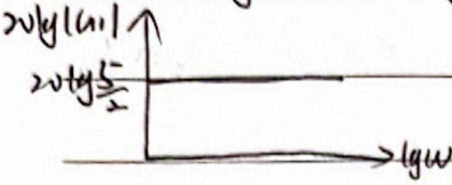
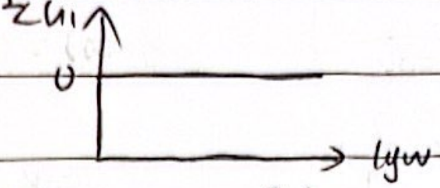
1、 $G(s)=\dfrac{5(s+1)}{s(2s+1)(s^2+2s+2)}$

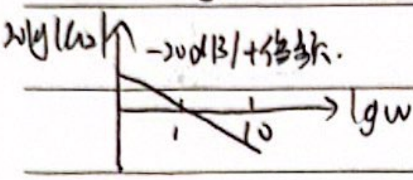
$G(j\omega)=\dfrac{5}{2}\cdot\dfrac{1}{j\omega}\cdot\dfrac{1}{2j\omega+1}\cdot\dfrac{1}{\frac{(j\omega)^2}{2}+j\omega+1}\cdot(1+j\omega)$ 分别记为 $G_1\sim G_5$.

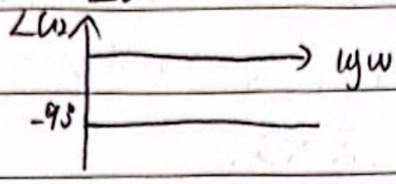
G_1: $20\lg|G_1| = 20\lg\frac{5}{2}$, $\angle G_1=0$



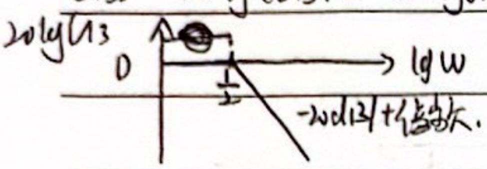


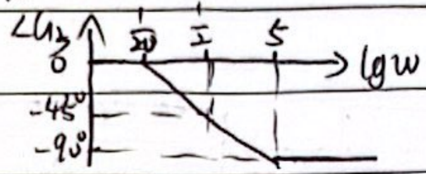
G_2: $20\lg|G_2| = -20\lg\omega$. $\angle G_2 = -90°$



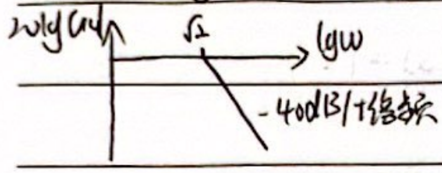


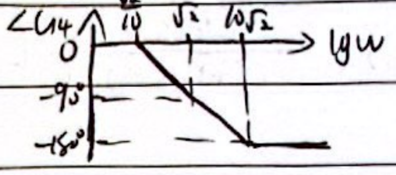
G_3: $20\lg|G_3| = -20\lg\sqrt{1+4\omega^2}$. $\angle G_2 = -\tan^{-1}2\omega$



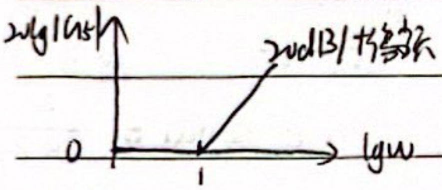


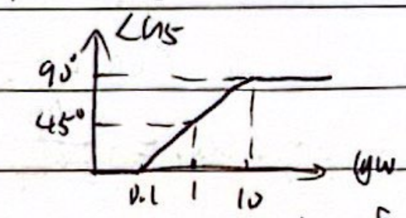
G_4: $20\lg|G_4|$. ~~$\omega_n=1,\ \xi=\frac{1}{\sqrt{2}}$~~. $\omega_n=\sqrt{2}$, $\xi=\frac{\sqrt{2}}{2}$. 不用修正



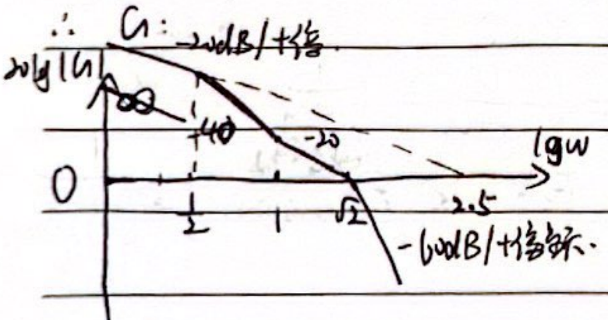


G_5: $20\lg|G_5| = 20\lg\sqrt{1+\omega^2}$. $\angle G_5 = \tan^{-1}\omega$.

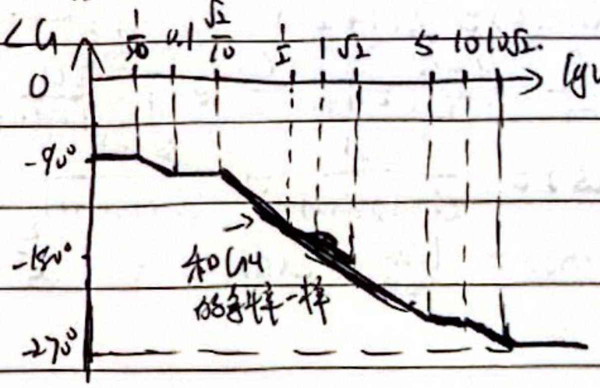




∴ G:



在$\omega=\sqrt{2}$时. $20\lg|G|\approx 0$. 但>0



增益裕度：当 $\omega=\sqrt{2}$ 时，$\angle G<-180^\circ$，而 $20\lg|G|>0$

根据趋势，增益裕度 <0，~~matlab~~ matlab跑出来 $-1.10dB$

相位裕量：同理 相位裕量 <0，-4.61°

这个系统不稳定.

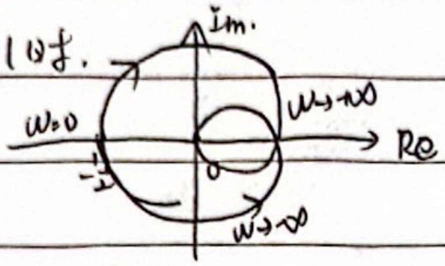
2. $G(s)=\frac{K(s-1)}{(2s+1)(s+1)(s+2)}$. $K=1$. $K=10$. , $HGH=HG$.

$G(j\omega)=K\frac{(j\omega-1)}{(j\omega+1)(2j\omega+1)(j\omega+2)}$, Δ ~~Re~~ $G(0)=-\frac{K}{2}$

$|G|=K\frac{1}{\sqrt{1+4\omega^2}}\frac{1}{\sqrt{\omega^2+4}}$, $\omega: 0^+\to\infty \Rightarrow |G|: \frac{K}{2}\to 0$

$\angle G=-2\tan^{-1}\omega-\tan^{-1}2\omega-\tan^{-1}\frac{\omega}{2}$.

K=1时.



$P=0$. $N=0$ ∴ $Z=0$, 系统稳定.

K=10时. 图象类似, 但在 -5 开始, $P=0$. $N=1$, $Z=1$ ∴ 系统不稳定 (~~系统稳定~~).

3、

(1) 校正前

很显然，$\omega \to 0$ 时，$G(j\omega) = \frac{K}{j\omega}$，$20\lg|G| = 20\lg|K| - 20\lg\omega$

$\therefore K = 10^{1.3}$，$\omega_1 = 2$，$\cancel{\omega_2 = 4}$，存在一个 $\frac{1}{1+j\frac{\omega}{2}}$

$\therefore G(j\omega) = 10^{1.3}\frac{1}{j\omega}\cdot\frac{1}{1+j\frac{\omega}{2}} \Rightarrow G(s) = 10^{1.3}\frac{2}{s(s+2)}$

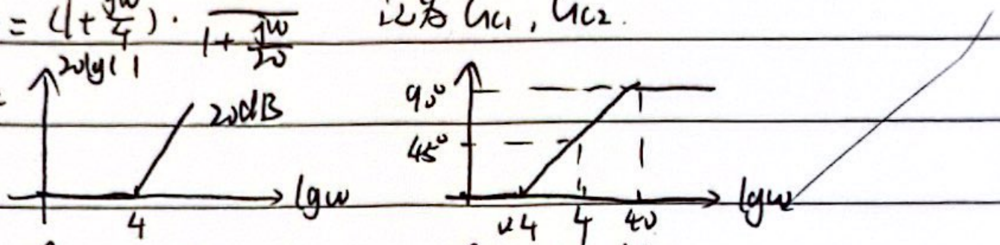
校正后，多了个 $\omega_2 = 4$，$\omega_3 = 20$，存在 $(1+j\frac{\omega}{4})$，和 $\frac{1}{1+j\frac{\omega}{20}}$

$\therefore G'(s) = 10^{1.3}\frac{2}{s(s+2)}\cdot\cancel{\frac{20+5s}{20+s}}\ \frac{20+5s}{20+s}$

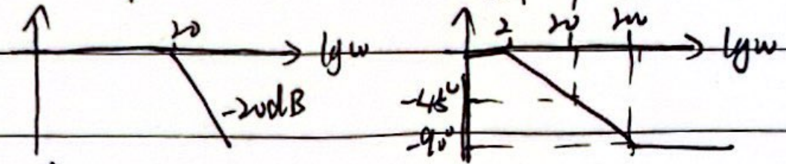
(2) $G_c(s) = \frac{1+\frac{s}{4}}{1+\frac{s}{20}} = (1+\frac{s}{4})/(1+\frac{s}{20})$

$G_c(j\omega) = (1+\frac{j\omega}{4})\cdot\frac{1}{1+\frac{j\omega}{20}}$　记为 G_{c1}，G_{c2}

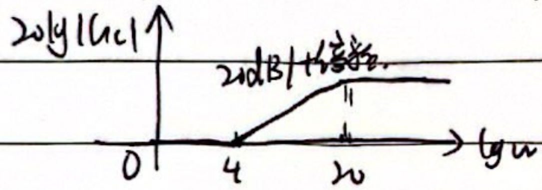
G_{c1}：



G_{c2}：



$\therefore$



特点：超前校正，提供正的相角 ~~并且在高频处会~~ 增大了增益交界频率.

利用上面两个特性，提高了相位裕量，系统更稳定，瞬态指标提升

(3) $K_v = \lim_{s\to 0} sG(s)$

之前：$K_v = \lim_{s\to 0} s\,10^{1.3}\frac{2}{s(s+2)} = 10^{1.3}$

之后：$K_v = \lim_{s\to 0} s\,10^{1.3}\frac{2}{s(s+2)}\cdot\frac{20+5s}{20+s} = 10^{1.3}$