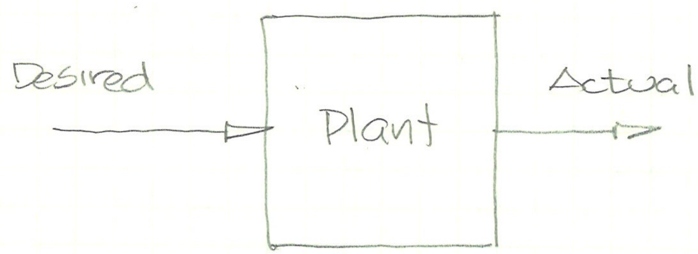
Why We Add Feedback

The model for the ideal system would be one in which my desired output is always my actual output.



(the perfect teenager!)

As previously stated this is not possible for three primary reasons

(1) Plant dyamics (plant cannot track rapid input changes)

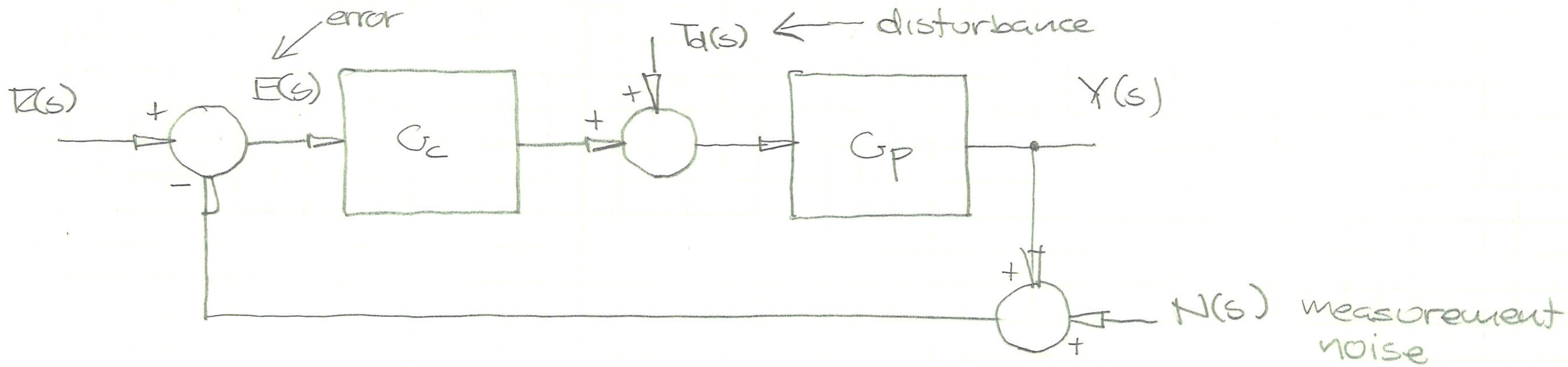
(2) Changes in or unmodeled plant dynamics

(3) External disturbances

ECE/MAE 5310 Superposition + Sensitivity   Chap. 7 & 9 Material

Feedback allows us to 'get closer' to the ideal in many instances.

Given the following feedback system



Let's look at the effect of feedback on

$$\frac{Y(s)}{R(s)} = \frac{G_c G_p}{1+G_c G_p} \qquad \frac{Y(s)}{T_d(s)} = \frac{G_p}{1+G_c G_p} \qquad \frac{Y(s)}{N(s)} = \frac{-G_c G_p}{1+G_c G_p}$$

we want this to close to 1   want this to be small   want this to be small

It appears that if G_c is big in comparison to G_p and 1

$$\frac{Y(s)}{R(s)} \simeq 1 \qquad \frac{Y(s)}{T_d(s)} \text{ is small} \qquad \frac{Y(s)}{N(s)} \simeq 1$$

(what happened?!)
(logical inferences?)

$$Y(s) = \frac{G_cG_p}{1+G_cG_p}R(s) + \frac{G_p}{1+G_cG_p}T_d(s) - \frac{G_cG_p}{1+G_cG_p}N(s)$$

$$E(s) = R(s) - Y(s) = \frac{1+G_cG_p}{1+G_cG_p}R(s) - \frac{G_cG_p}{1+G_cG_p}R(s) - \frac{G_p}{1+G_cG_p}T_d(s) + \frac{G_cG_p}{1+G_cG_p}N(s)$$

true error

$$= \frac{1}{1+G_cG_p}R(s) - \frac{G_p}{1+G_cG_p}T_d(s) + \frac{G_cG_p}{1+G_cG_p}N(s)$$

Define the sensitivity as $S(s) = \frac{1}{1+G_cG_p}$ $\qquad L(s) = G_cG_p$

loop transmission