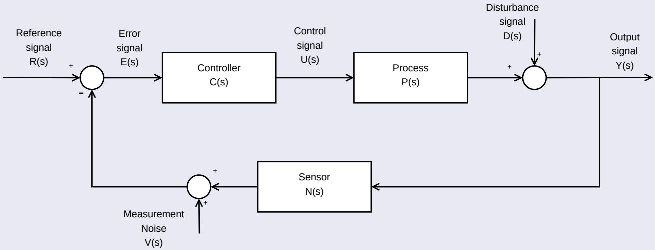
Outline

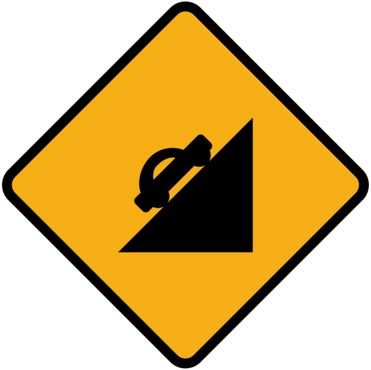
Noise and disturbance rejection

- Measurement noise is often modelled by zero-mean white noise.
- Disturbances are actual changes to the state of the system



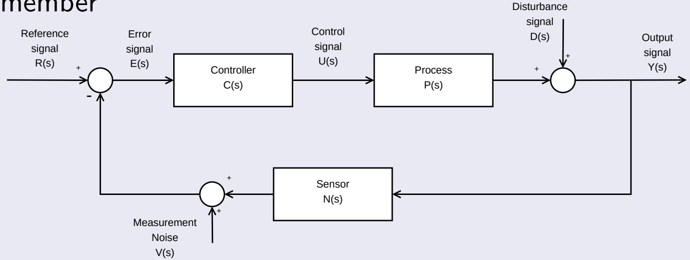
Noise and disturbance rejection

- Cruise control:
  - Measurement errors on the speed are noise
  - A change in slope is a disturbance



Noise and disturbance rejection

- Remember

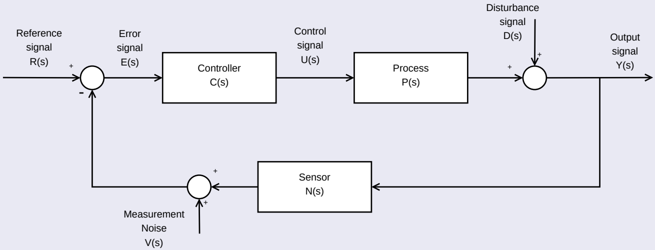


$$Y(s) = \frac{P(s)C(s)}{1+P(s)C(s)}R(s) + \frac{1}{1+P(s)C(s)}D(s)$$

- Setting $M(s) = \frac{1}{1+P(s)C(s)}$ sufficiently small results in the rejection of D. This can be achieved by choosing $C(s)$ sufficiently high.

Noise and disturbance rejection

- What happens to the measurement noise?
  - It will be amplified and applied to the input of the plant which in turn leads to a nervous controller.



Noise and disturbance rejection

- Good disturbance rejection requires fast control actions to bring the system back to the desired state
- Good noise rejection requires slow control actions
- Note that a controller can not see the difference between measurement noise and disturbances. Slow controllers will be less sensitive to measurement noise but fast controllers will have better disturbance rejection

Slow Controllers
Not sensitive to noise
Small control actions

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Fast Controllers
Good disturbance rejection
Fast tracking

Robust Controllers
Model errors will not affect the behaviour of the system strongly

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Aggresive Controllers:
Exchanges robustness for better performance