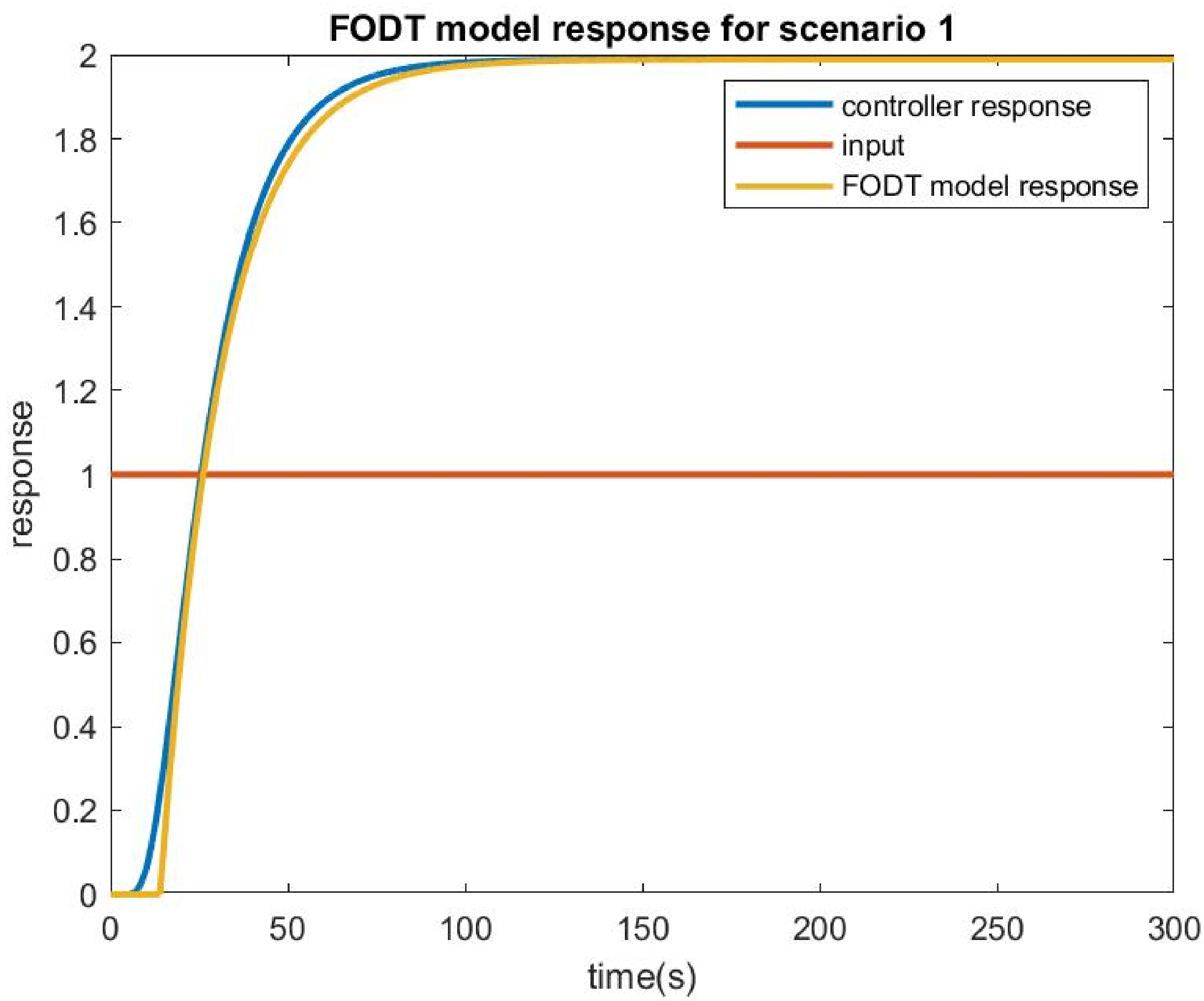
Lab Report 5(170747)

A two input-single output process is provided to us. There are two scenarios. The process output, y, is controlled using the first input, u1 (Scenario 1), or using the second input, u2 (Scenario 2). The process input that is not used for control (u2 for Scenario 1 and u1 for Scenario 2) then acts as the disturbance to the process.

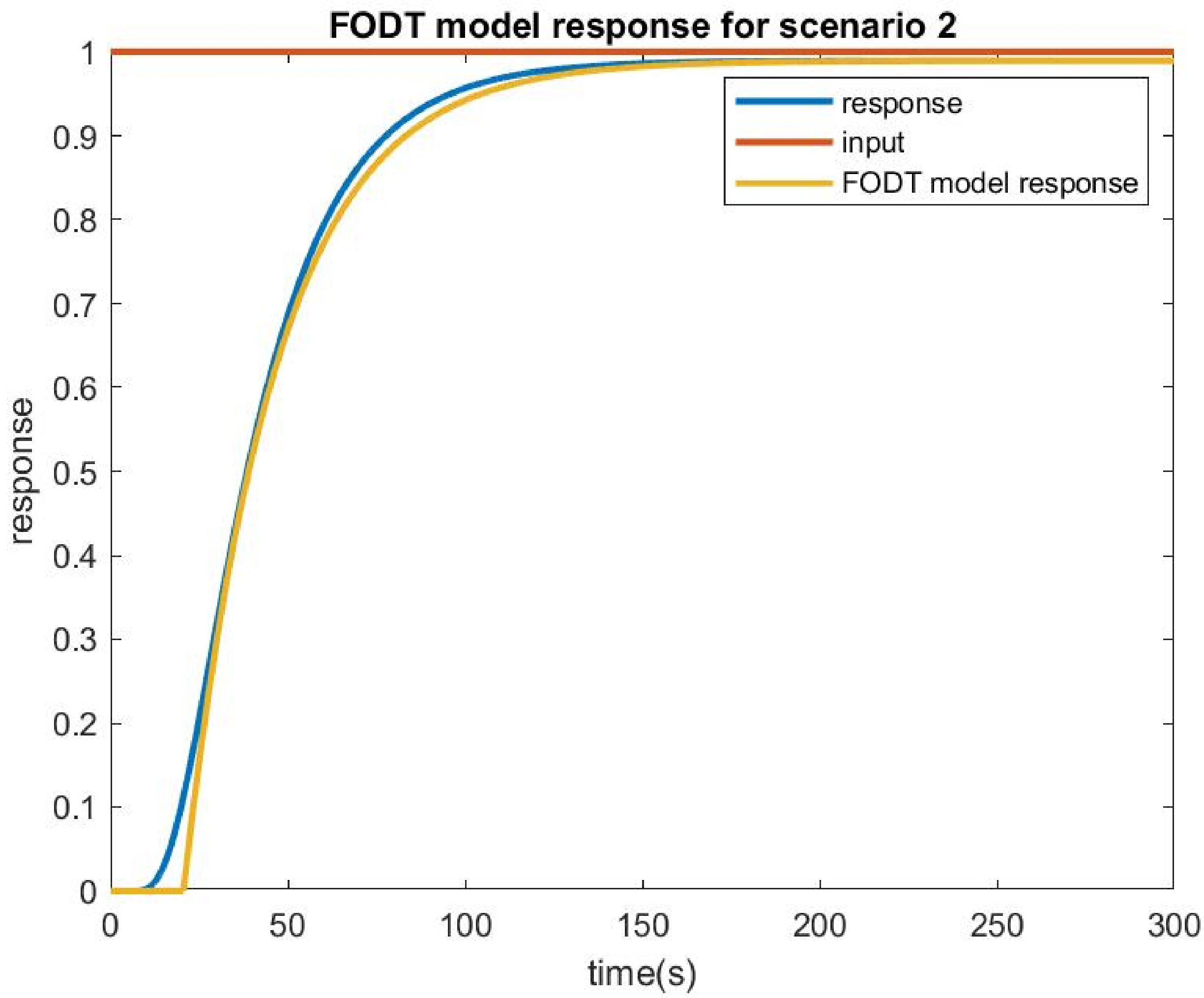
Feedforward Compensator Design

Part A: Using fitted first order plus dead-time models

(use FODTfiiting.slx file)



Km =1.9886;
D+T/3 =t283=19.8;
D+T =t632=31.4;
T =17.4;
D =14;



Km =0.9894;

D+T/3 =t283=29.3;

D+T =t632=46.7;

T =26.1;

D =20.6;

Using this data, we designed feedforward compensators as discussed in class

$$G_{ff} = -\left(\frac{Gp}{Gd}\right) = -\frac{Kd}{Kp}\frac{(Tps+1)}{(Tds+1)}\,e^{-(Dd-Dp)}$$

(use feedforward.slx file)

For Scenario 1

Kp =1.9886;

Tp =17.4;

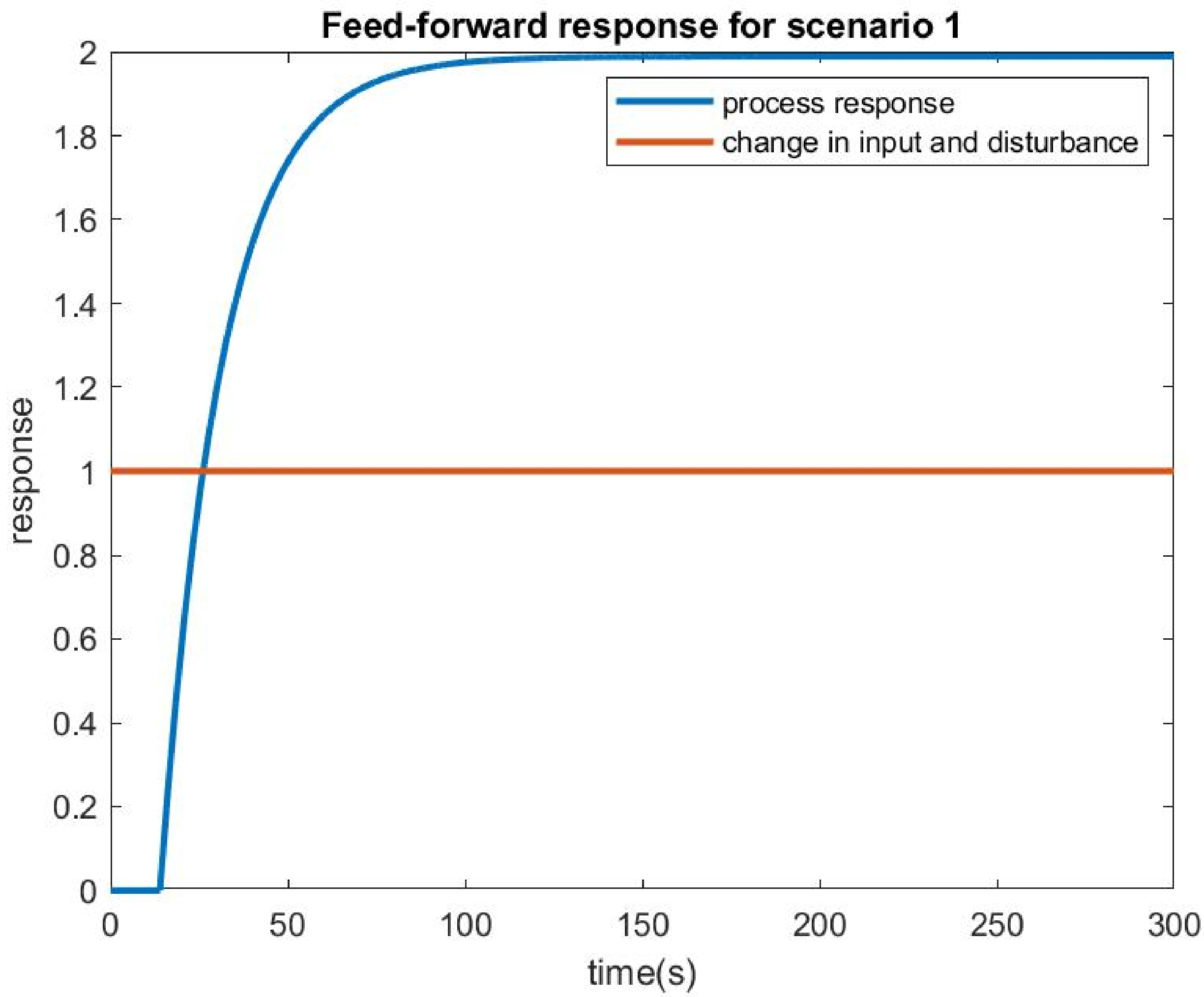
Dp =14;

Kd =0.9894;

Td =26.1;

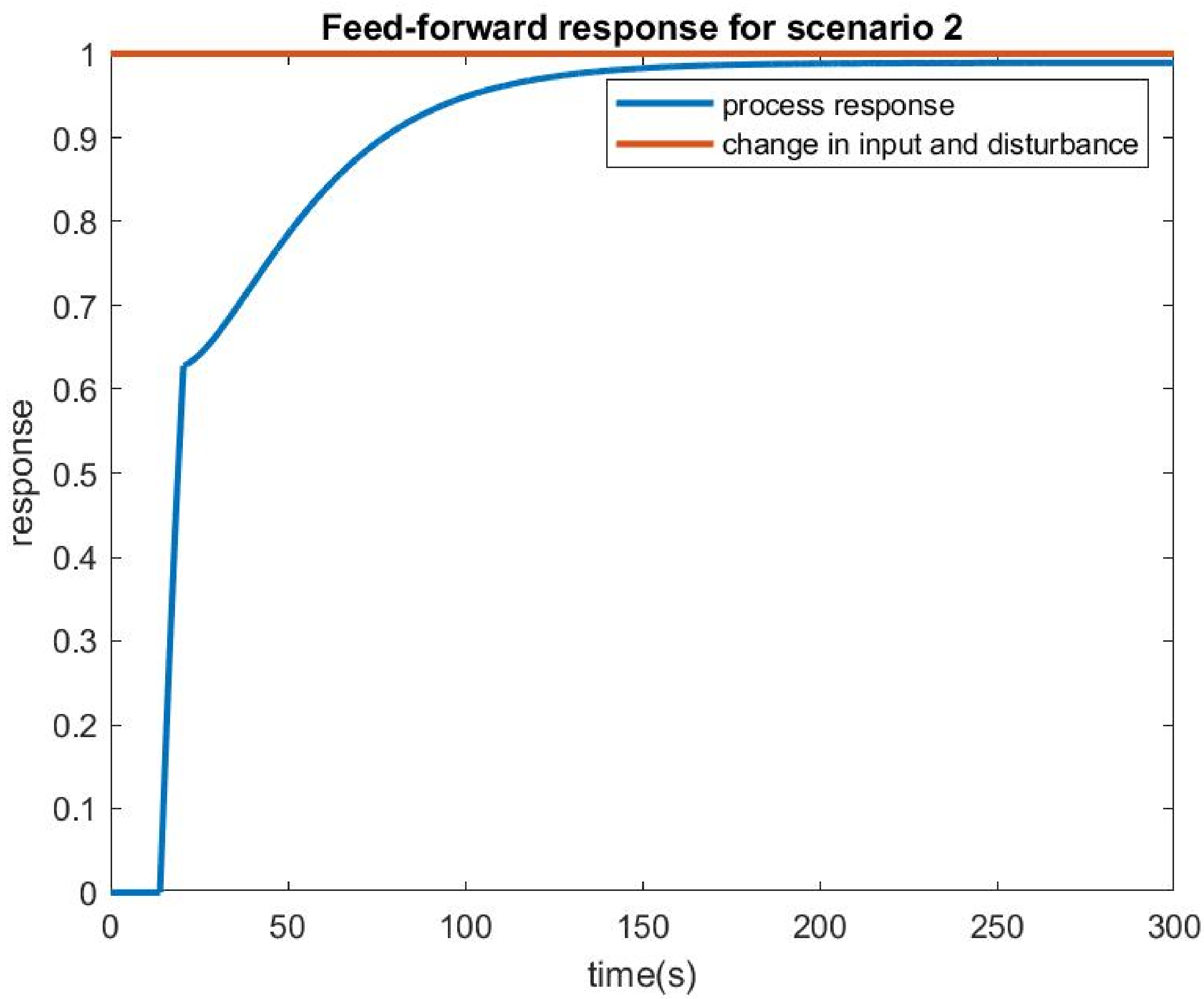
Dd =20.6;

D=Dd-Dp=6.6;



For Scenario 2
Kd =1.9886;
Td =17.4;
Dd =14;
Kp =0.9894;
Tp =26.1;
Dp =20.6;
D=Dd-Dp=-6.6;

Dp > Dd => Dead time block is removed



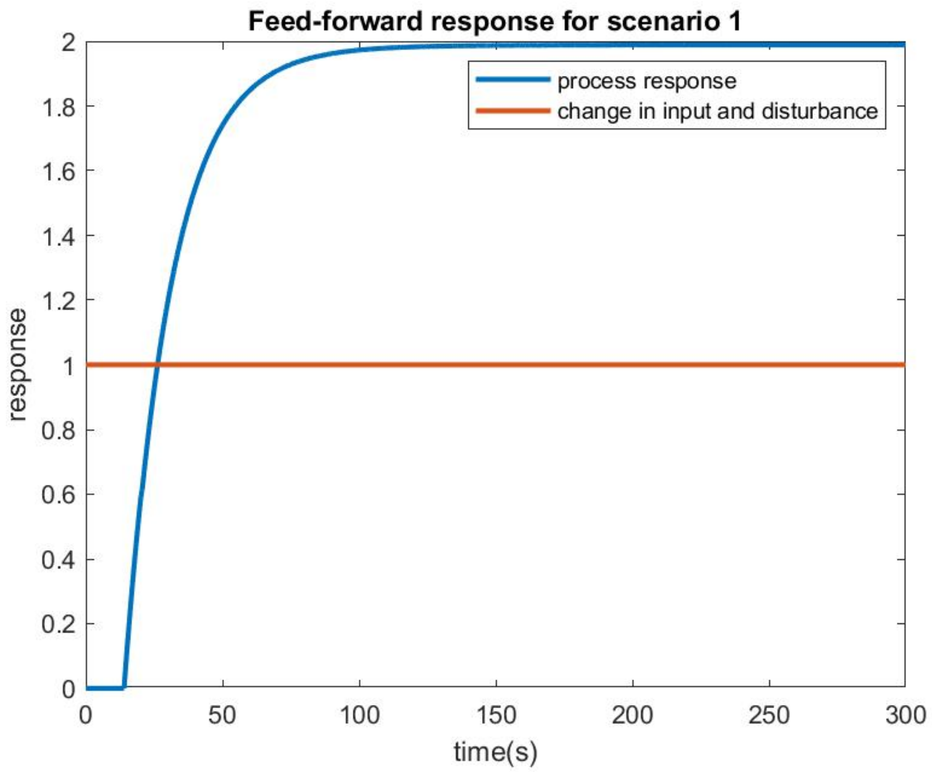
Part B: Using fmincon IAE is minimized to optimize Tp, Td and D for feedforward compensator

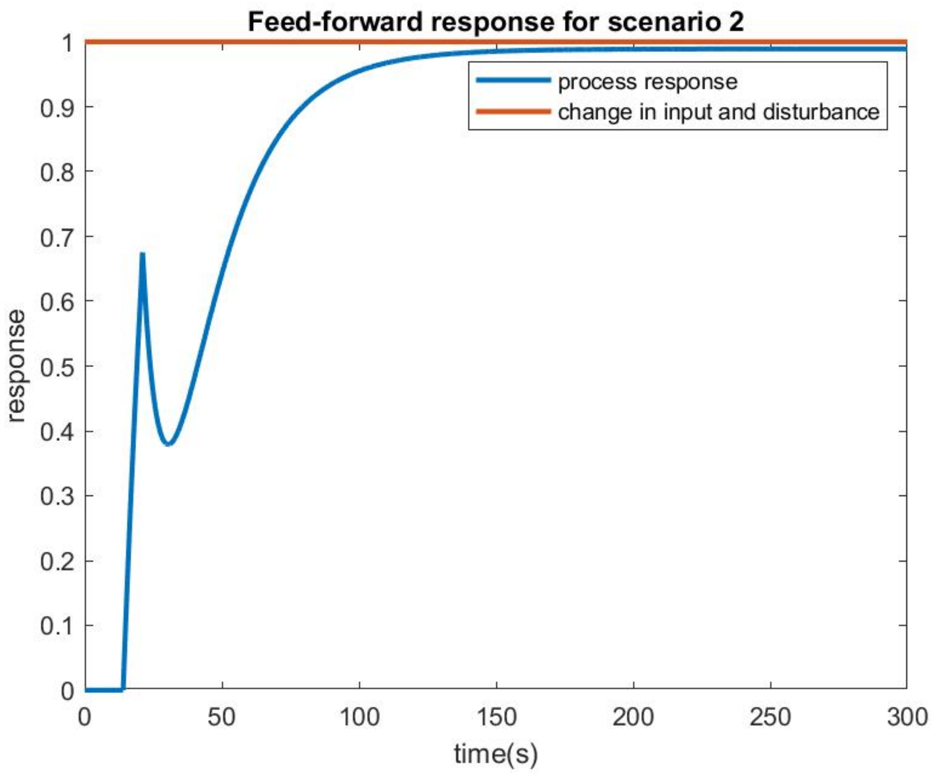
Initial value x0 = [10 20 10]

Optimized values x = [Tp Td D]

For scenario 1: x= [15.4360 24.4450 6.1507] (use IAE.m and feedforwardOptimizer.slx files)

For scenario 2: x= [20.9992 8.1508 0.4912] (use IAE2.m and feedforwardOptimizer2.slx files)





Feedback Controller Design

Estimate KU and PU for Scenario 1 and Scenario 2 using the **relay feedback test**. A PID controller is then implemented with the **Zeigler Nichols** tuning settings.

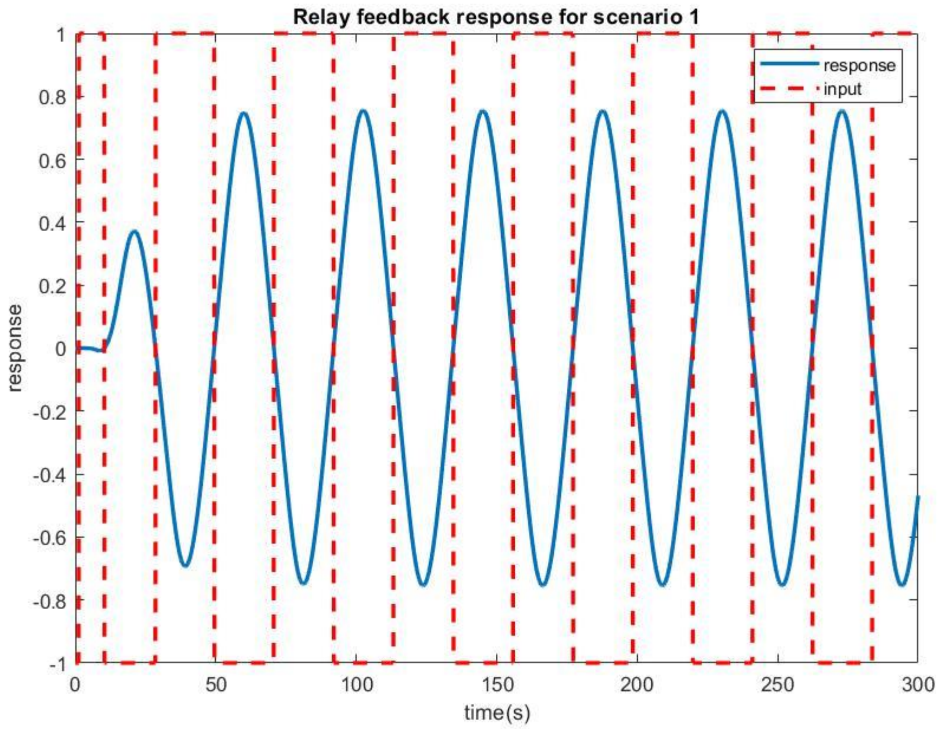
(use Relayfeedback.slx file)

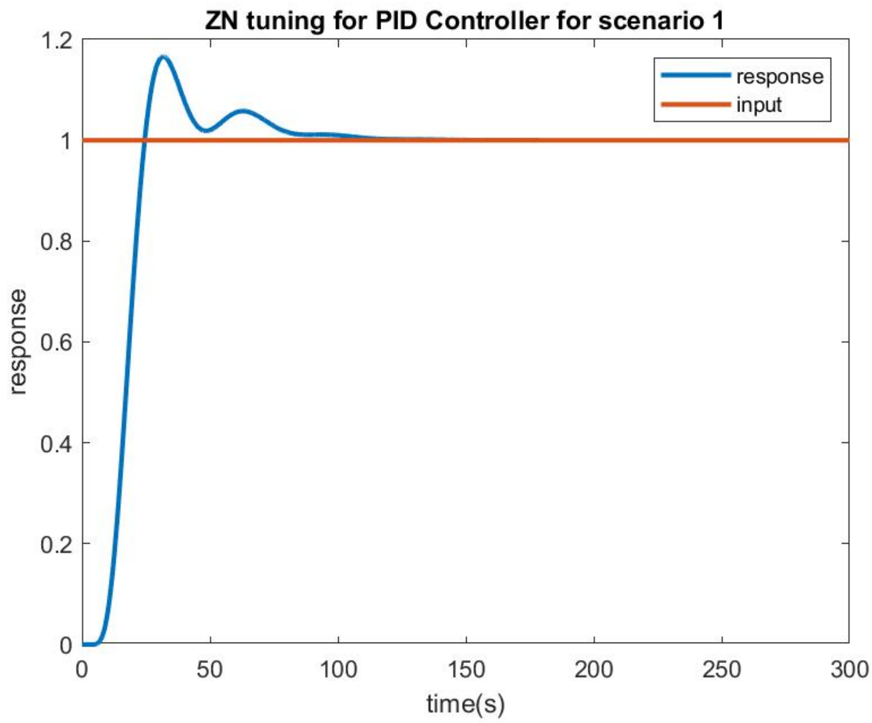
For scenario 1:

Ku=1.6889

Pu=51.9 s

For Zeigler Nichols tuning: Kc=Ku/1.7 = 0.993 **Ti=**Pu/2 = 25.95s **Td=**Pu/8=6.487s



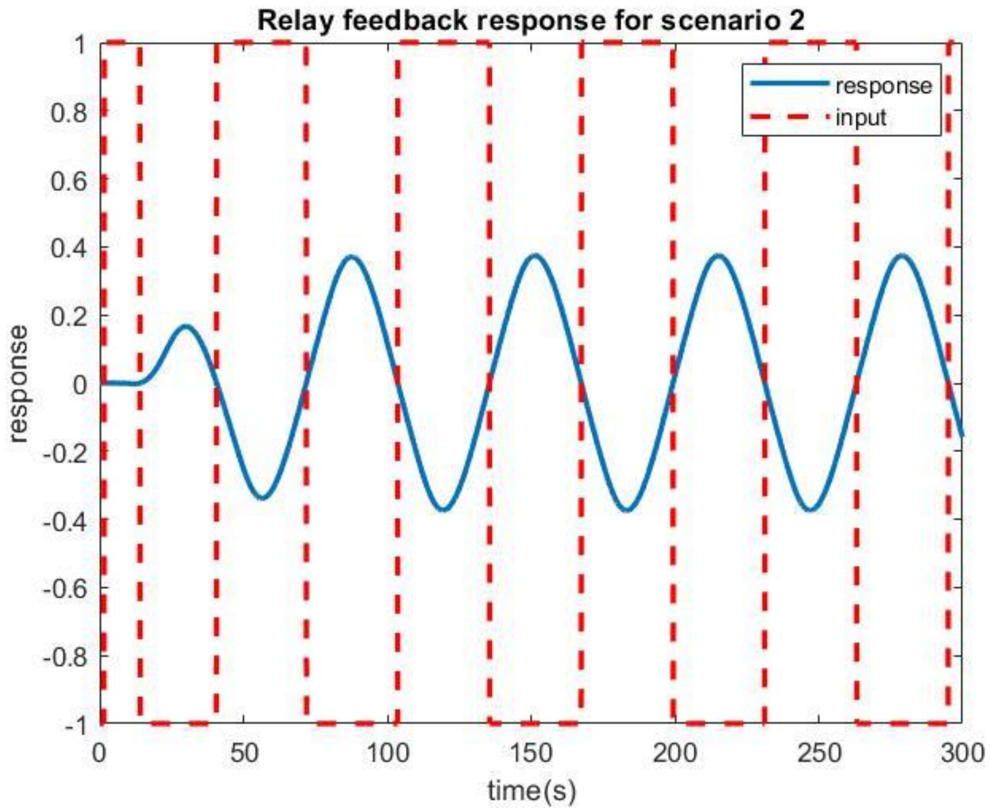


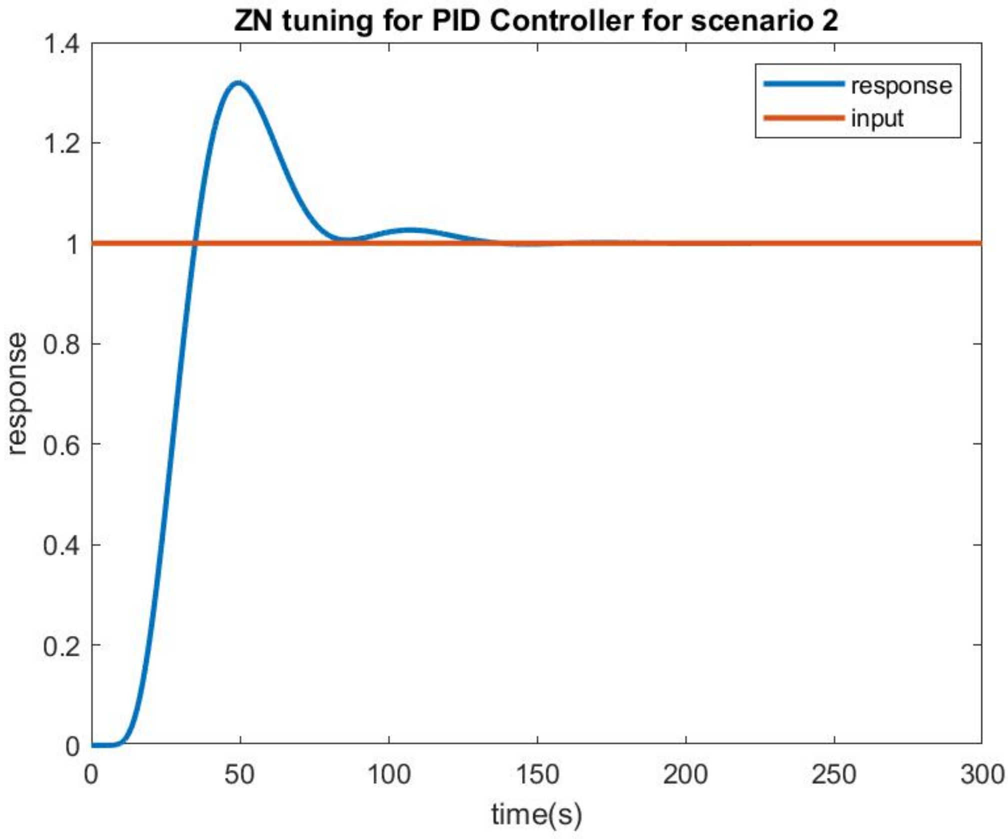
For scenario 2:

Ku=3.398

Pu=63.5 s

For Zeigler Nichols tuning: Kc=Ku/1.7= 1.998 **Ti=**Pu/2=31.75s **Td=**Pu/8=7.9375s

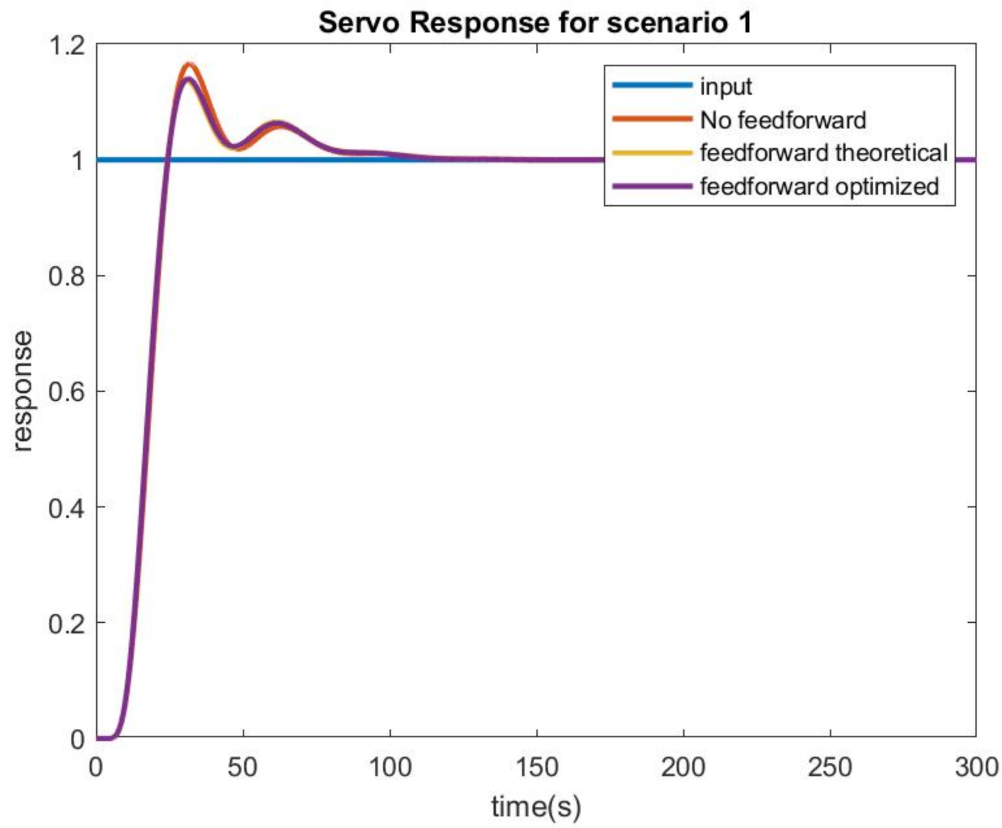


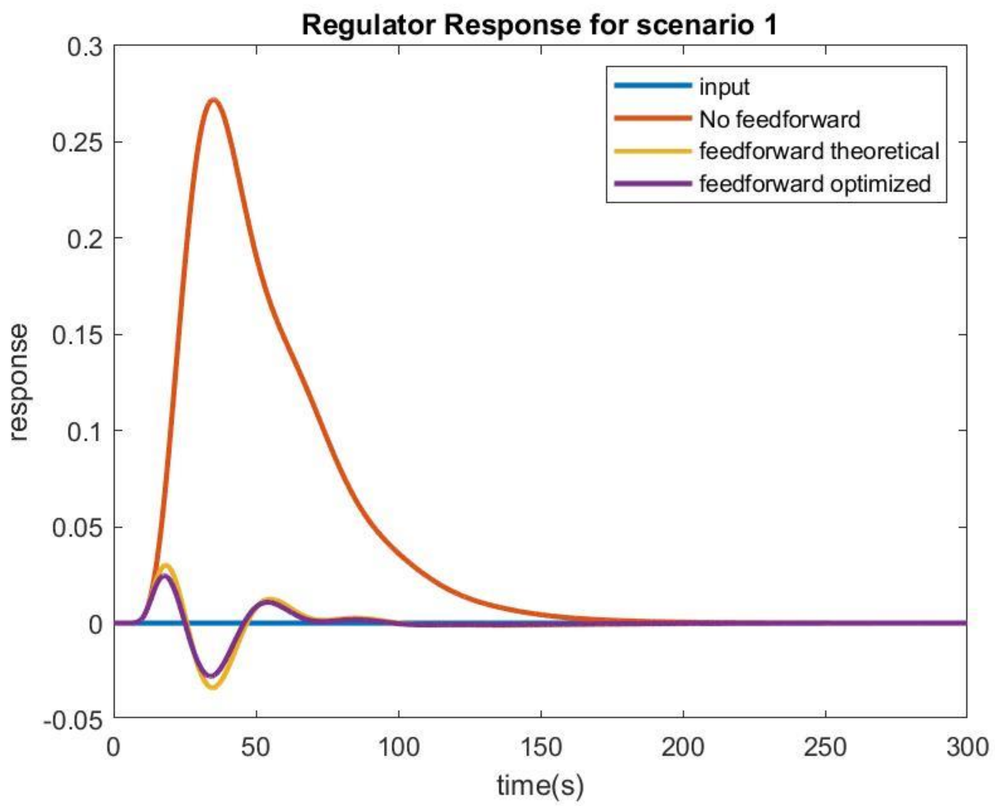


Control Performance Evaluation

(use PID_and_feedforward.slx file)

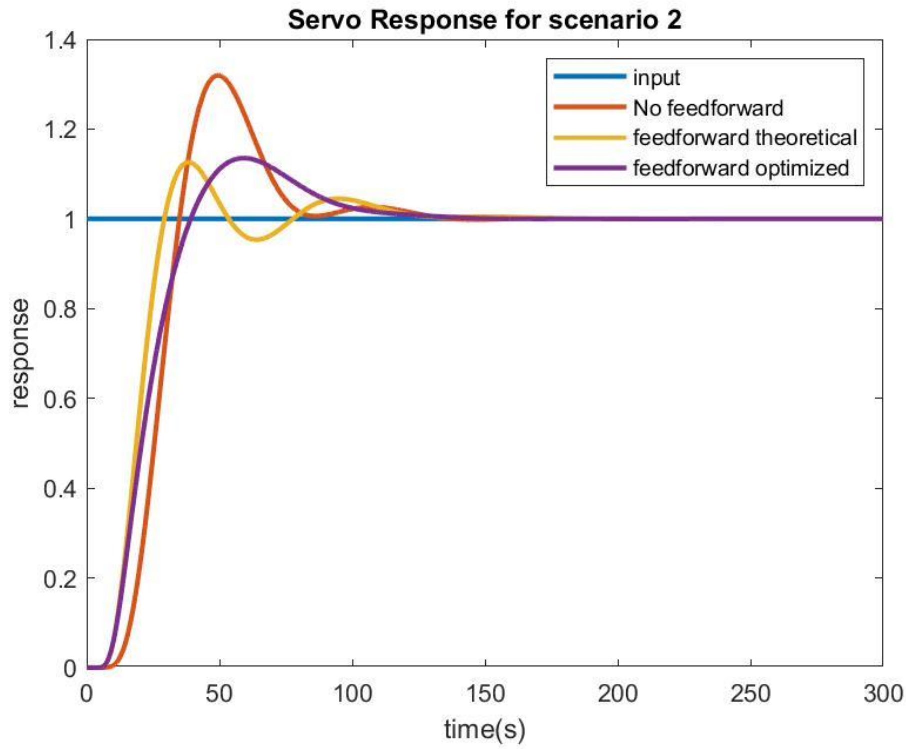
For scenario 1

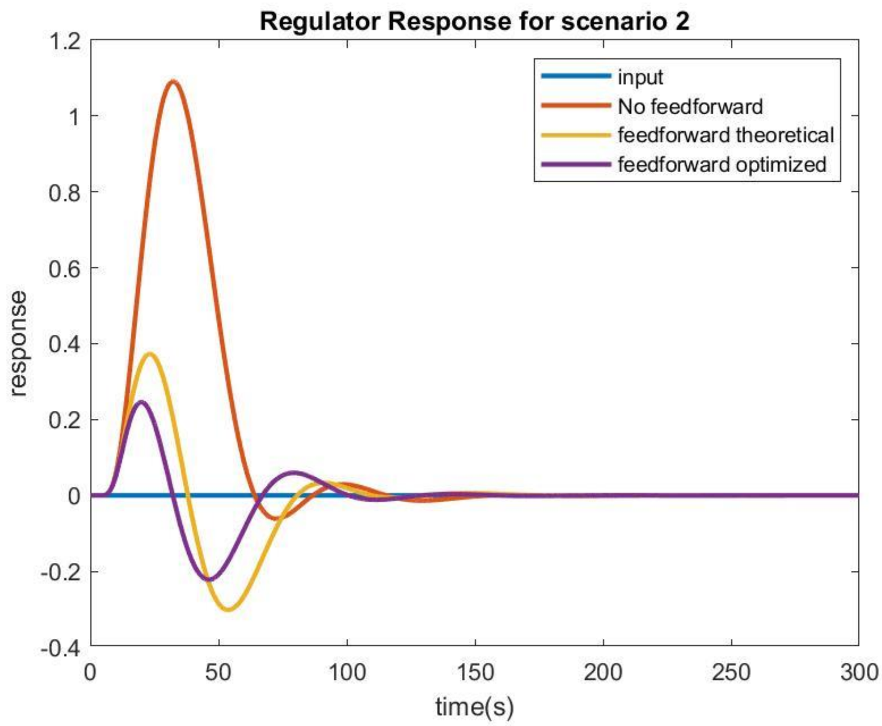




Feed Forward compensator gives more control as it cancels out any disturbance in servo response and give much tighter control in regulator response. Both theoretical and optimized responses are similar

For scenario 2





In servo response, both feedforward gives more control but theoretical one gives tighter control than the optimized one

In Regulator response, optimized feedforward gives much tighter control than the theoretical one.