TP & IMP Final Remarks

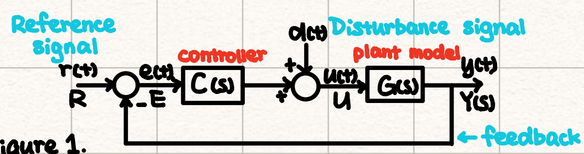


Figure 1.

Find: $E(s) = \frac{1}{1+CG}\cdot R(s) - \frac{G}{1+CG}\cdot D(s) = \frac{1}{1+\underbrace{\frac{2s+1}{s}}_{\text{if "K" used}}\cdot\frac{1}{s(s+1)}}\cdot\frac{r_0}{s} - \frac{\frac{1}{s(s+1)}}{1+\underbrace{\frac{2s+1}{s}}_{K}\cdot\frac{1}{s(s+1)}}\cdot\frac{d_0}{s} = \frac{s^2(s+1)}{s^3+s^2+2s+1}\cdot\frac{r_0}{s} - \frac{s}{s^3+s^2+2s+1}\cdot\frac{d_0}{s}$

$E(s) = \frac{s(s+1)}{(\cdots poly)}\cdot r_0 - \frac{1}{(poly)}\cdot d_0$; for any $r(t)$ $d(t)$ in the class of ref. dist.

poles of $E(s) \in$ OLHP $\Rightarrow$ can use FVT

$e(\infty) = \lim_{s\to 0} s.E(s) = \lim_{s\to 0} \frac{s^2(s+1)}{(poly)}\cdot r_0 - \frac{s}{(poly)}\cdot d_0 = 0$, $\forall r(t), d(t) \Rightarrow$ TP is resolved

if "K" controller used $e(\infty) = 0 - \frac{d_0}{poly(0)} \neq 0$ (finite) $d(t)$ is not rejected

$\Rightarrow$ shows that (iii) cond. in IMP is necessary. $C(s)$ has to have all $D(s)$ poles

Note: (ii), (iii) say "including multiplicity"

e.g: $R(s) = \frac{1}{s^3}$; $D(s) = \frac{1}{s^2}$

By (ii) C·G has to have poles at $s=0$ (3^{rd} order multiplicity) $\Rightarrow \frac{1}{s^3}$ factor

By (iii) C itself has to have: $\frac{1}{s^2}$ factor

Consider:

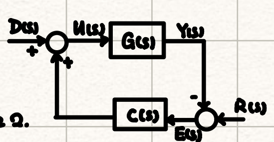
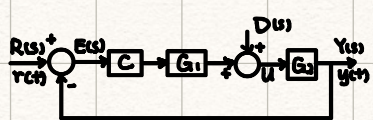


Figure 2.

Solve TP for given $G(s), R(s), D(s)$

Figure 1 & 2 are the same!

Given G_1, G_2



Let $\tilde{C}(s) = C\cdot G_1 \Rightarrow$ find $\tilde{C}$ by IMP, apply FVT, Routh, find C

Note: what if we want not necessarily perfect tracking. (e.g $d(t) \equiv 0$) but $e(\infty) \leq 0.01$, $\forall r(t)$ in the class

Try $C(s) = K$, use FVT: $e(\infty) = \lim_{s\to 0} s\cdot E(s)$

Alternative criteria to check feedback stability instead of Routh : graphical one: Nyquist Criteria

Bode plots

we'll see that : it can be used based on "measurements" of frequency response of system (not necessarily relying on a model)

(i) $\left\{\begin{array}{l}\text{poles of } \frac{1}{1+CG} \in \text{OLHP} \\ \text{(ii) no p/z "unstable" cancellation in C·G}\end{array}\right.$