Adaptive Feedforward Control for Uncertain Linear System

Yang Wang

Supervisor: Prof. T. Parisini

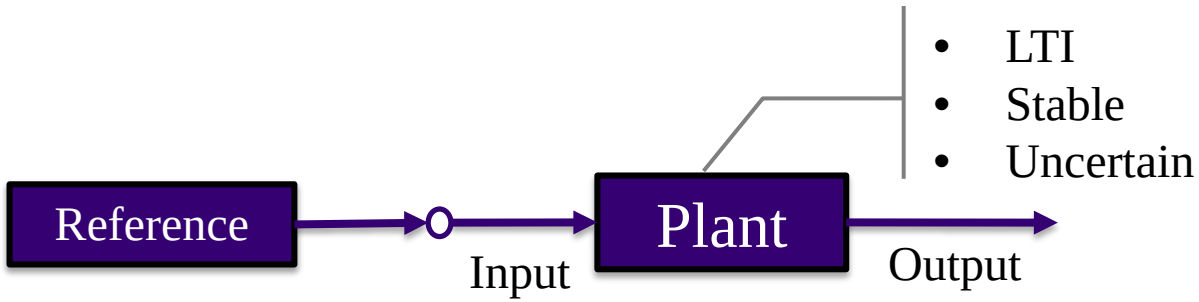
Imperial College London

Imperial College London

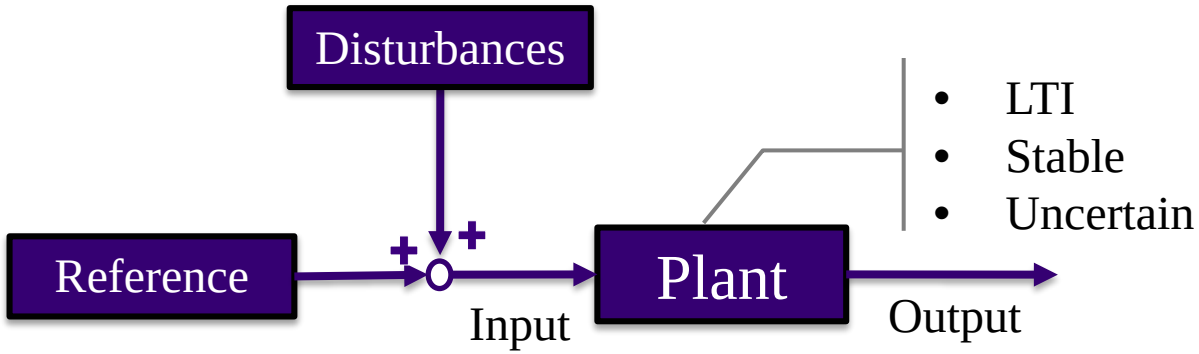
UKACC PhD Presentation Showcase

UKACC

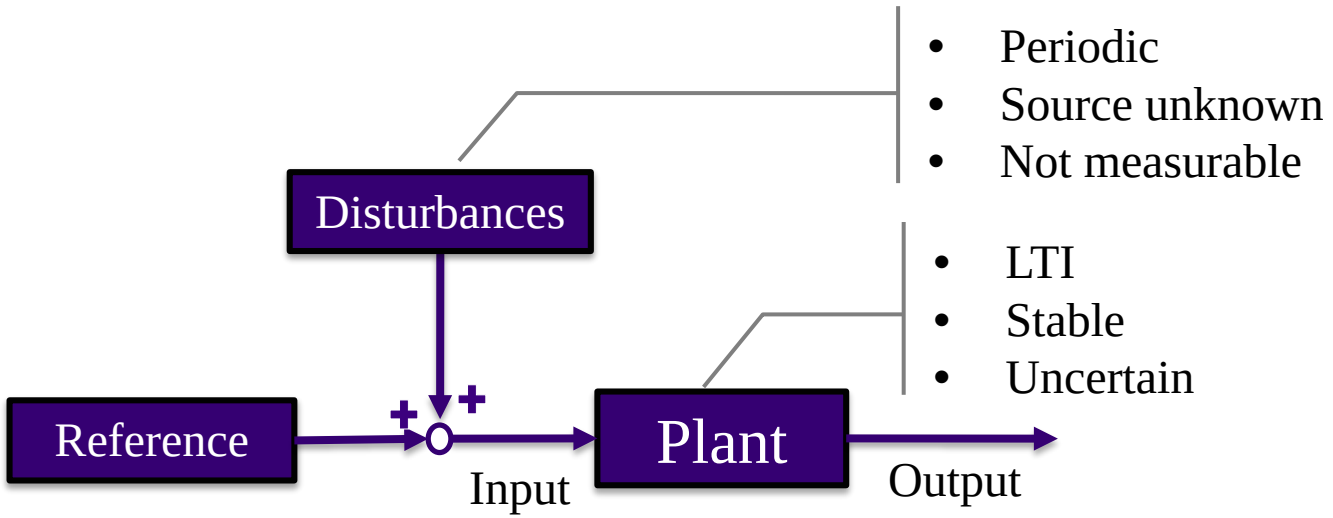
Problem Formulation



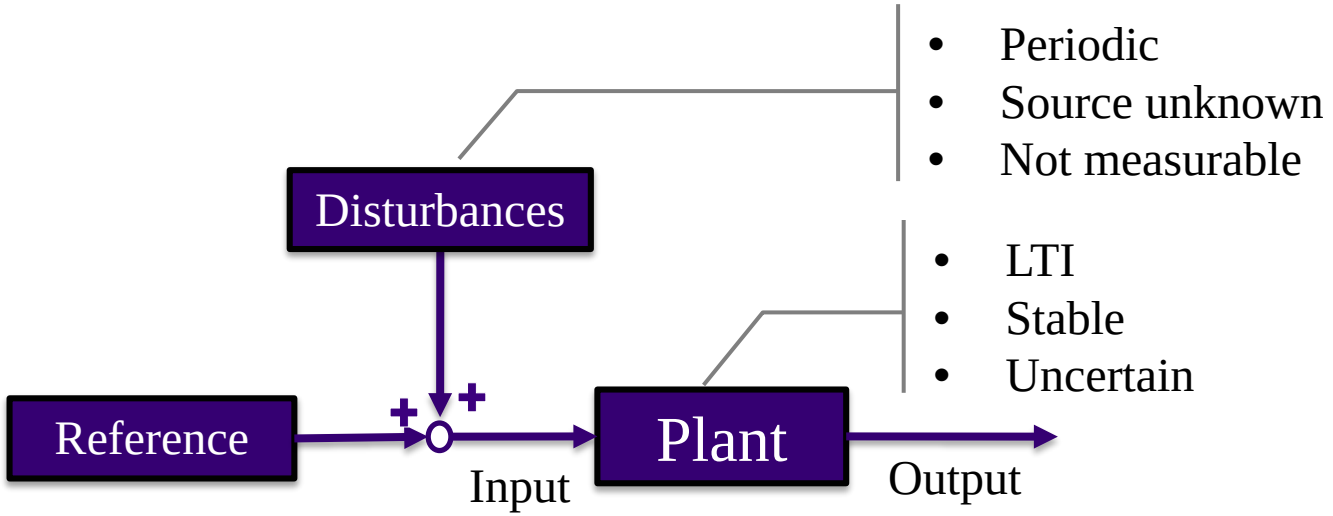
Problem Formulation

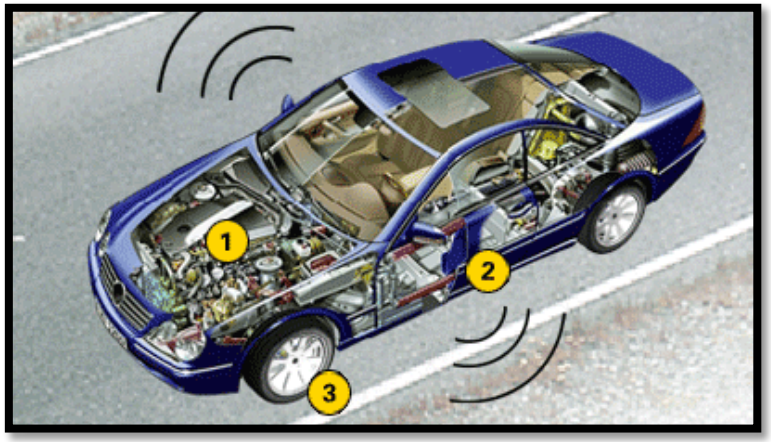


Problem Formulation

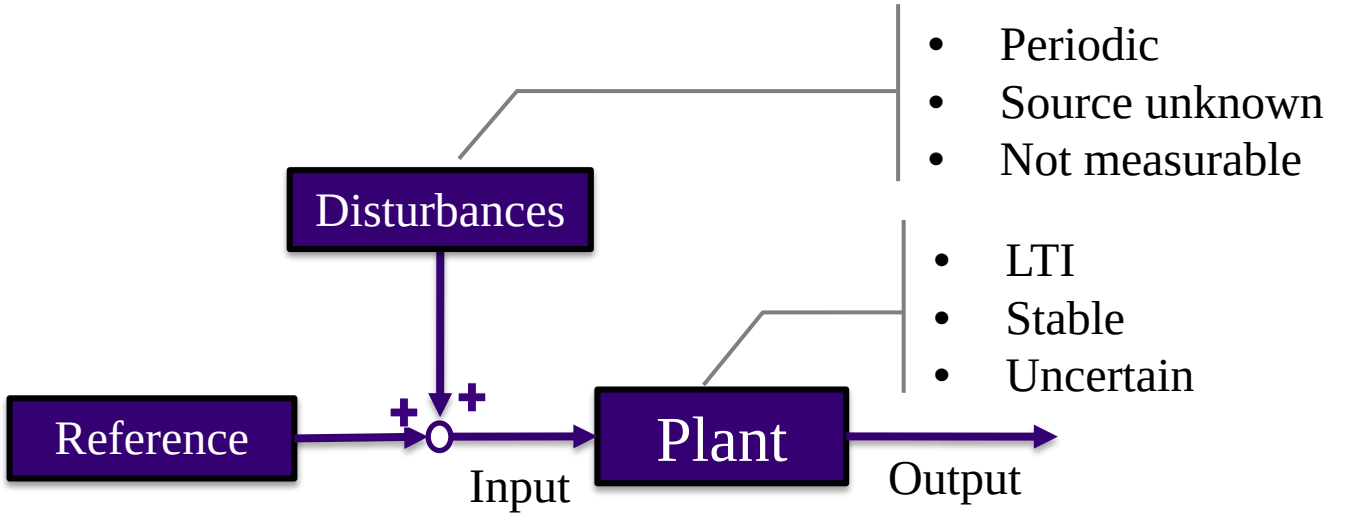


Problem Formulation

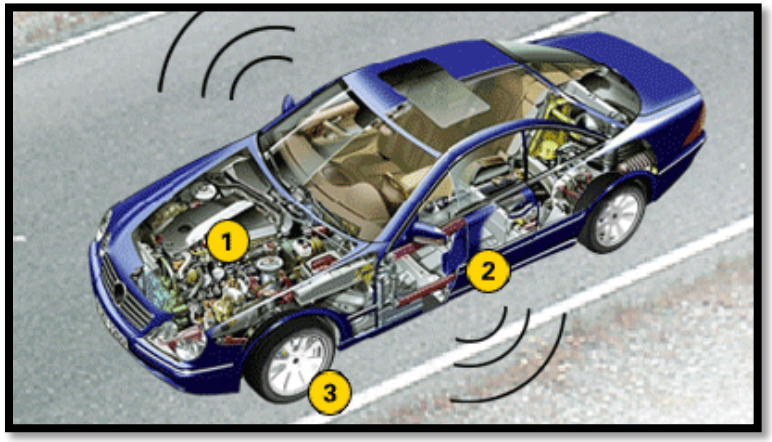




Problem Formulation



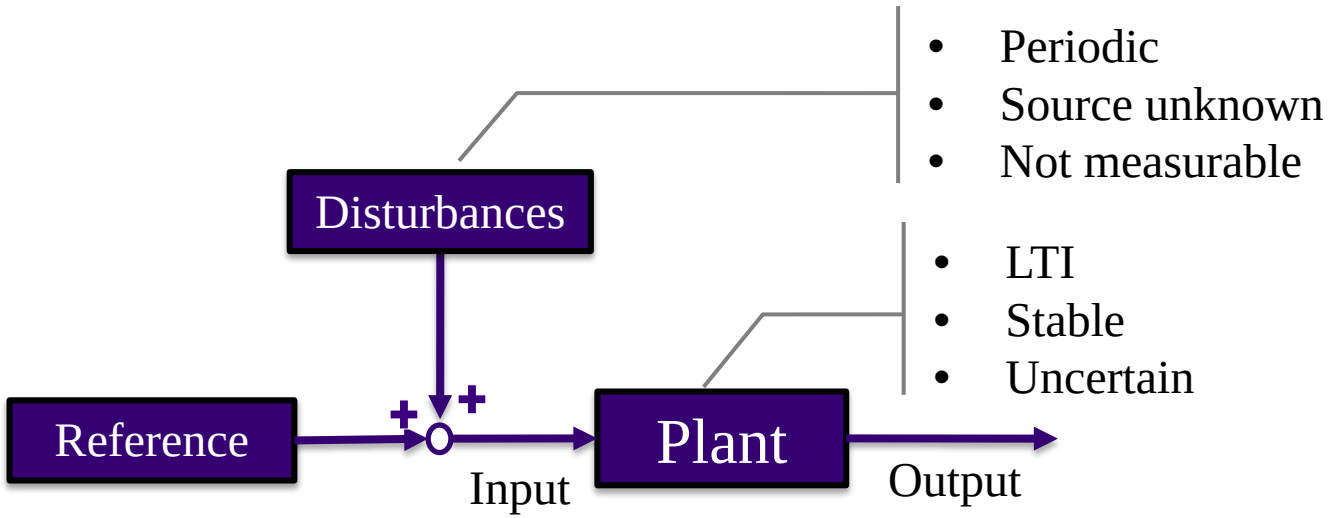
1. Engine Noise



2. Wind Noise

3. Tire (Break) Noise

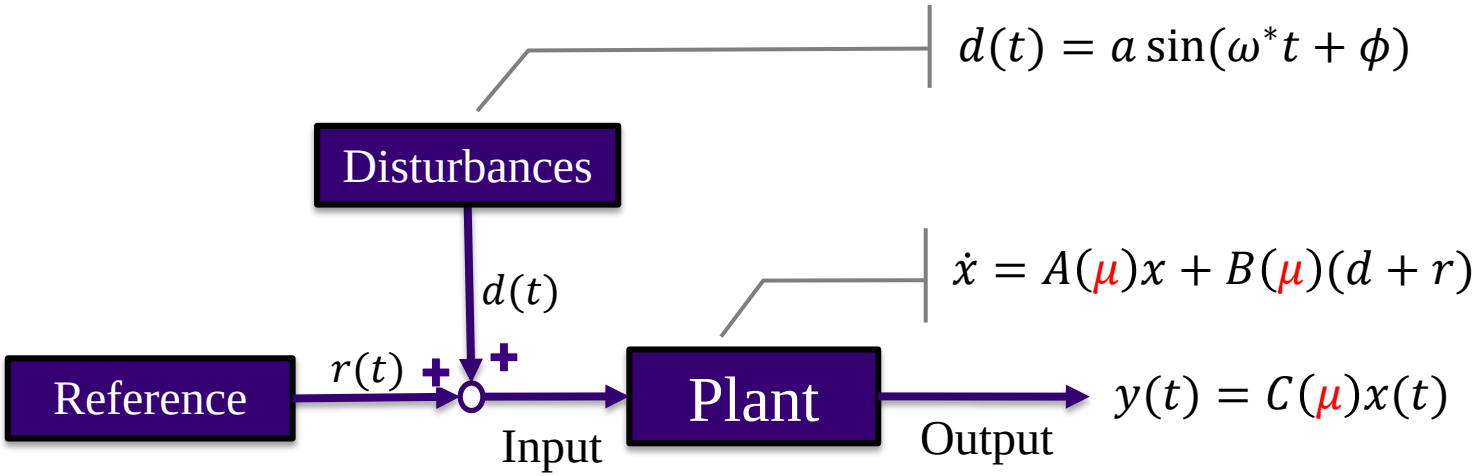
Problem Formulation



Goal:

Minimize the influence of the disturbances

Problem Formulation

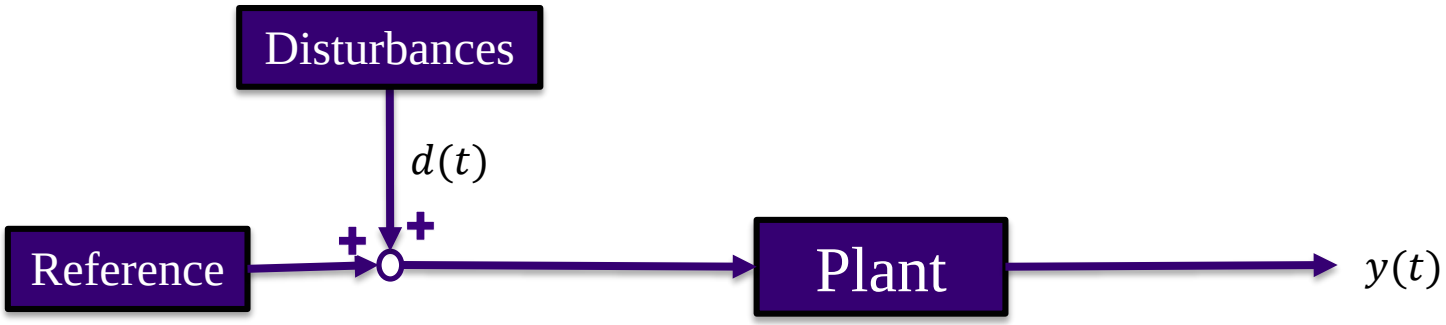


Goal:

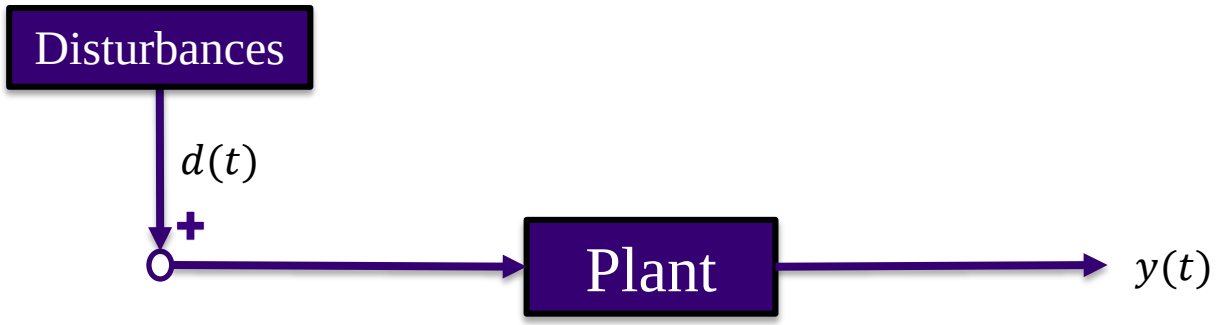
Minimize the influence of the disturbances

$$\lim_{t\to\infty}(y(t) - r(t)) = 0$$

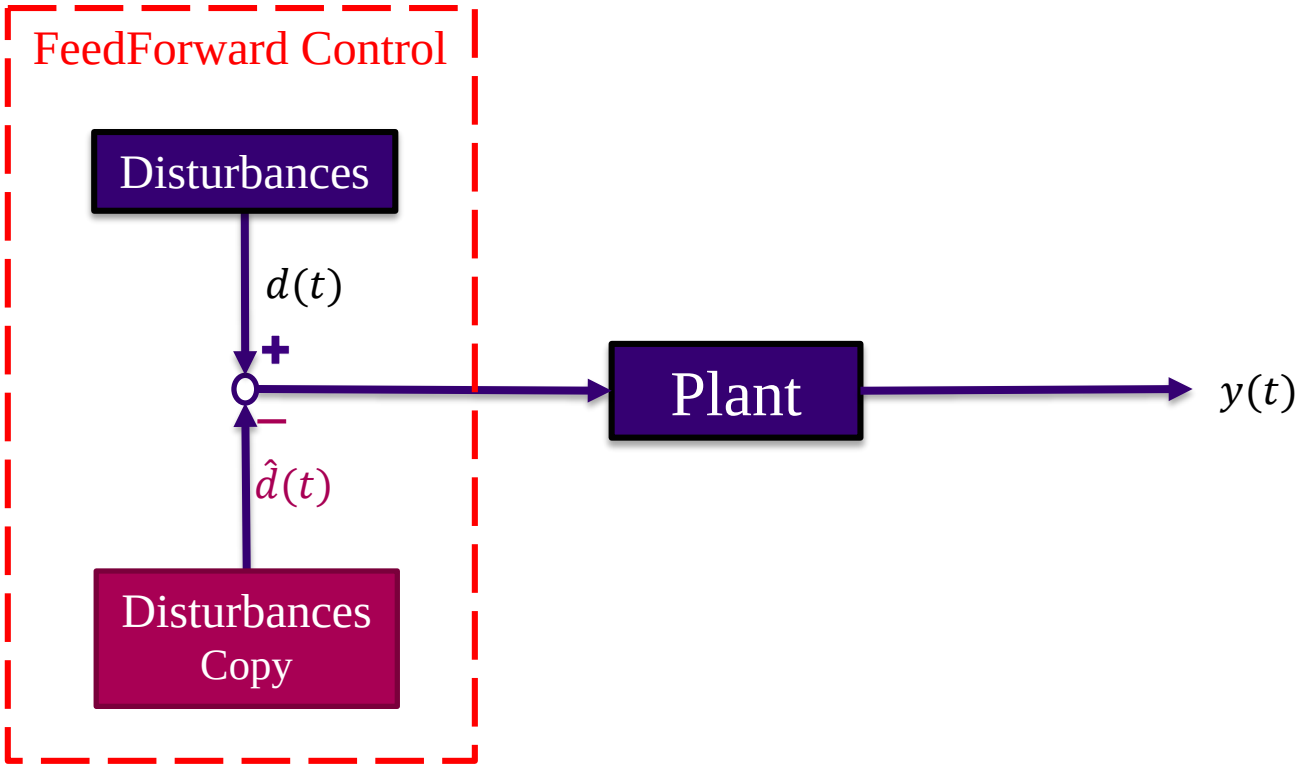
Solution: Adaptive Forward Control



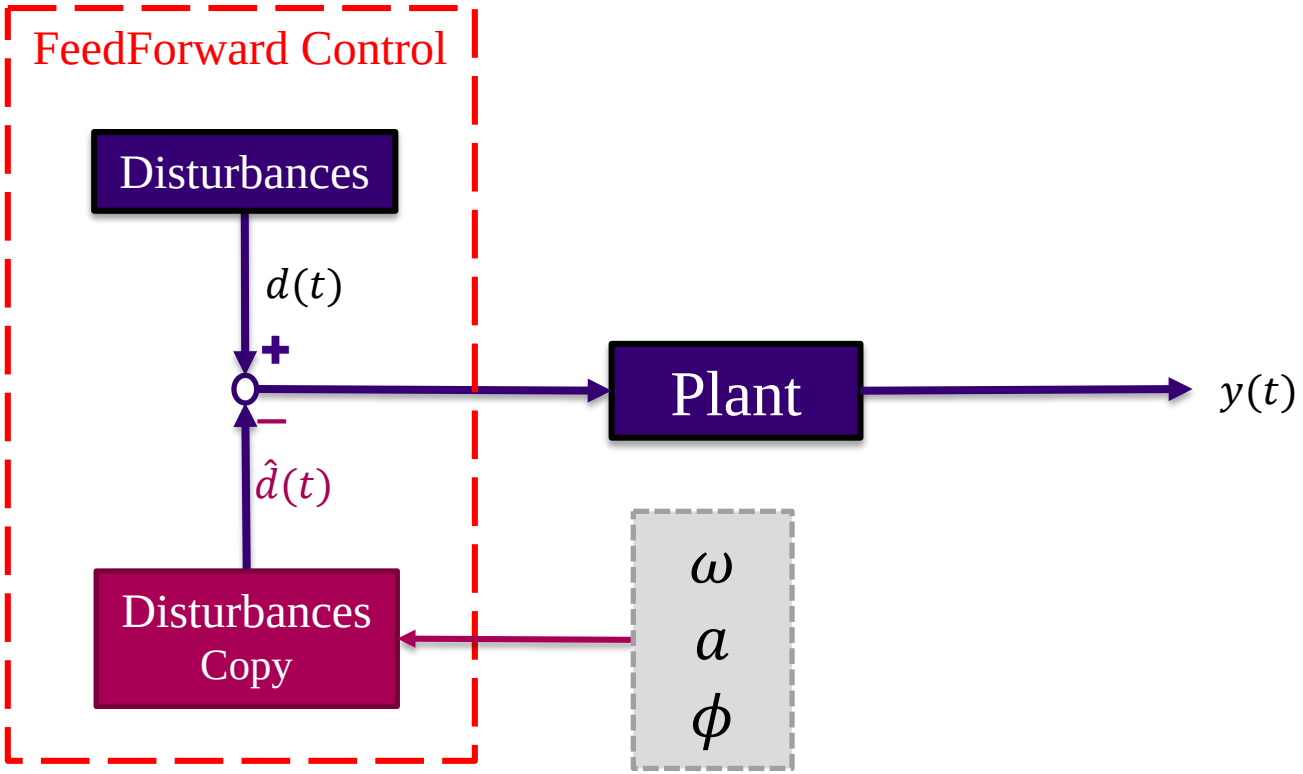
Solution: Adaptive Forward Control



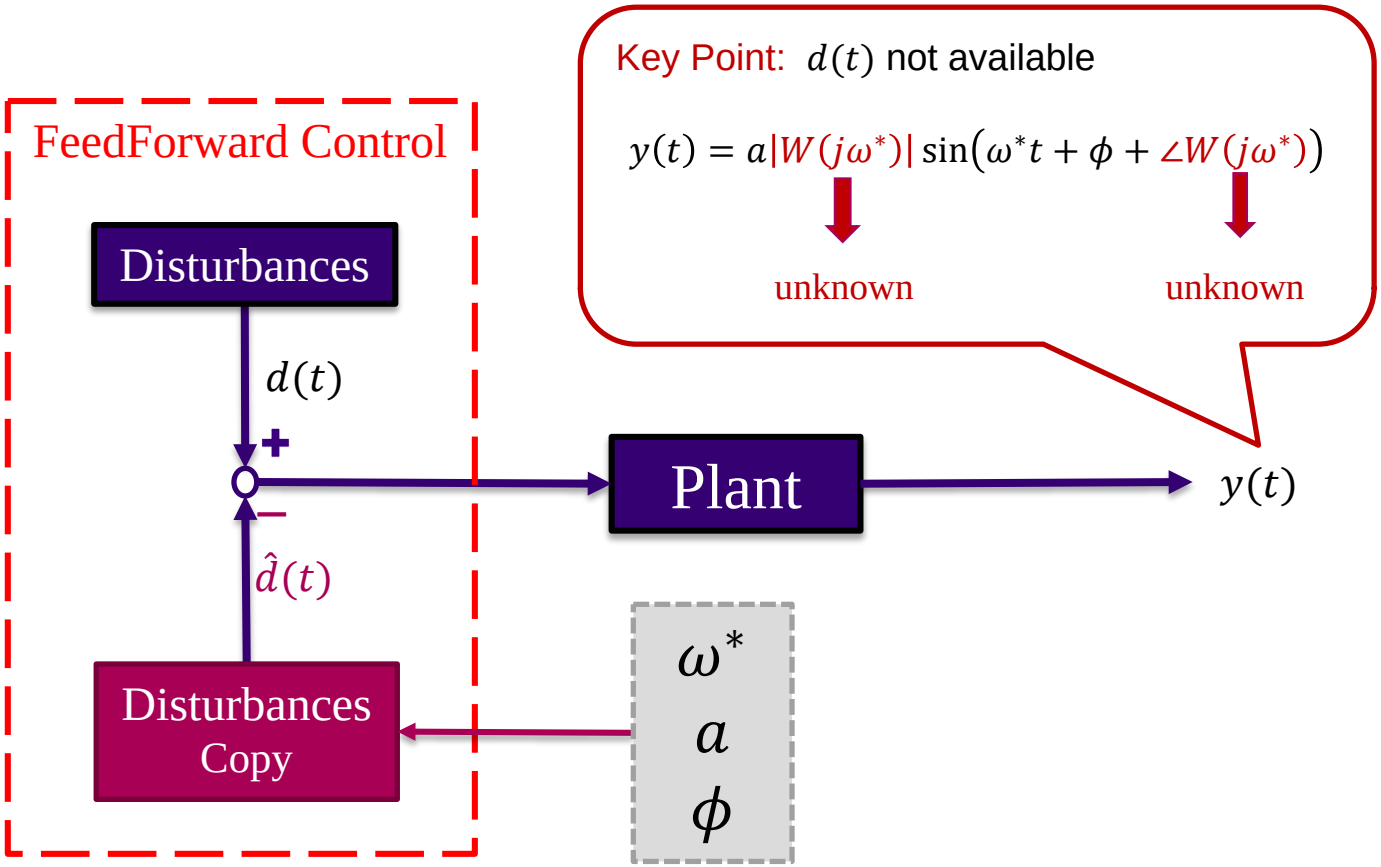
Solution: Adaptive Forward Control



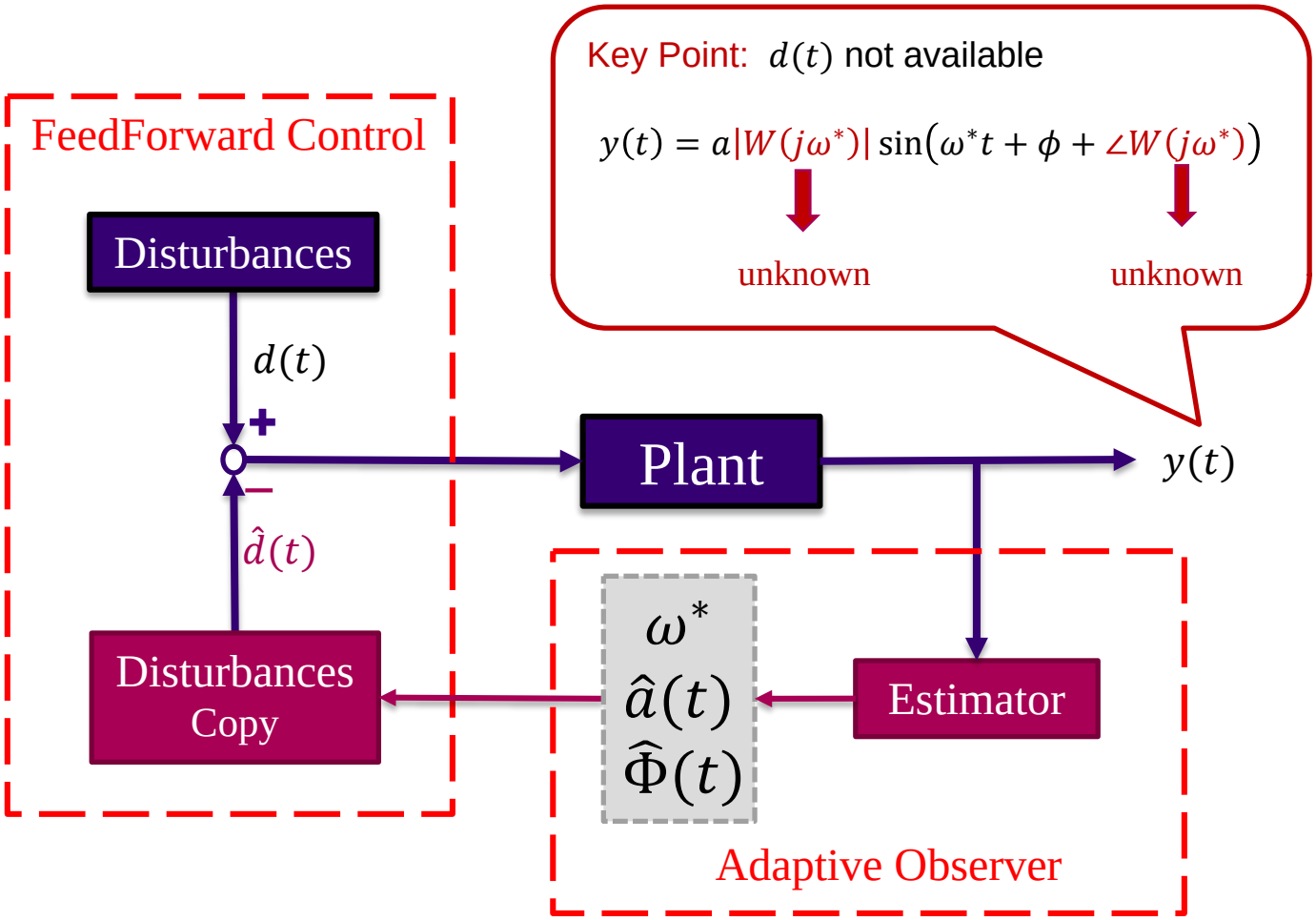
Solution: Adaptive Forward Control



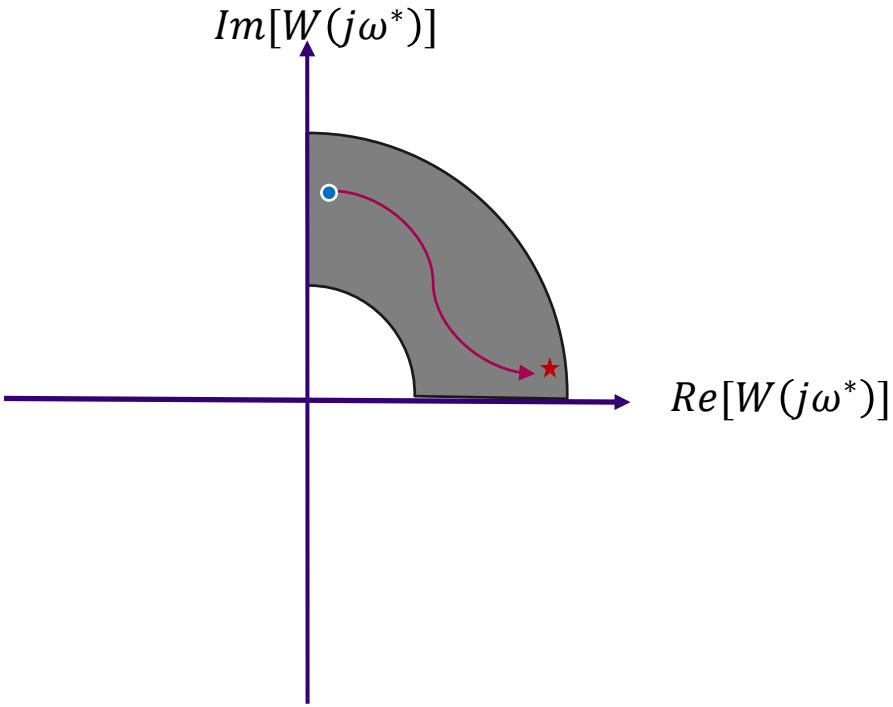
Solution: Adaptive Forward Control



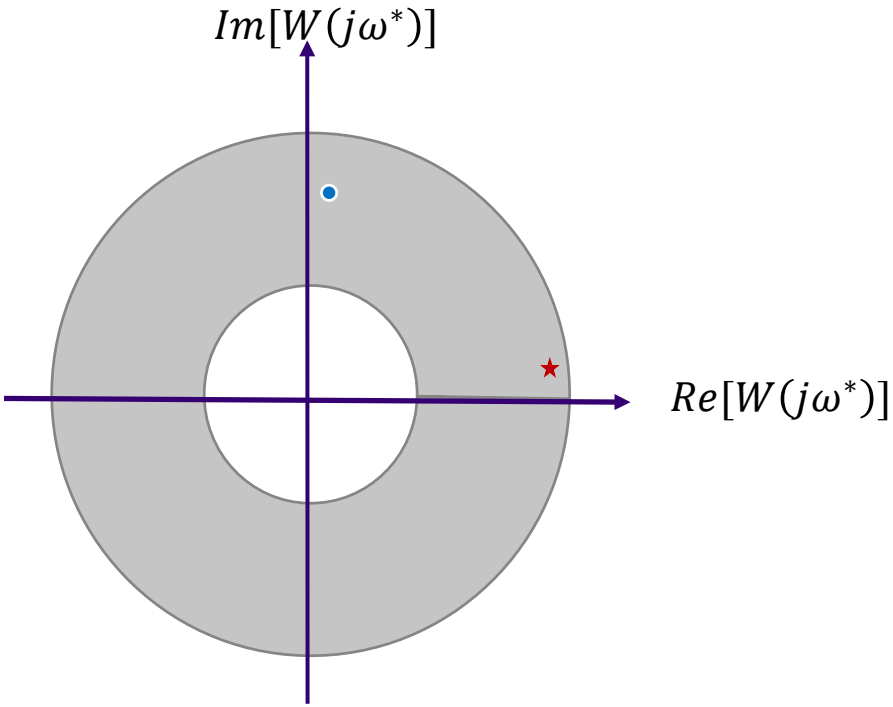
Solution: Adaptive Forward Control



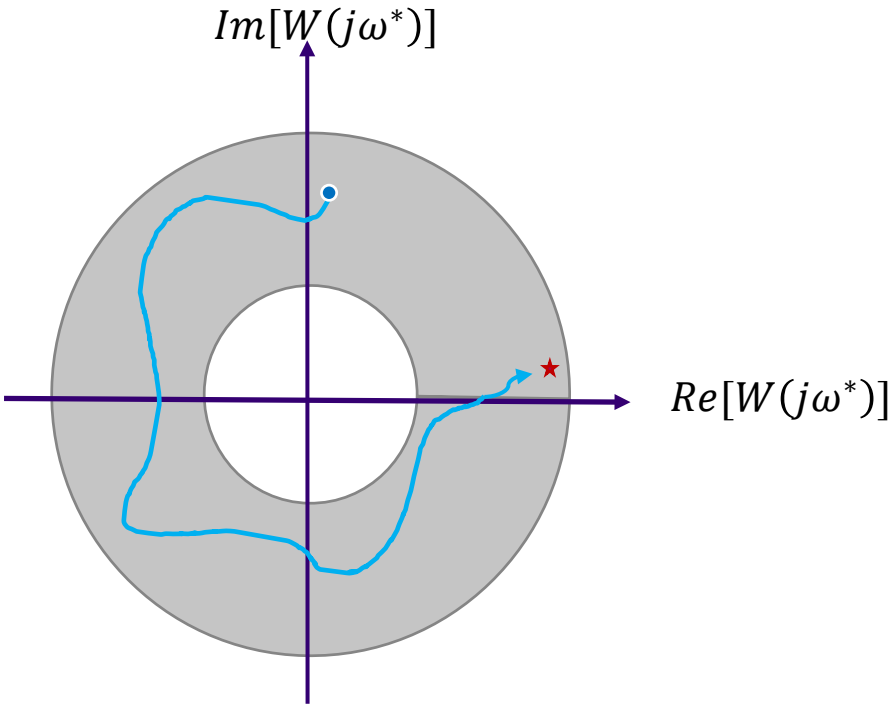
Estimator



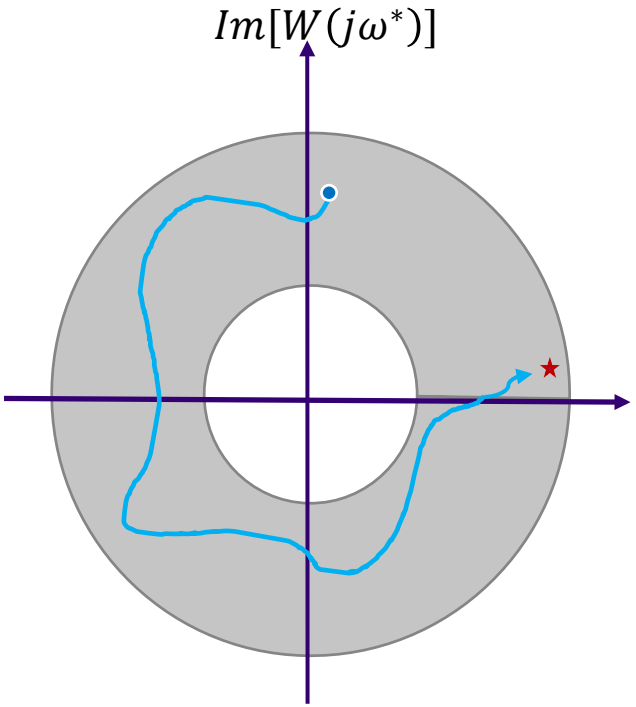
Estimator



Estimator



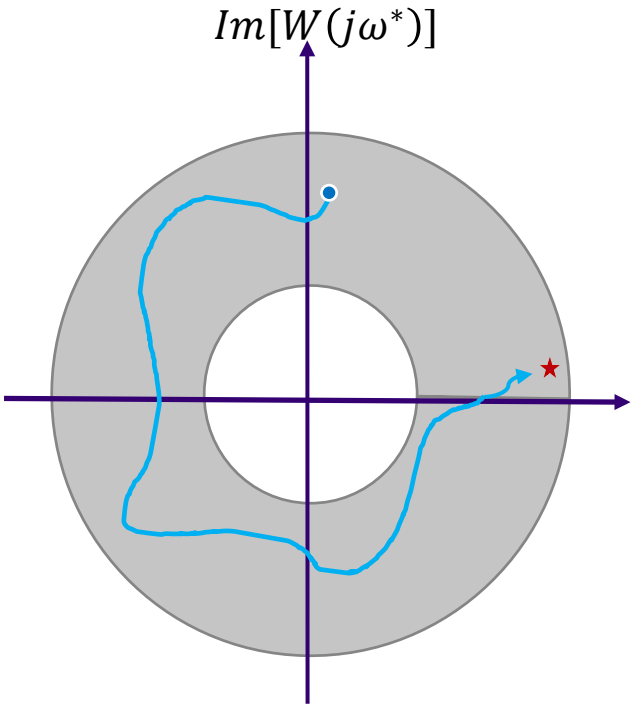
Estimator



Price:

- Computation burden
- Slower convergence

Estimator



Price:

- Computation burden
- Slower convergence

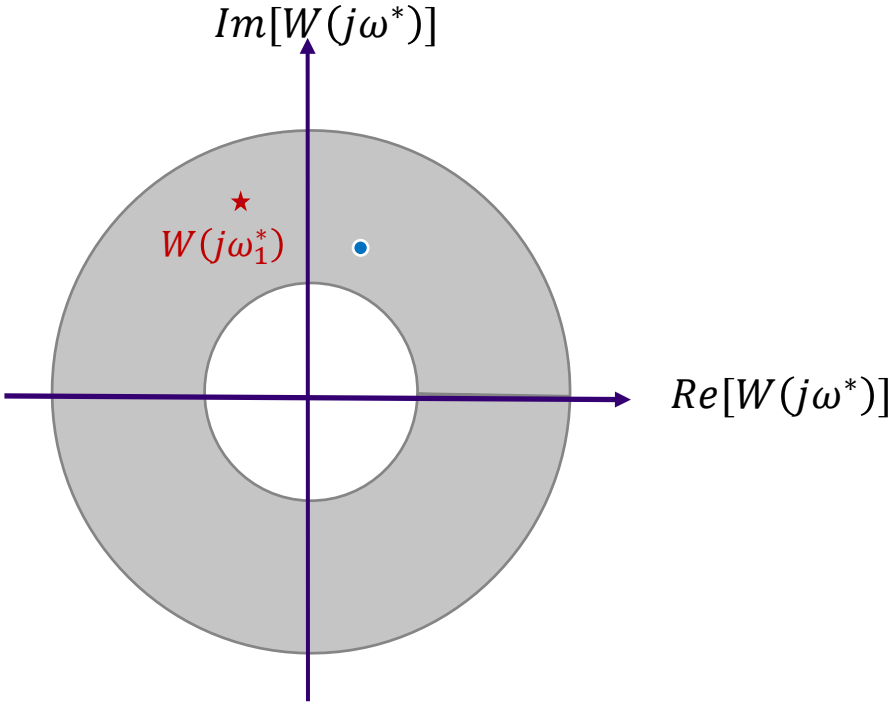
Achievements:

- Time-varying system
- Time-varying disturbance

Simulation Results

$$\text{Plant}: W(s) = \frac{2(s-1)}{s^2+2s+5}$$

1) $\omega_1^* = 1$, $d(t) = 2\sin(t)$

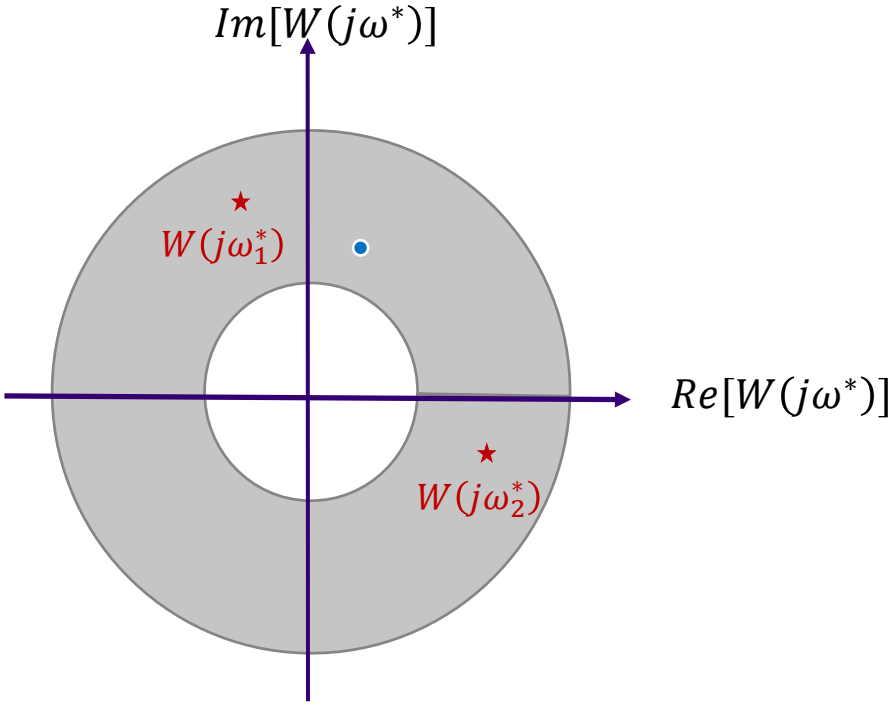


Simulation Results

$$\text{Plant}: W(s) = \frac{2(s-1)}{s^2+2s+5}$$

1) $\omega_1^* = 1$, $d(t) = 2\sin(t)$

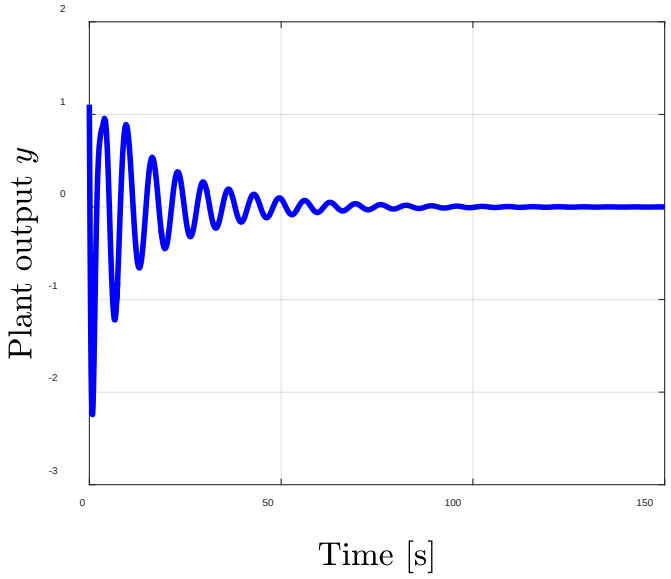
2) $\omega_2^* = 3$, $d(t) = 2\sin(3t)$



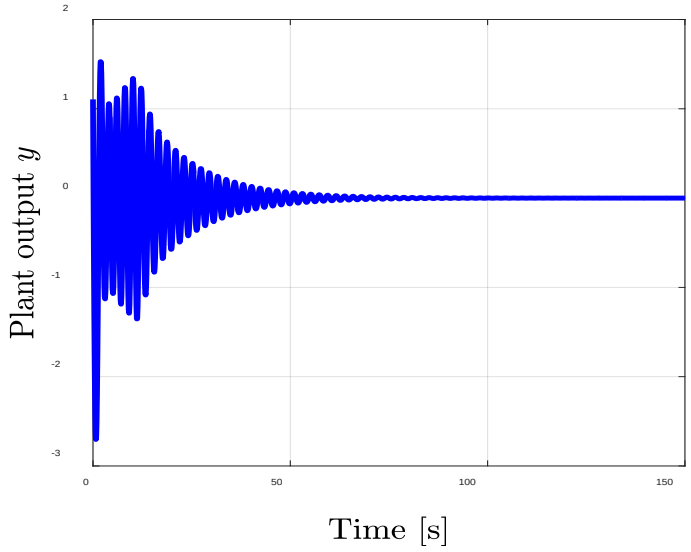
Results

$$\text{Plant}: W(s) = \frac{2(s-1)}{s^2+2s+5}$$

1) $\omega_1^* = 1$, $d(t) = 2\sin(t)$



2) $\omega_2^* = 3$, $d(t) = 2\sin(3t)$



Intermediate Results and Further Plans

Current results:

- **Remove the SPR-like conditions in AFC of uncertain system**

Plans:

- **Simplify controller**
- **Extend to MIMO system**
- **Combine controller with frequency estimator**