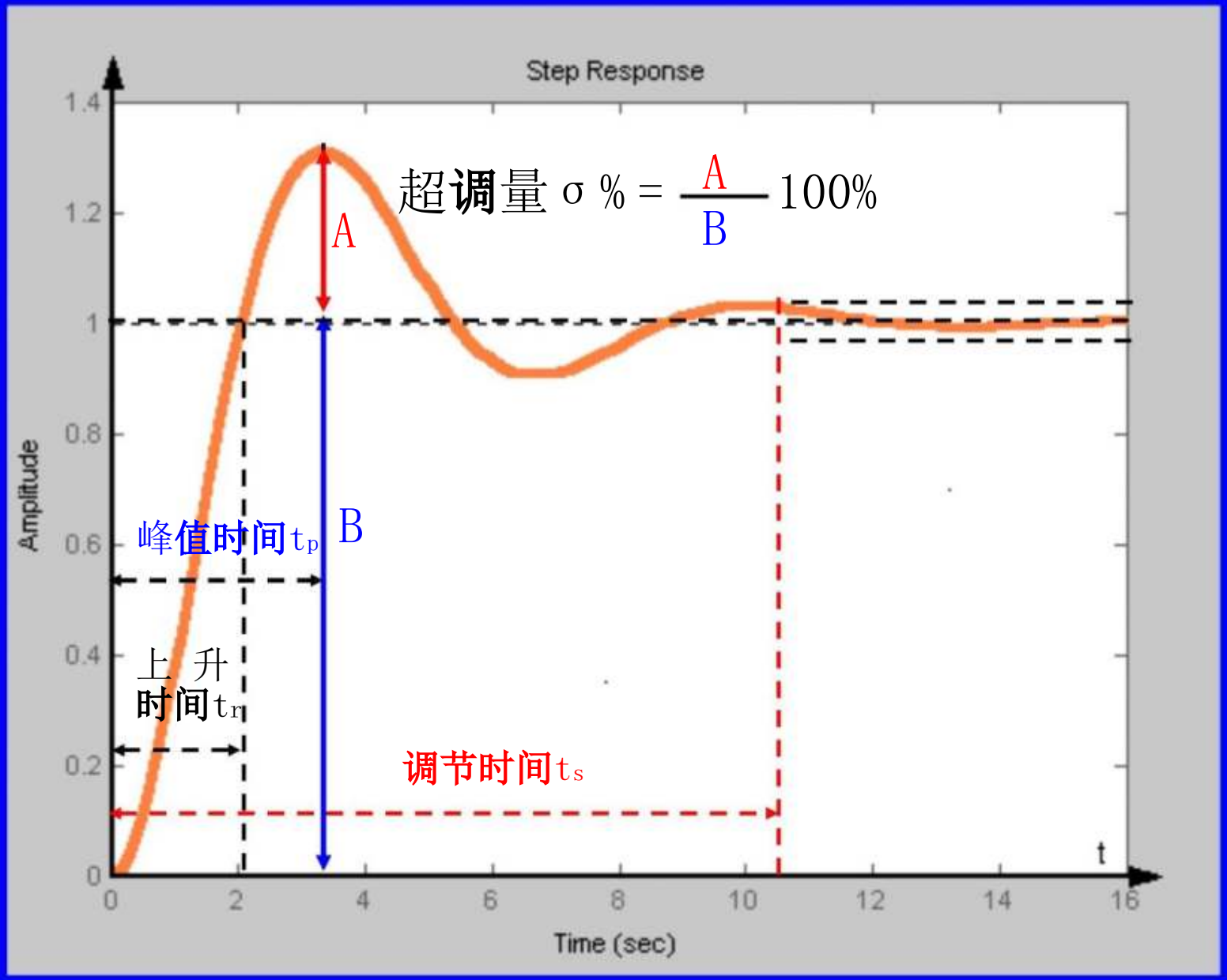
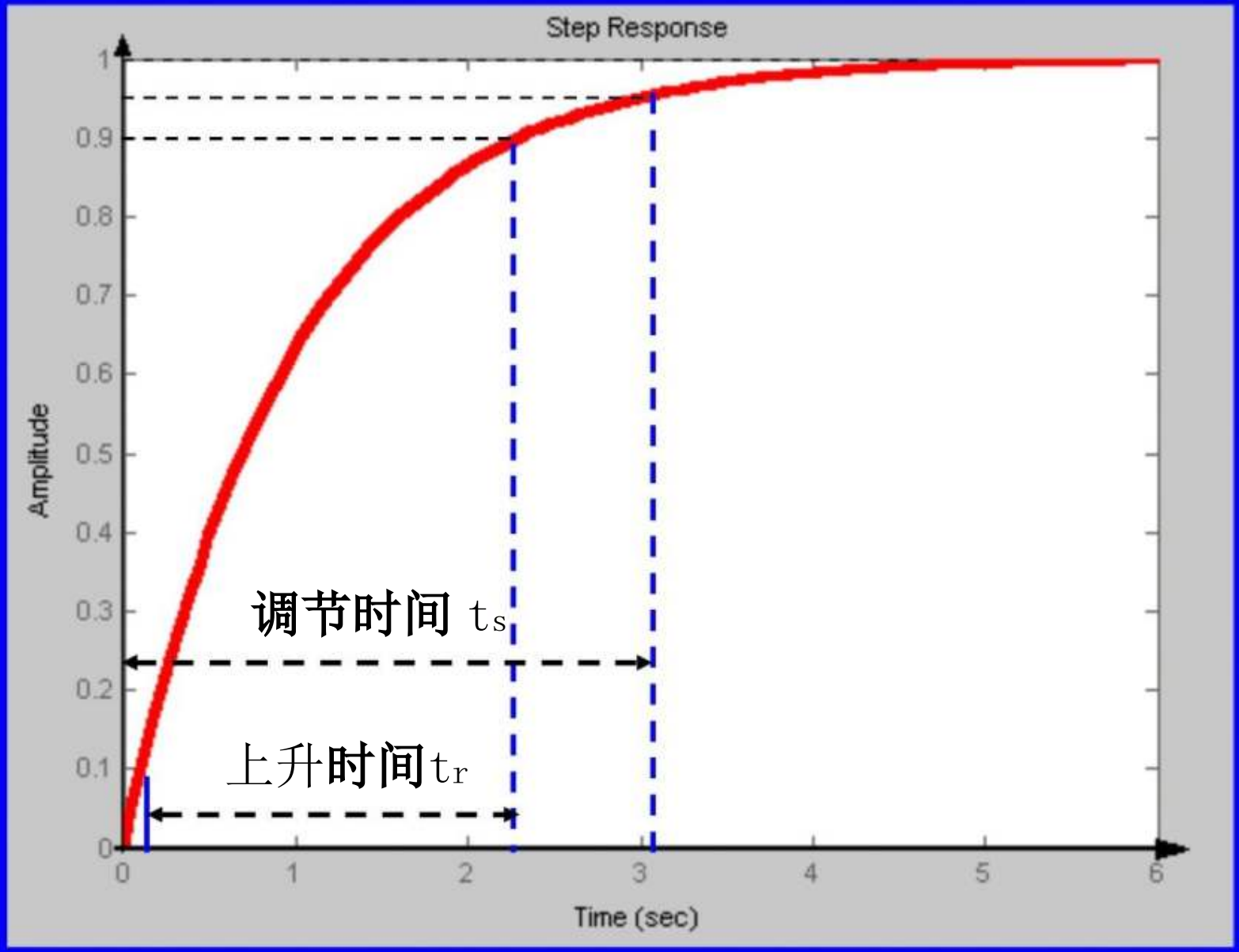
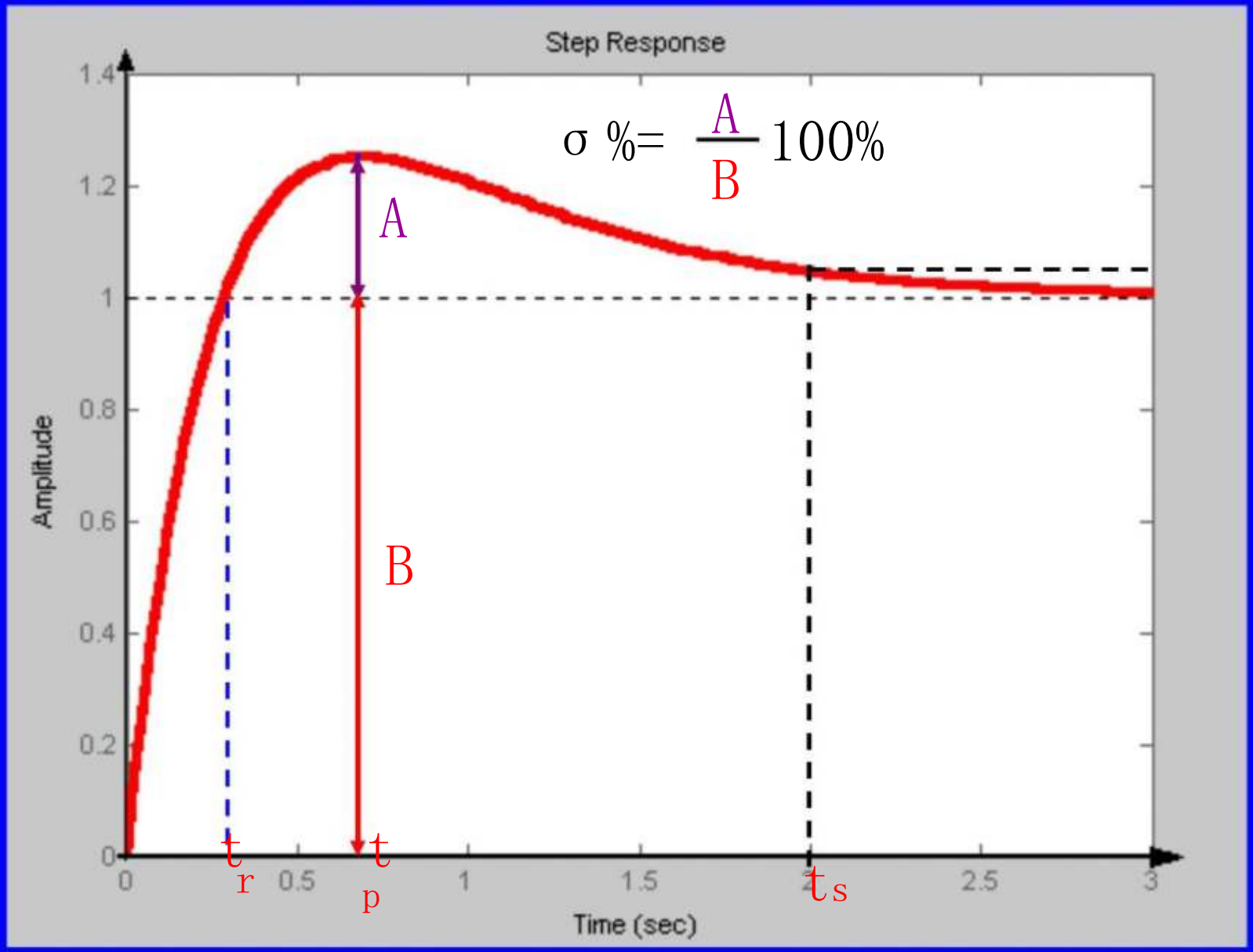
动态性能指标定义1


Step Response
超调量 σ % = A/B 100%
A
B
峰值时间 t_p
上 升
时间 t_r
调节时间 t_s
Amplitude
Time (sec)
t
0
0.2
0.4
0.6
0.8
1
1.2
1.4
0
2
4
6
8
10
12
14
16

动态性能指标定义2


Step Response
Amplitude
Time (sec)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
1
2
3
4
5
6
调节时间 ts
上升时间tr

动态性能指标定义3


Step Response
σ %= A/B 100%
A
B
Amplitude
Time (sec)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
0
0.5
1
1.5
2
2.5
3
t r
t p
t s

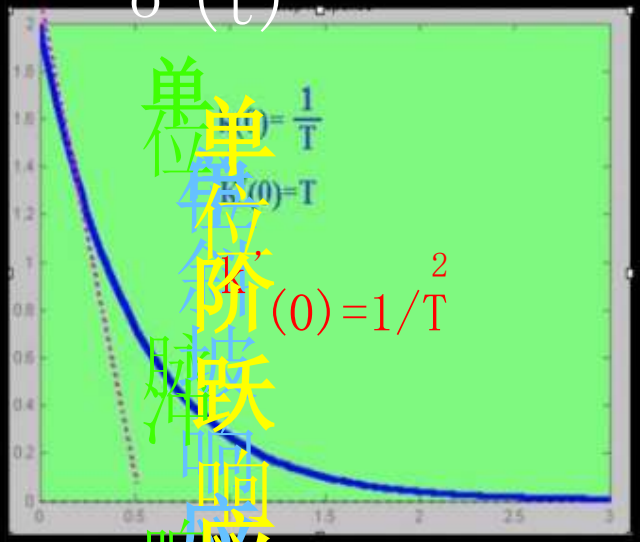
一阶系统时域分析

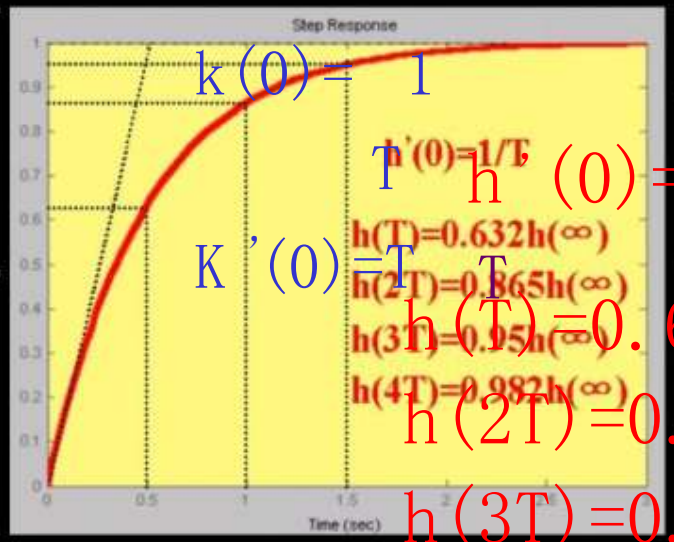
无零点的一阶系统 $\Phi(s)=\frac{k}{Ts+1}$，$\frac{T}{}$ （画图时取 时间常数

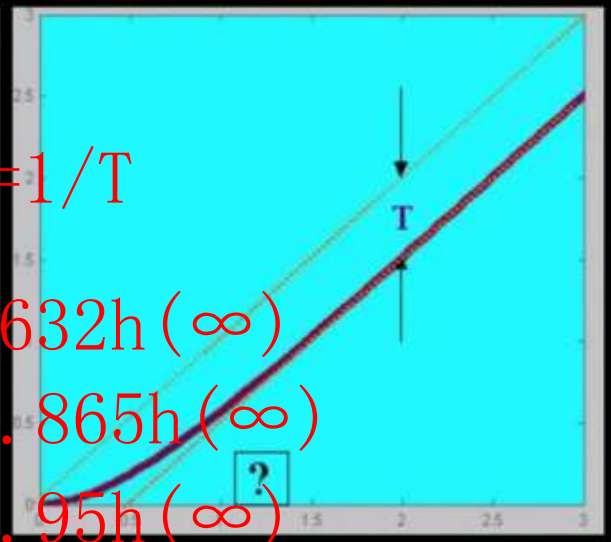
k=1, T=0.5)

$k(t)=\frac{1}{T}e^{-\frac{t}{T}}$　　$h(t)=1-e^{-t/T}$　　$c(t)=t-T+Te^{-t/T}$

$r(t)=\delta(t)$　　$r(t)=1(t)$　　$r(t)=t$







单位脉冲响应

$k(0)=\frac{1}{T}$

$h'(0)=1/T$

$K'(0)=T^2$

$h'(0)=1/T$

$h(T)=0.632h(\infty)$

$h(2T)=0.865h(\infty)$

$h(3T)=0.95h(\infty)$

$h(4T)=0.982h(\infty)$

问应

1 、3个图各如何求T？

2、调节时间 t_s =？

3 、$r(t)=at$时，e_{ss} =？

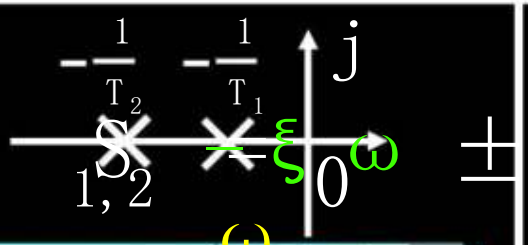
4、求导关系？

二阶系统单位阶跃响应
定性分析

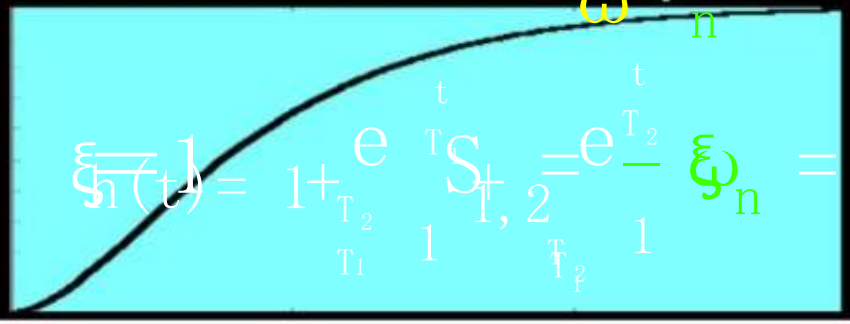
$$\Phi(s)=\frac{\omega_n^2}{s^2+2\xi\omega_n s+\omega_n^2}$$

$\xi>1$：

$$S_{1,2}=-\xi\omega_n\pm\omega_n\sqrt{\xi^2-1}=-\frac{1}{T_2},-\frac{1}{T_1}$$

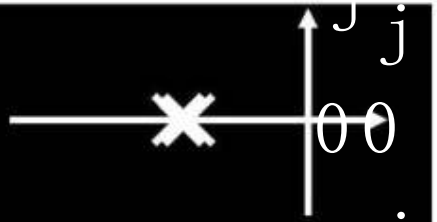


$$h(t)=1+\frac{1}{T_1-T_2}\left(T_2e^{-\frac{t}{T_2}}-T_1e^{-\frac{t}{T_1}}\right)$$

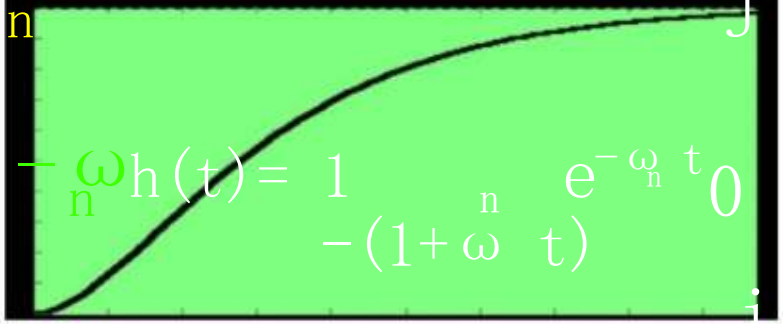


$\xi=1$：

$$S_{1,2}=-\xi\omega_n=-\omega_n$$

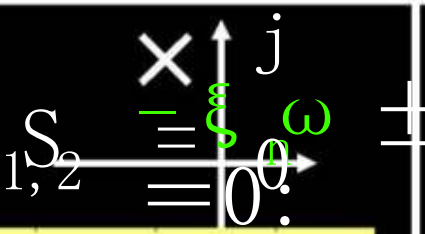


$$h(t)=1-e^{-\omega_n t}-\omega_n te^{-\omega_n t}=1-e^{-\omega_n t}(1+\omega_n t)$$

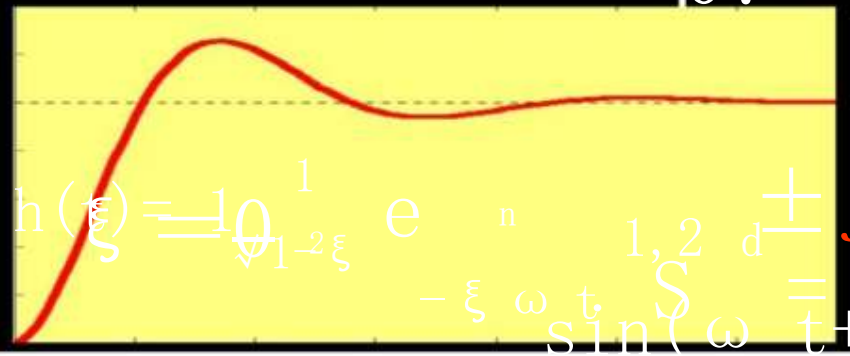


$0<\xi<1$：

$$S_{1,2}=-\xi\omega_n\pm j\omega_n\sqrt{1-\xi^2}$$

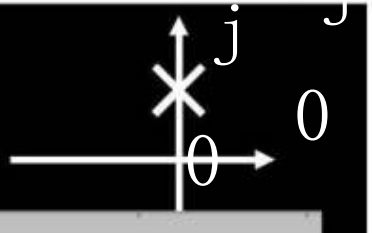


$$h(t)=1-\frac{1}{\sqrt{1-\xi^2}}e^{-\xi\omega_n t}\sin(\omega_d t+\beta)$$

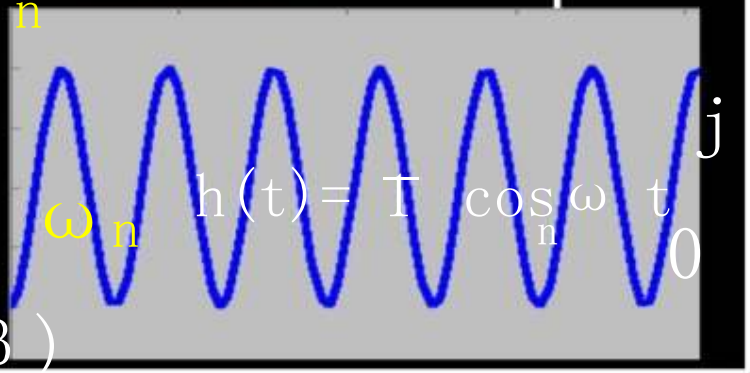


$\xi=0$：

$$S_{1,2}=\pm j\omega_n$$



$$h(t)=1-\cos\omega_n t$$



欠阻尼二阶系统动态性能分析与计算

$$h(t)=1-\frac{1}{\sqrt{1-\xi^2}}e^{-\xi\omega_n t}\sin(\omega_d t+\beta)$$

$$\omega_d=\omega_n\sqrt{1-\xi^2}$$

$$\Phi(s)=\frac{\omega_n^2}{s^2+2\xi\omega_n s+\omega_n^2}$$

$$\beta=\arctan\frac{\sqrt{1-\xi^2}}{\xi}$$

令h(t)=1取其解中的最小值，

$-\xi\omega_n h(t)$ 一阶导数

，取其解中的最小值，

得 $t_r=\frac{\pi-\beta}{\omega_d}$

得 $t_p=\frac{\pi}{\omega_d}=\frac{\pi}{\omega_n\sqrt{1-\xi^2}}$

$$S_{1,2}=-\xi\omega_n\pm j\omega_n\sqrt{1-\xi^2}$$

由 $\sigma\%=\frac{h(t_p)-h(\infty)}{h(\infty)}100\%$

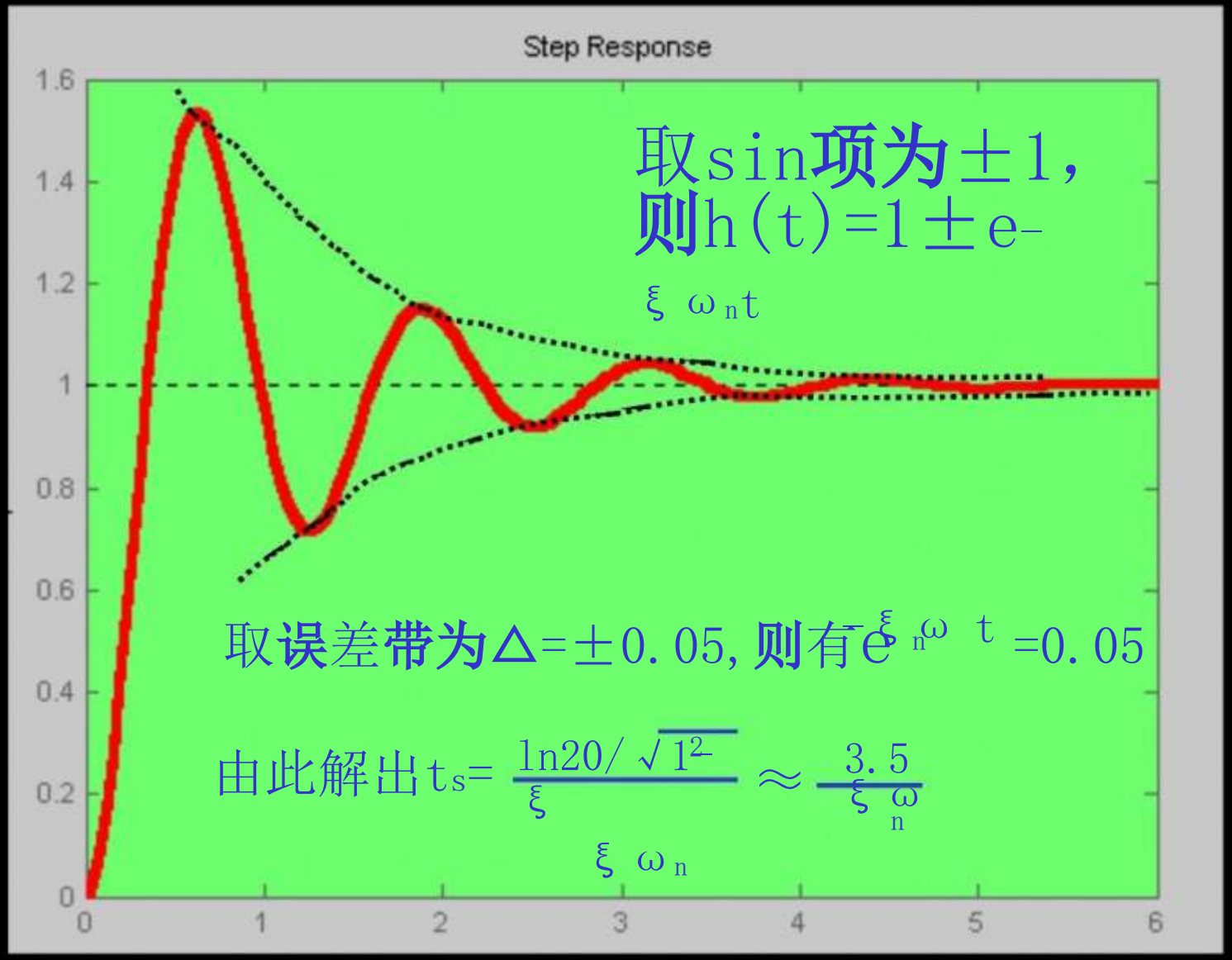
$$h(t)=1-\frac{1}{\sqrt{1-\xi^2}}e^{-\xi\omega_n t}\sin(\omega_d t+\beta)$$

得 $\sigma\%=e^{-\pi\xi/\sqrt{1-\xi^2}}100\%$

由包络线求调节时间

得 $t_s\approx\frac{3.5}{\xi\omega_n}$

欠阻尼二阶系统的t_s



取sin项为±1，则$h(t)=1\pm e^{-\xi\omega_n t}$

取误差带为$\Delta=\pm 0.05$，则有$e^{-\xi\omega_n t}=0.05$

由此解出$t_s=\dfrac{\ln 20/\sqrt{1^2-\xi^2}}{\xi\omega_n}\approx\dfrac{3.5}{\xi\omega_n}$

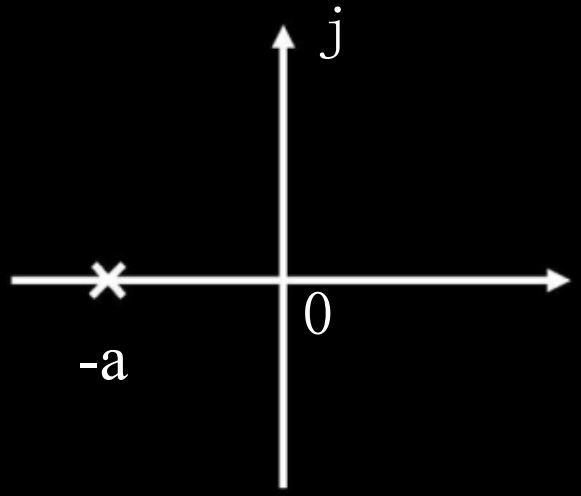
运动模态1

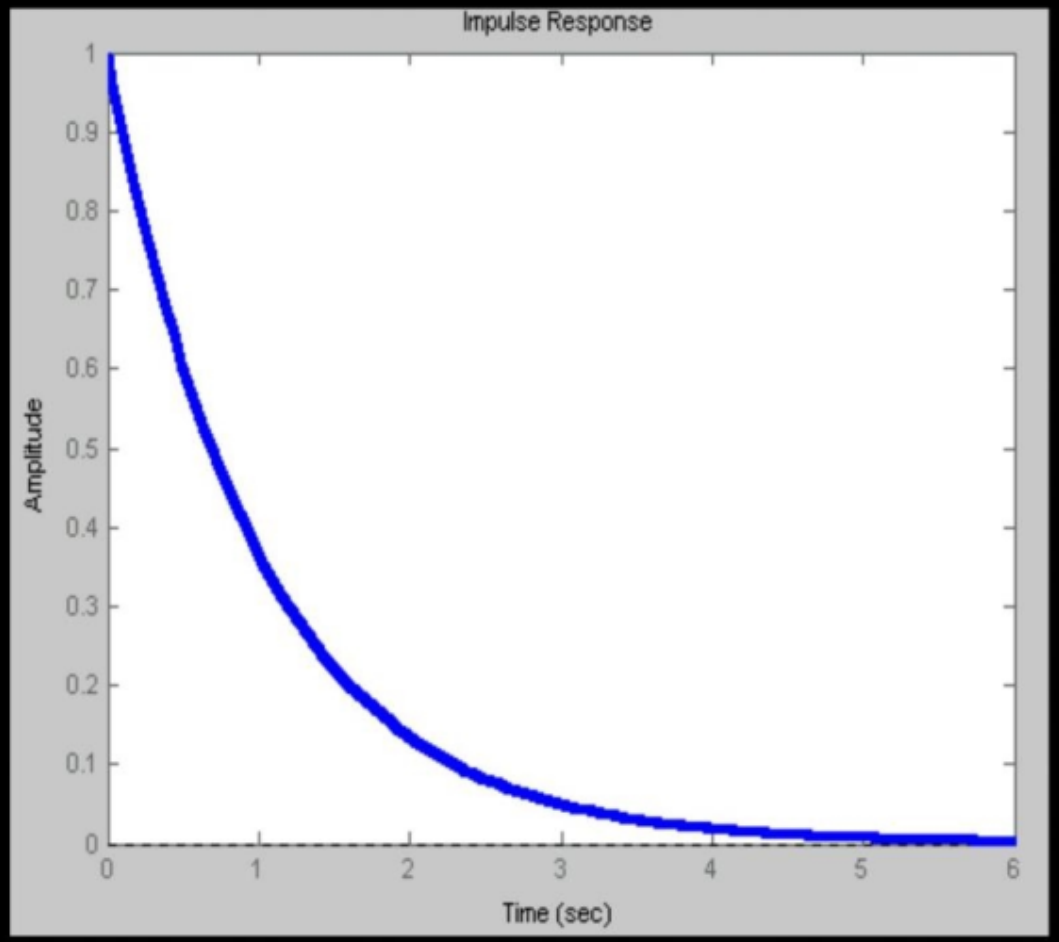
传递函数：

$$\Phi(s)=\frac{A}{S+a}$$

$$K(t)=Ae^{-at}$$

零极点分布图：





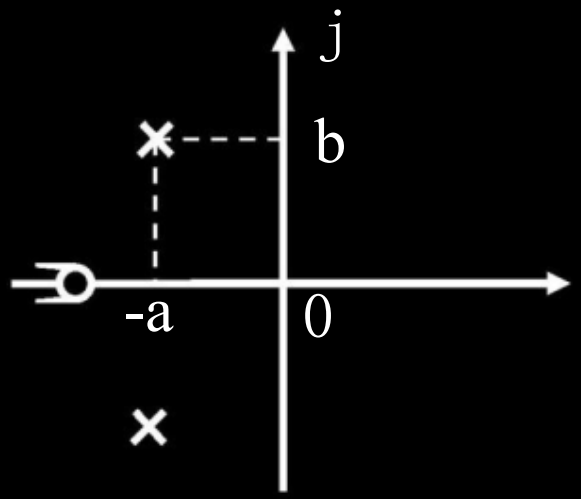
运动模态2

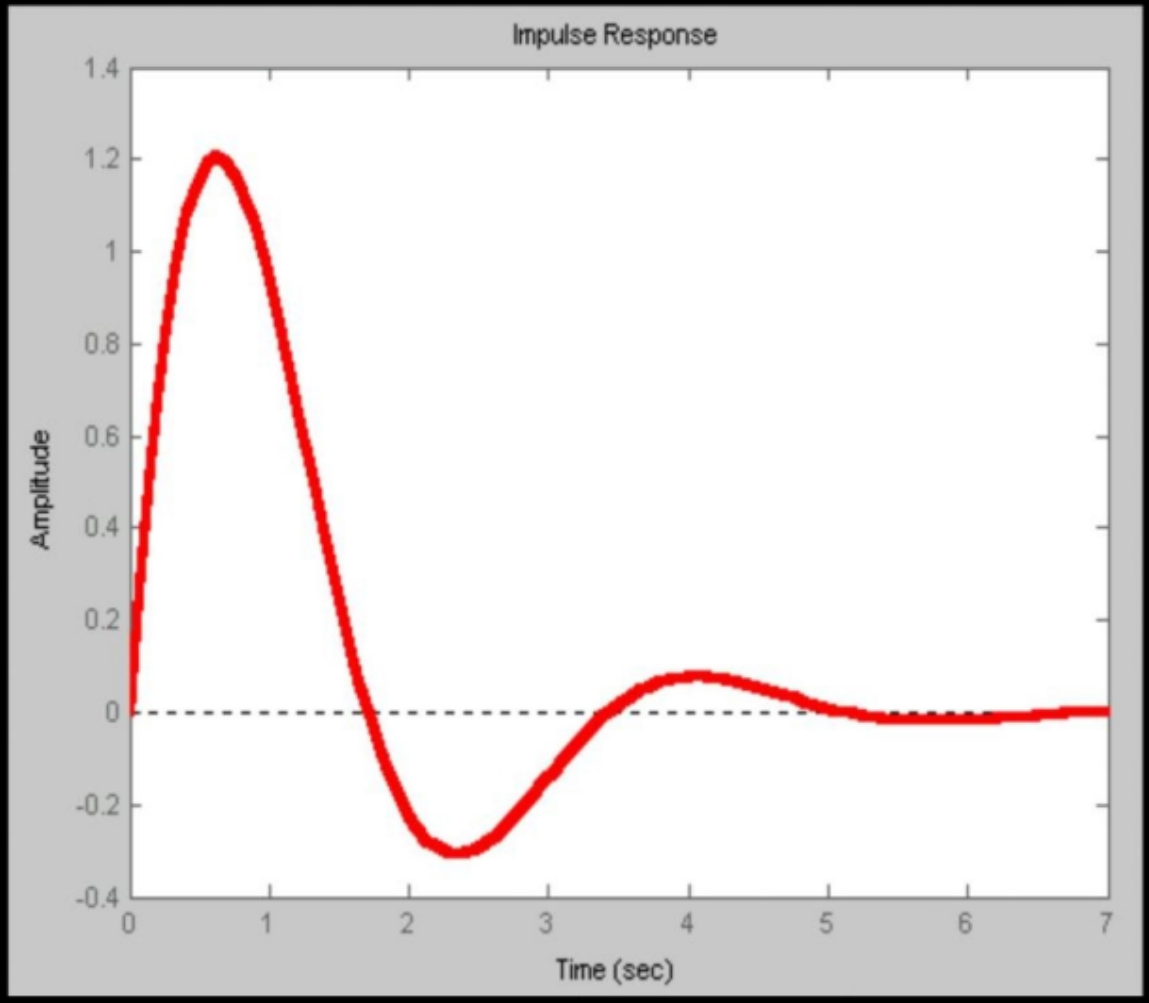
传递函数：

$$\Phi(s)=\frac{A_1 s+B_1}{(S+a)^2+b^2}$$

$$K(t)=Ae^{-at}\sin(bt+\alpha)$$

零极点分布图：





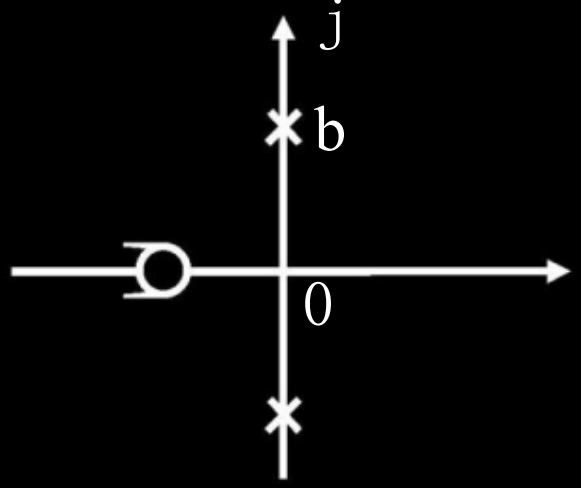
运动模态3

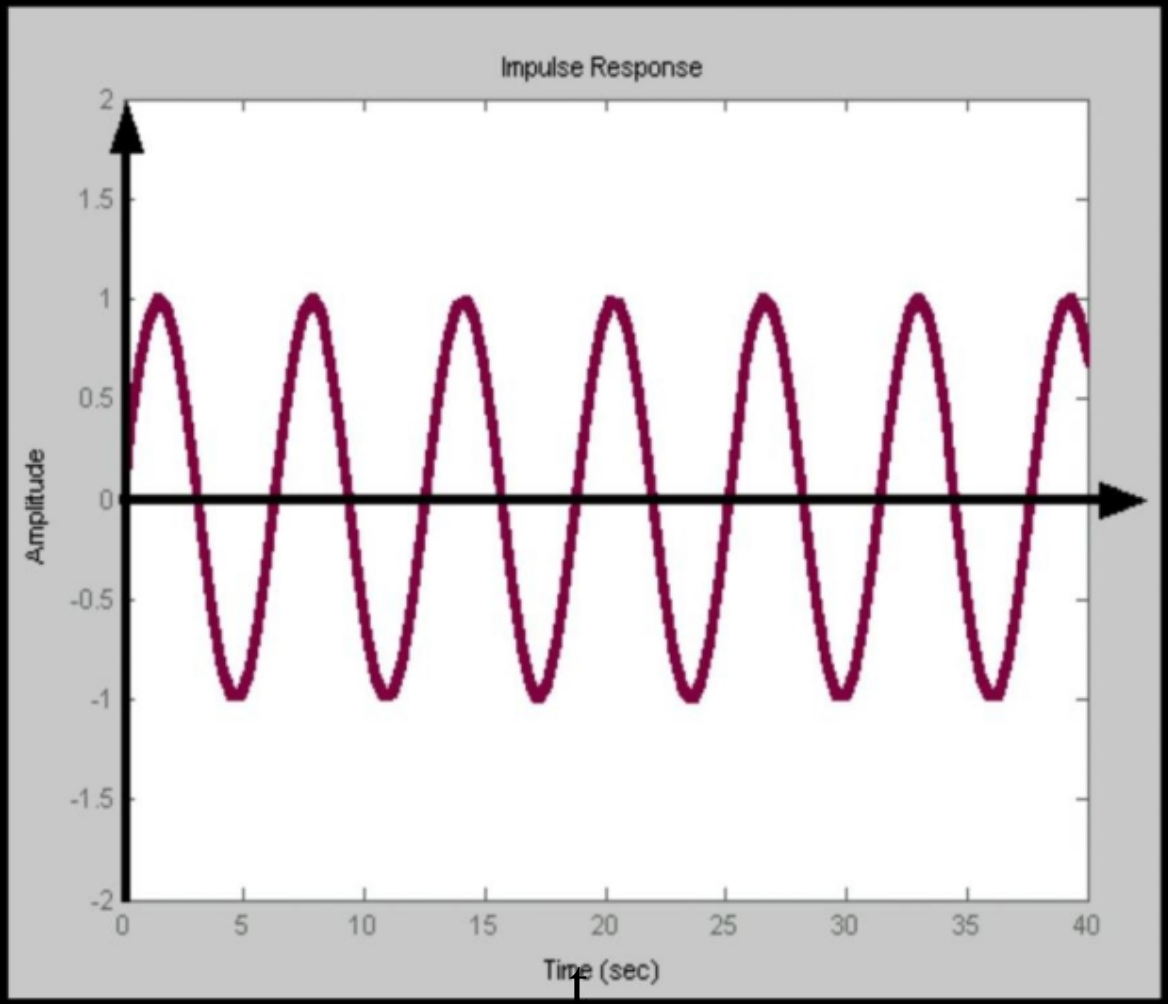
传递函数：

$$\Phi(s)=\frac{A_1 s+B_1}{s^2+b^2}$$

$$K(t)=A\sin(bt+\alpha)$$

零极点分布图：



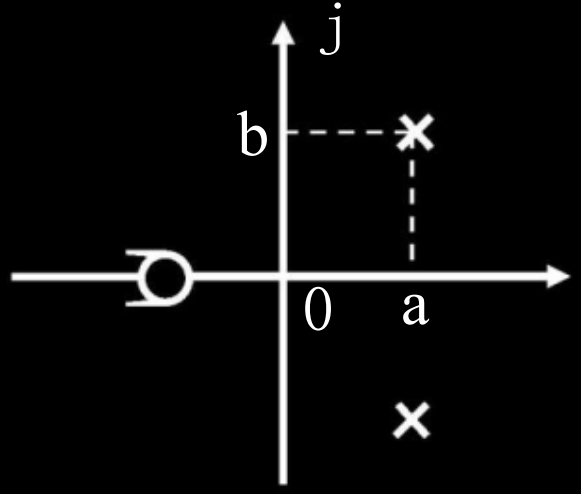


运动模态4

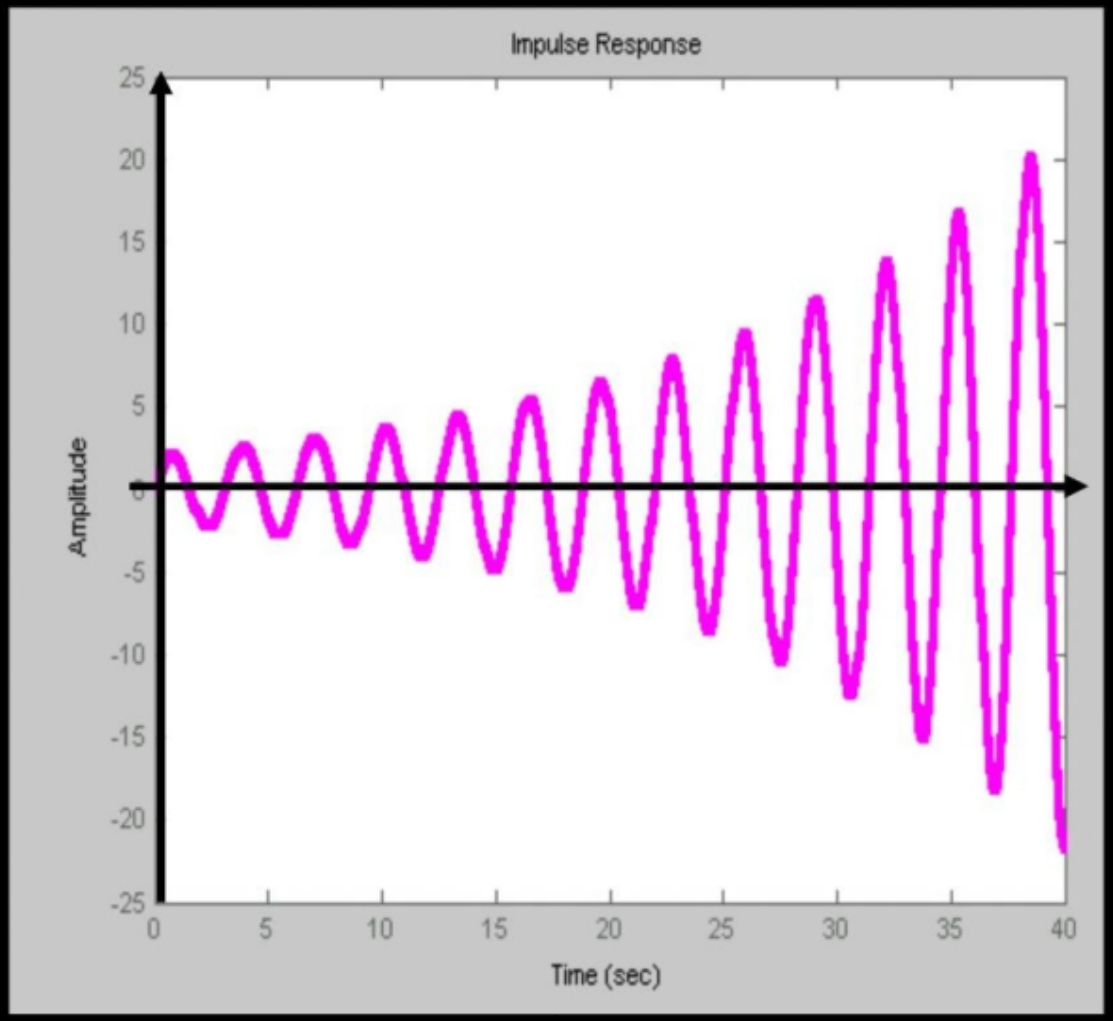
传递函数：

$$\Phi(s)=\frac{A_1 s+B_1}{(S-a)^2+b^2}$$

零极点分布图：



$$K(t)=Ae^{at}\sin(bt+\alpha)$$



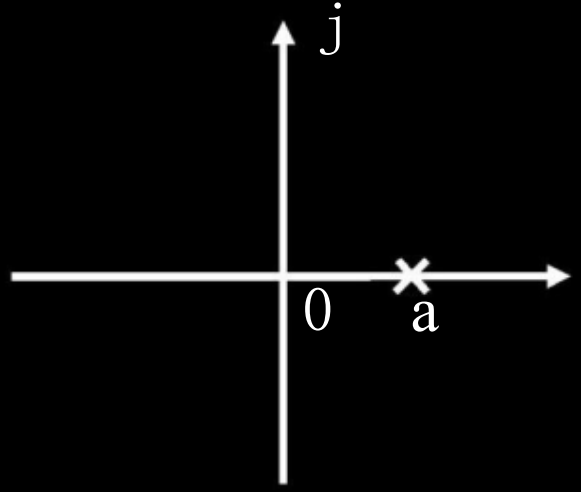
运动模态5

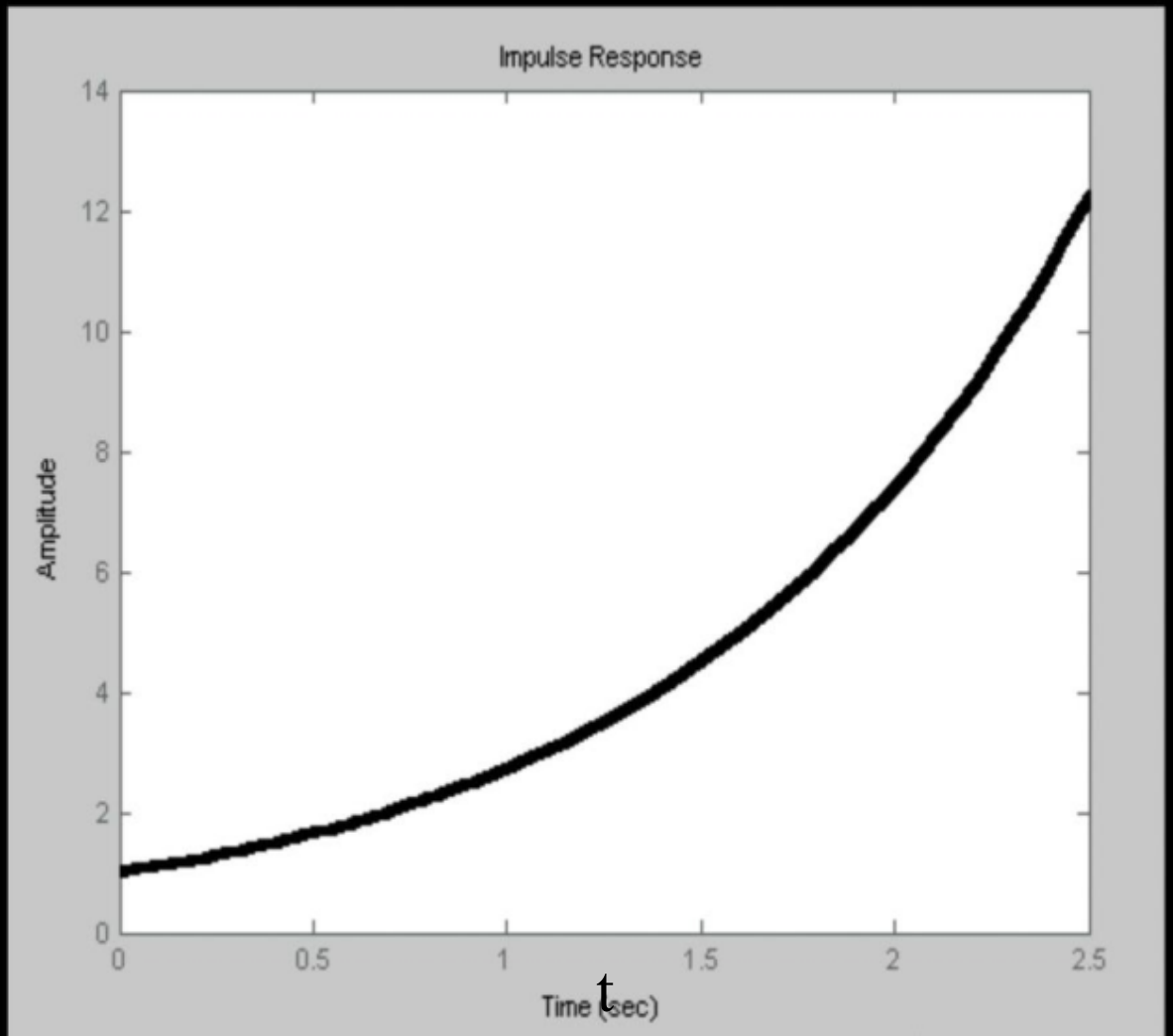
传递函数：

$$\Phi(s)=\frac{A}{S-a}$$

$$K(t)=Ae^{at}$$

零极点分布图：





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