In the name of GOD

Second project of linear control laboratory

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Project title: Tuning parameters of PID controller used by Cohen-Coon method

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Explore: It is generally believed that PID controllers are the most popular controllers used in process control. Because of their remarkable effectiveness and simplicity of implementation, these controllers are overwhelmingly used in industrial applications, and more than 90% of existing control loops involves PID controllers. Since the 1940s, many methods have been proposed for tuning these controllers, but every method has brought about some disadvantages or limitations. As a result, the design of PID controllers still remains a challenge before researchers and engineers. In order to provide closed loop responses with a damping ratio of 25%, Cohen and Coon suggested. Similar to the Ziegler and Nichols methods, this technique sometimes brings about oscillatory responses but, with this method in some systems that their time delay is more than half constant time, we observe an exact result.

With these parameters we design a PID controller with Cohen-Coon method:

$$K_p = \frac{\frac{\tau_d}{4T}+\frac{4}{3}}{K\frac{\tau_d}{T}} \ \& \ T_i = \tau_d \frac{\frac{3\tau_d}{4T}+4}{\frac{\tau_d}{T}+\frac{13}{8}} \ \& \ T_d = \tau_d \frac{2}{\frac{\tau_d}{T}+\frac{11}{2}}$$

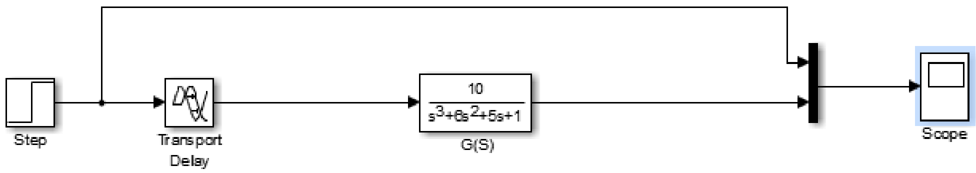
$T=t_{0.9}-t_{0.1}=t_r$: Rise time

$\tau = t_{0.1} - t_0$: Time delay

K=slope * T, slope: To getting, we calculate slope of curve when in the period of time, the response is linear

To explain the subject, we use following transfer function's plant:

First of all, we define it in the simulink of MATLAB:



And response to step input is:

With cursor tool, we obtain rise time, time delay and K:

T = 11.749s – 3.396s = 8.353s

τ = 3.396s – 2s = 1.396s

K = 1.5 × 8.353 = 12.5745

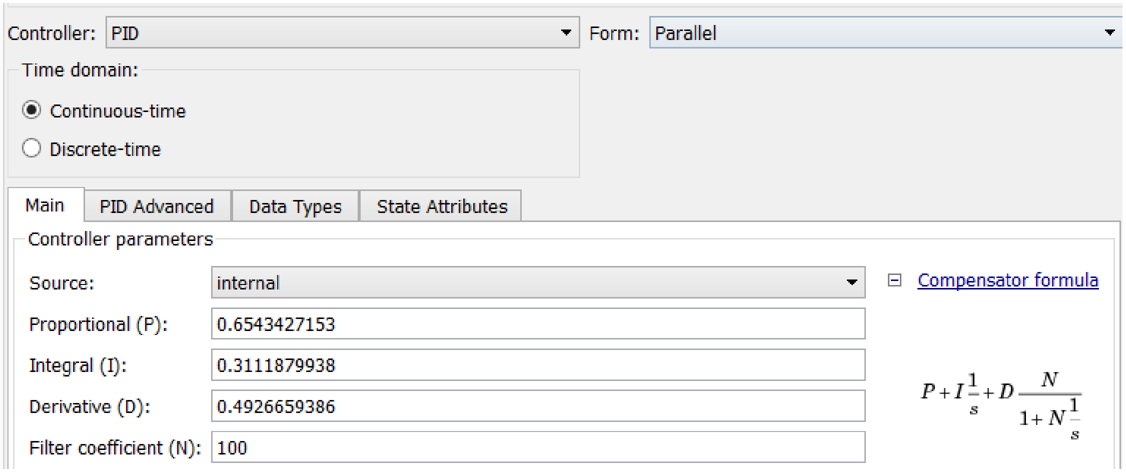
Now, we obtain PID parameters with Cohen-Coon method:

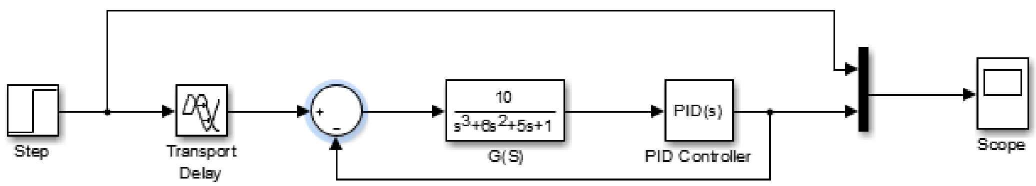
K_p = 0.6543427153

T_i = 3.213491587 → $T_i = \frac{1}{T_i} = 0.3111879938$

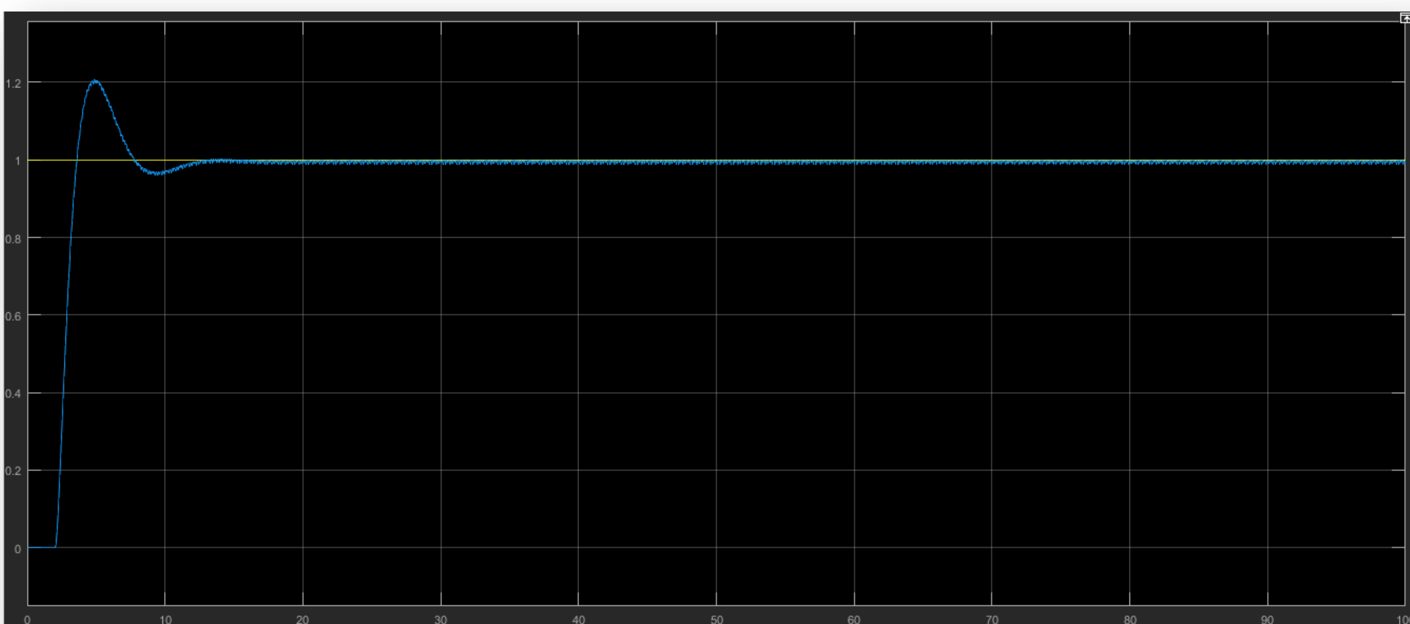
T_d = 0.4926659386

Finally, we design PID controller with unit negative feedback and put into circuit:





Now, we can see output of system:



As we seen, system can become stable in half period of time that system has not controller