시스템공학

시뮬링크를 이용한 시뮬레이션

Simulink ® MATLAB®

홍성욱

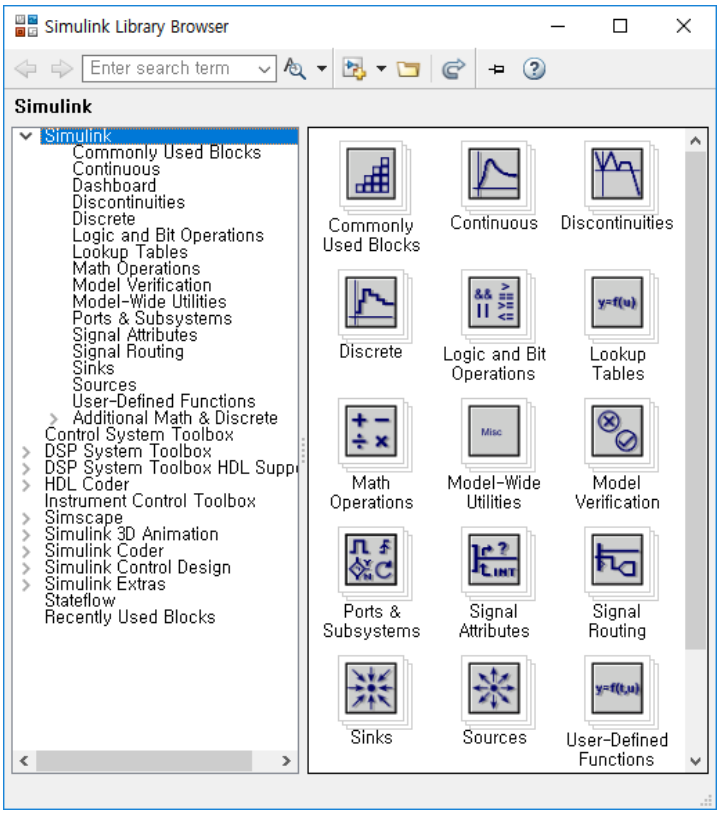
기계시스템공학과

Simulink (시뮬링크)

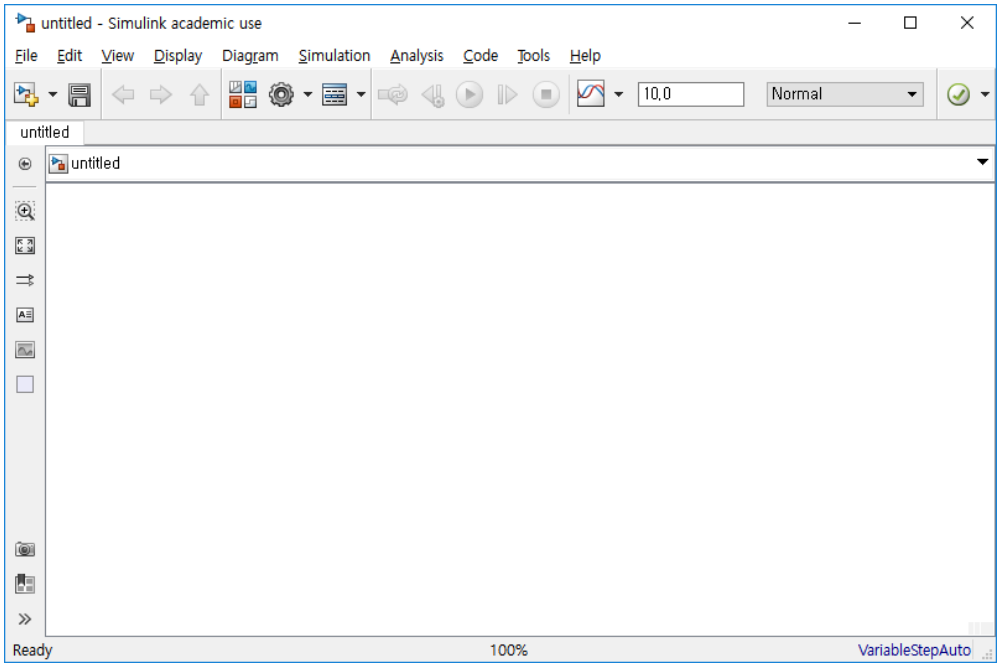
- 블록(block)이라는 다양한 소자를 사용하여 동적 시스템 모델링 및 시뮬레이션 (블록선도 이용)
- 독립 변수가 시간인 미분방정식이나 차분방정식으로 모델링할 수 있는 시스템 대상
- 시뮬레이션을 위해 그래픽 사용자 인터페이스(GUI) 제공 – MATLAB 내장 도구

시뮬링크 시작

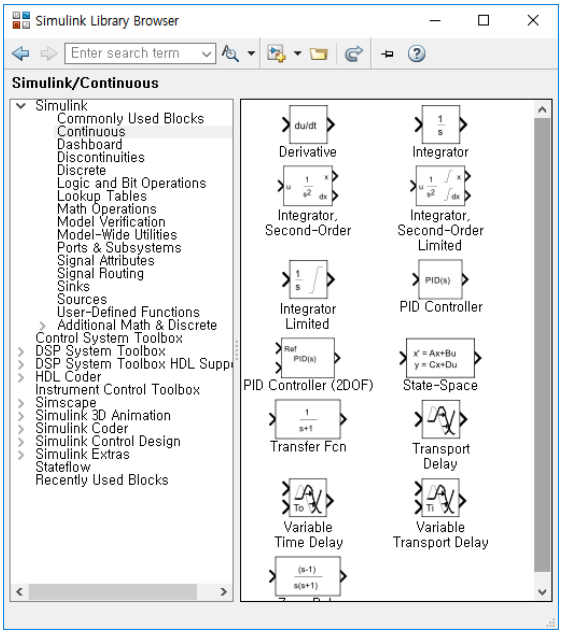
- 시뮬링크의 시작 : 명령창에서 simulink 타이핑
- 시뮬링크 라이브러리 브라우저 창
  - New model, Open model 등

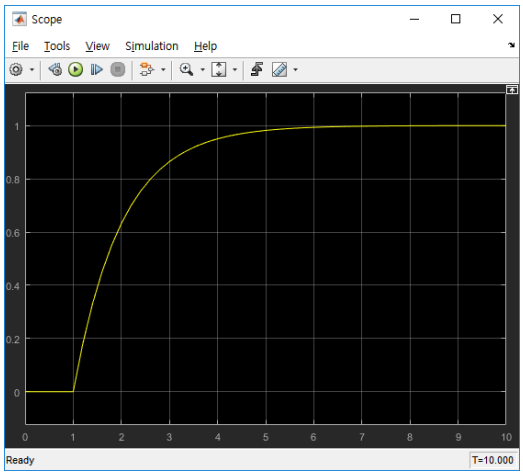


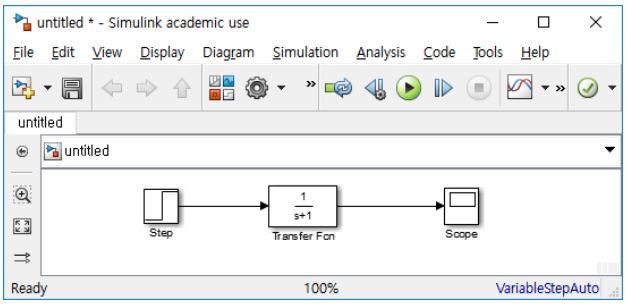
시뮬링크 새 모델 (작업 시작화면)



단위계단 응답



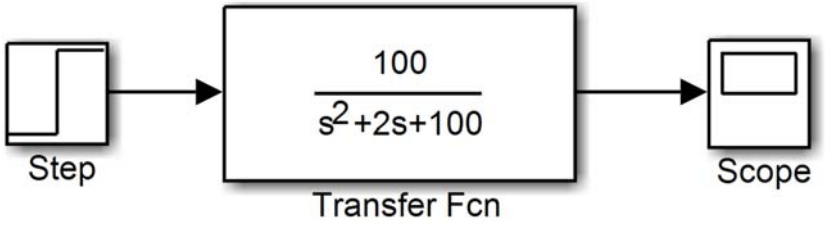


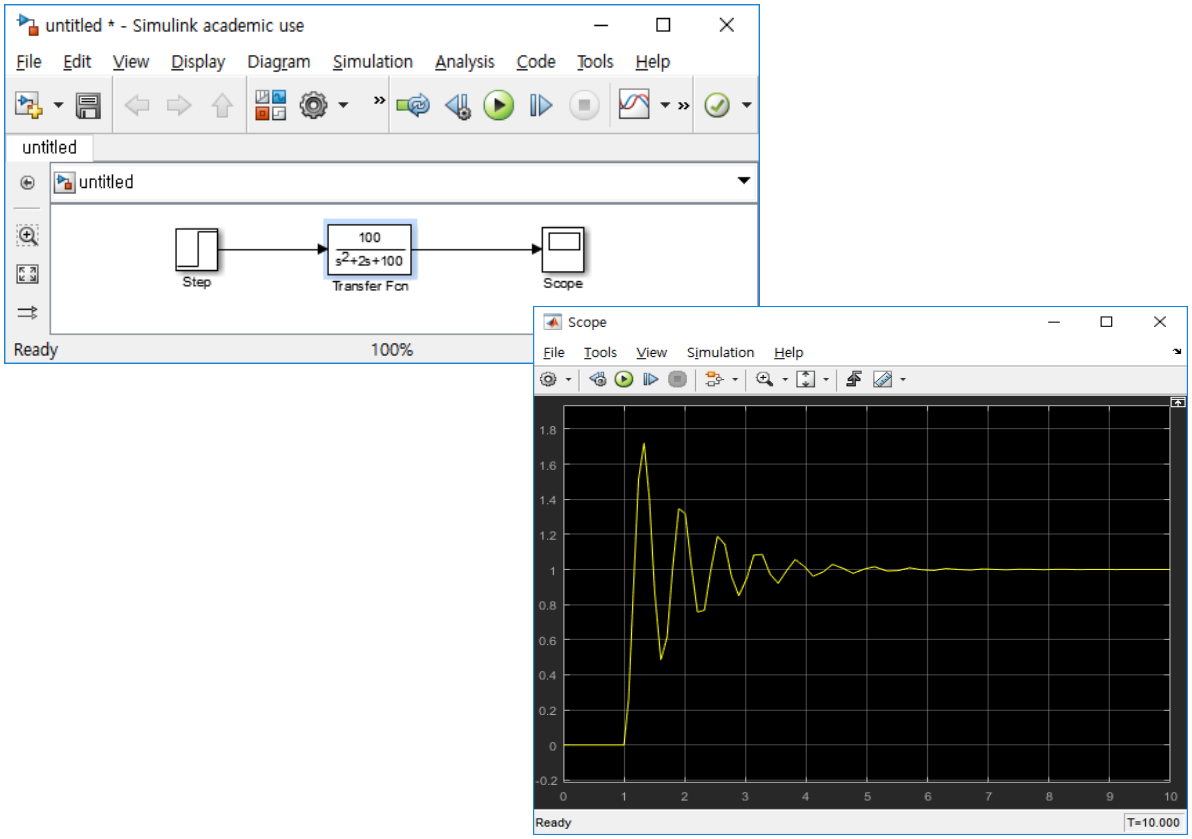


전달 함수 모델

- 1자유도 진동계 단위계단 응답

$$G(s)=\frac{\omega_n^2}{s^2+2\varsigma\omega_n s+\omega_n^2} \qquad \omega_n^2=100,\ 2\varsigma\omega_n=2$$

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File Edit View Display Diagram Simulation Analysis Code Tools Help
untitled
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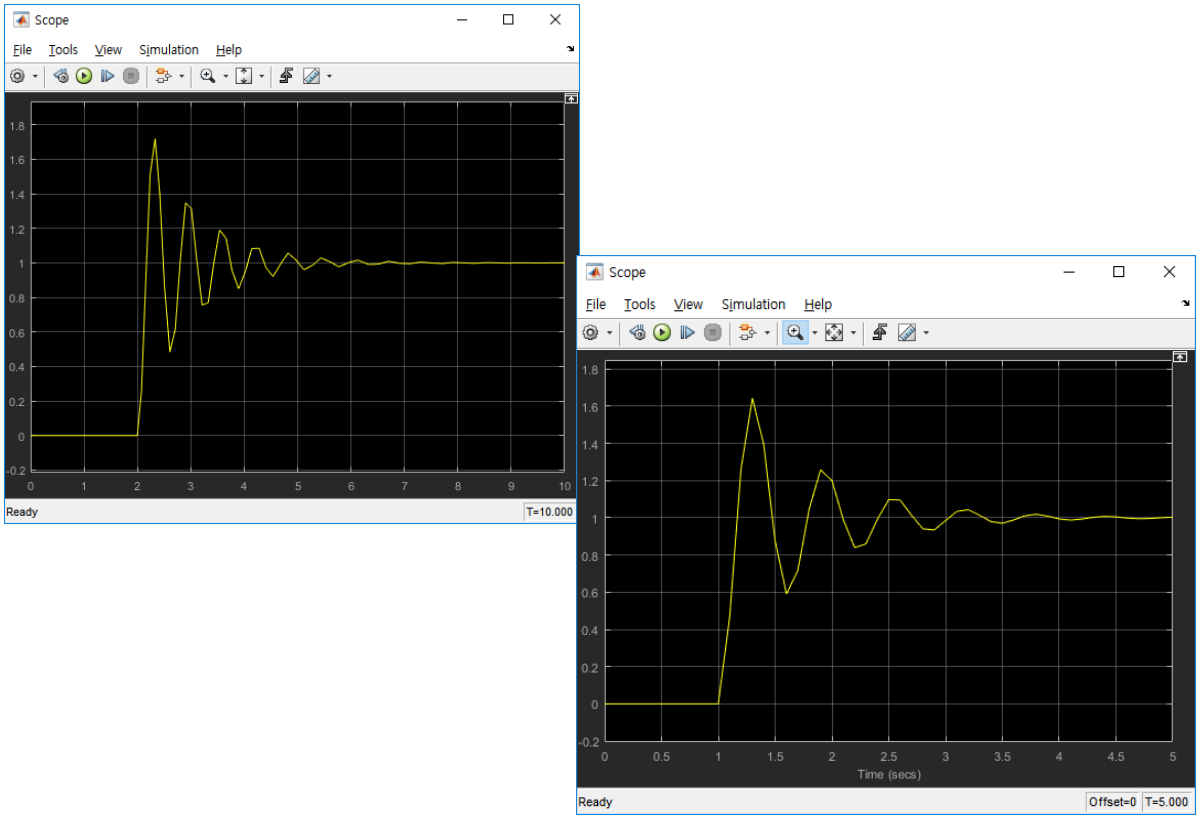
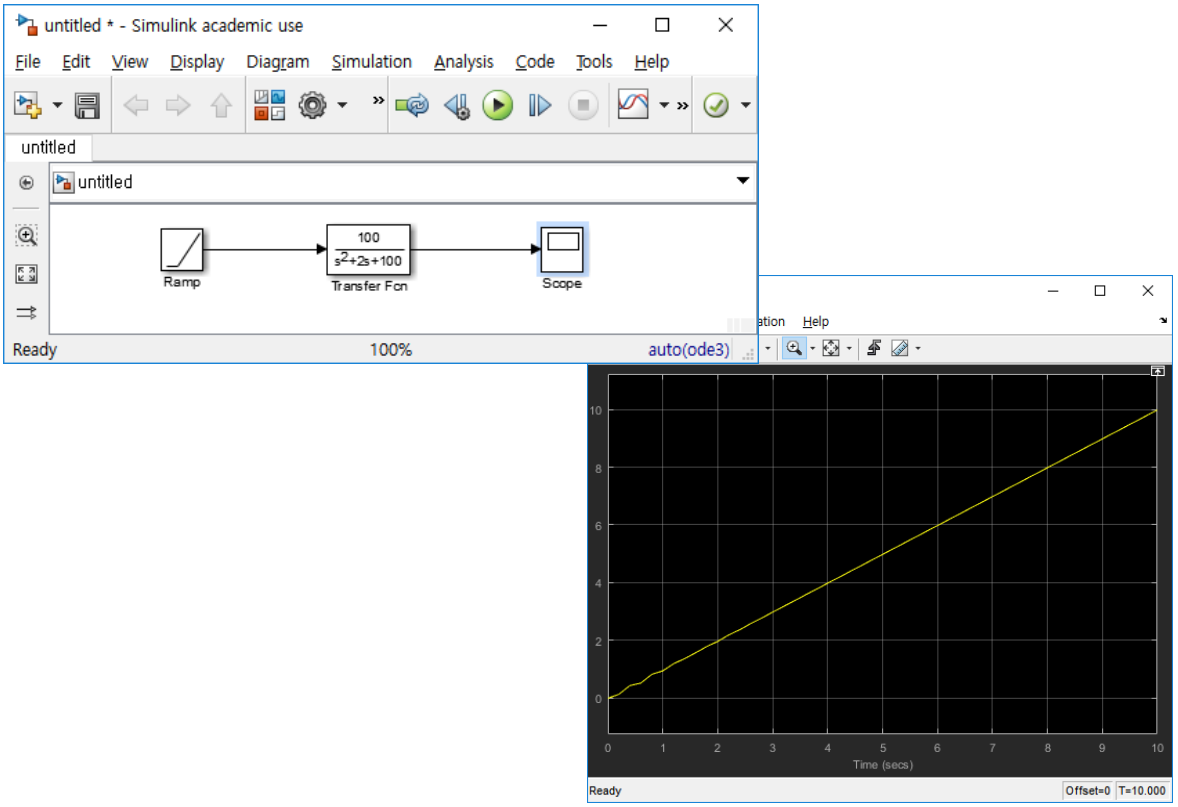
Step
100
s2+2s+100
Transfer Fcn
Scope
Ready
100%
Scope
File Tools View Simulation Help
Ready
T=10.000


Scope
File Tools View Simulation Help
Ready
T=10.000
Scope
File Tools View Simulation Help
Time (secs)
Ready
Offset=0
T=5.000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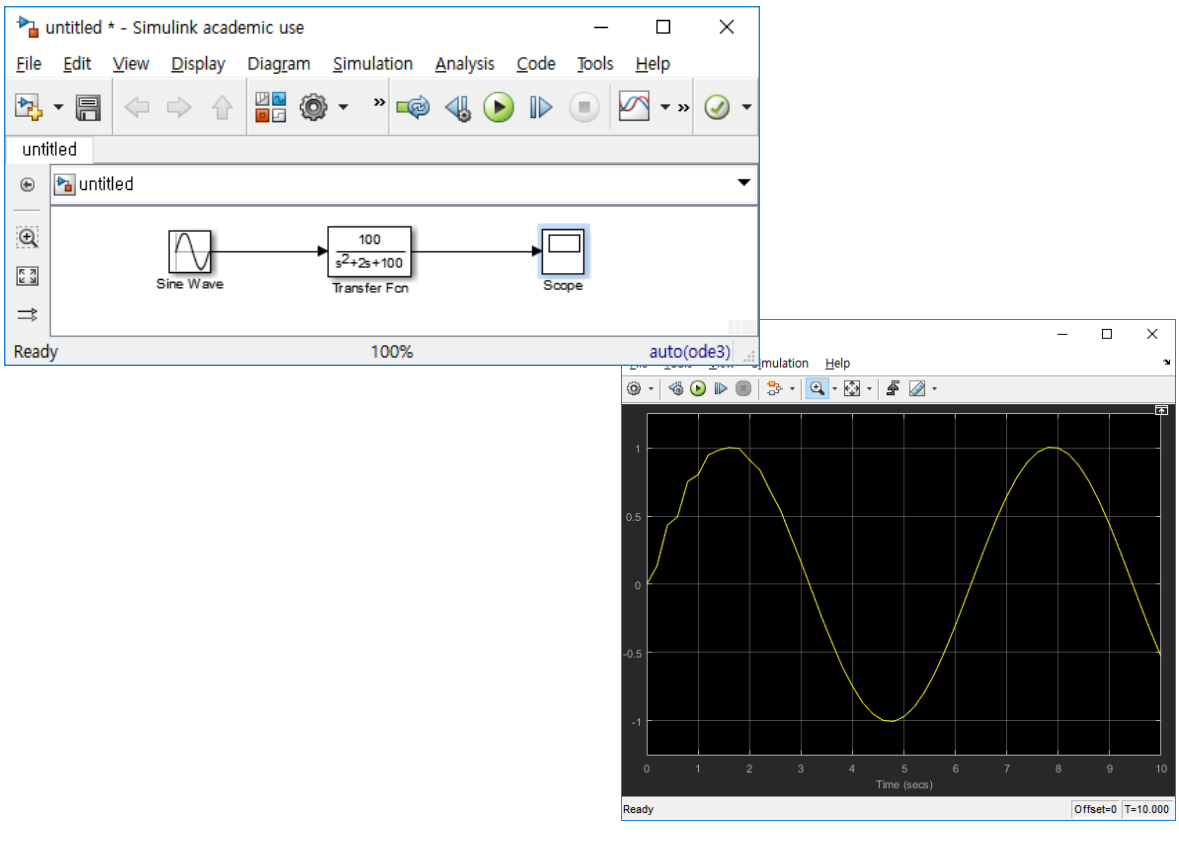
Ramp
100
s2+2s+100
Transfer Fcn
Scope
Ready
100%
auto(ode3)
Help
10
8
6
4
2
0
0 1 2 3 4 5 6 7 8 9 10
Time (secs)
Ready
Offset=0
T=10.000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File Edit View Display Diagram Simulation Analysis Code Tools Help
untitled
untitled
Sine Wave
100
s2+2s+100
Transfer Fcn
Scope
Ready
100%
auto(ode3)
Help
1
0.5
0
-0.5
-1
0 1 2 3 4 5 6 7 8 9 10
Time (secs)
Ready
Offset=0
T=10.000

전달 함수 모델 변경 (비선형 고려)

- 진동 시스템의 운동방정식
  - 데드존(dead-zone)의 비선형성을 갖는 유압 피스톤에 정현파 입력 전압을 인가하여 힘f(t)를 구성하는 경우

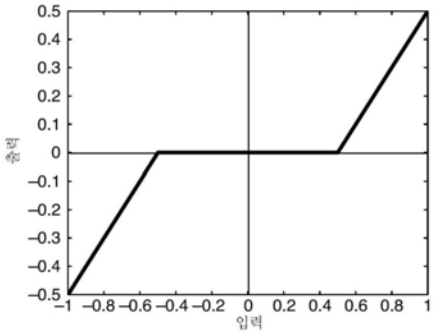
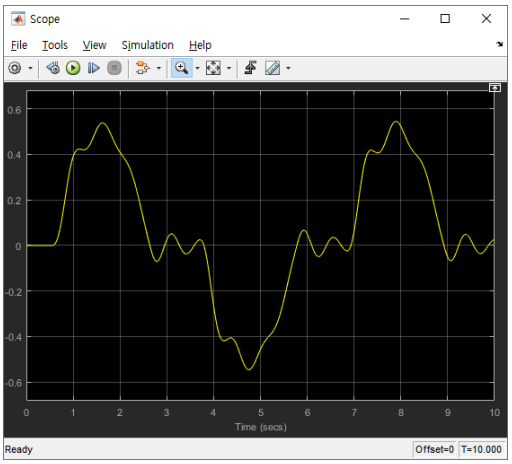
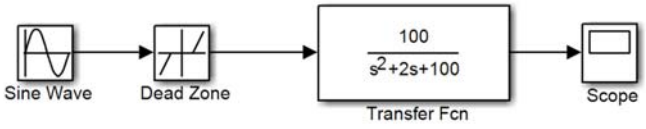


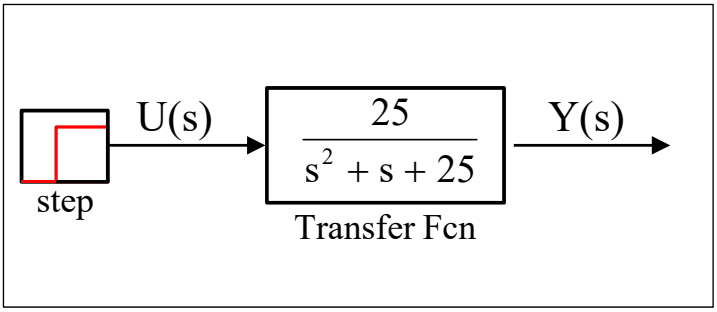
그림 A 데드존



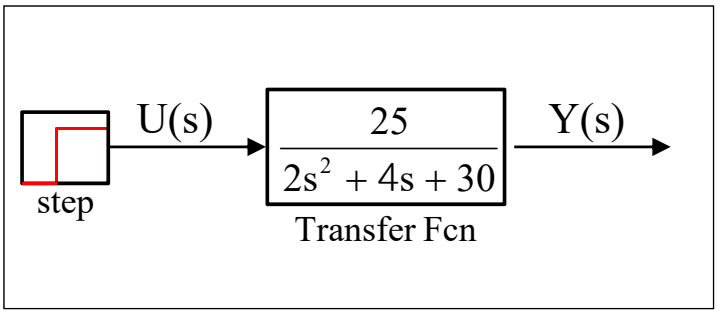


데드존 응답의 시뮬링크 모델

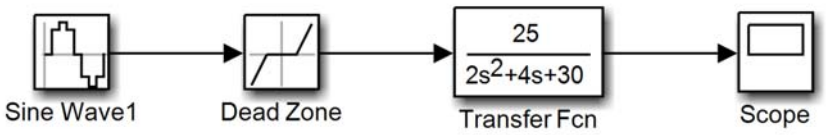
(예제 1)

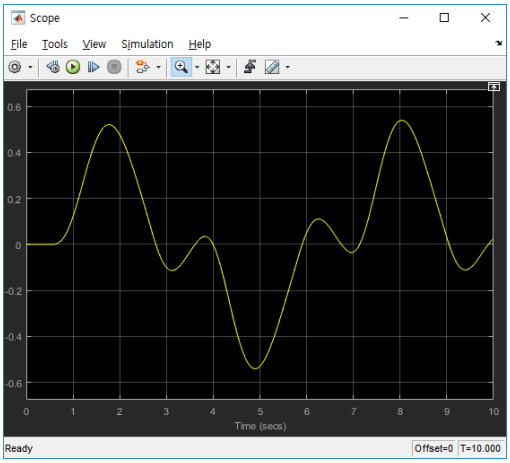


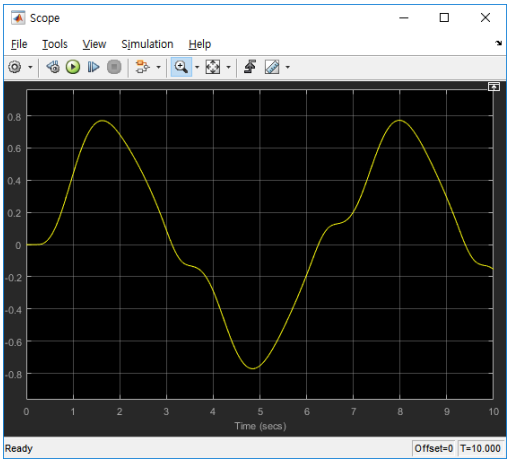
(예제 2) 응답 해석



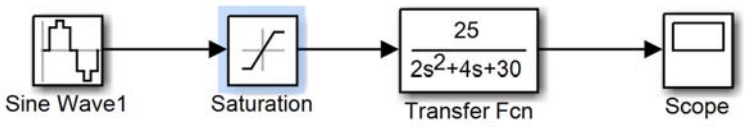
(예제 3) 비선형 시스템 응답해석

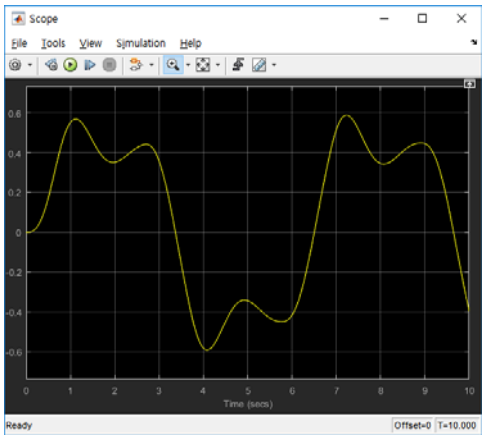


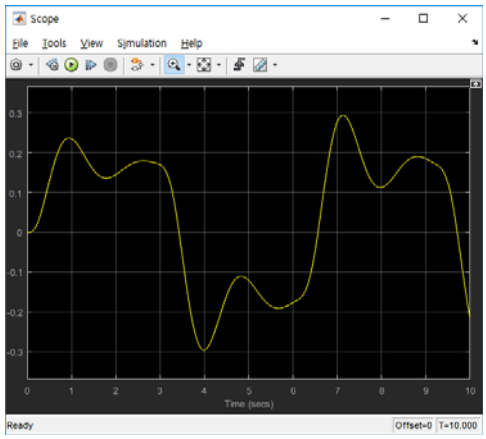




(예제 4) 비선형 모델 응답 해석 (Saturation model)



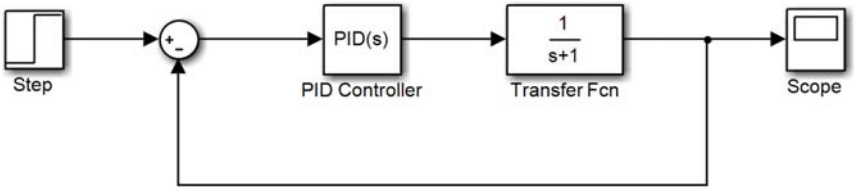




PID 제어 (1차시스템)

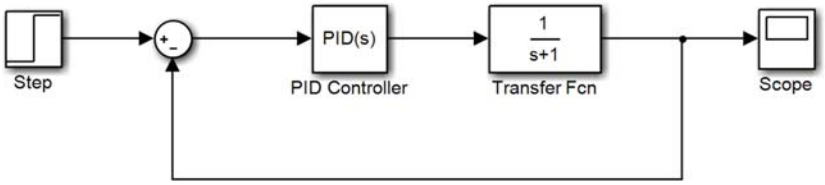
- 대상 시스템

$$G(s) = \frac{1}{Ts+1}, \quad T = 1$$

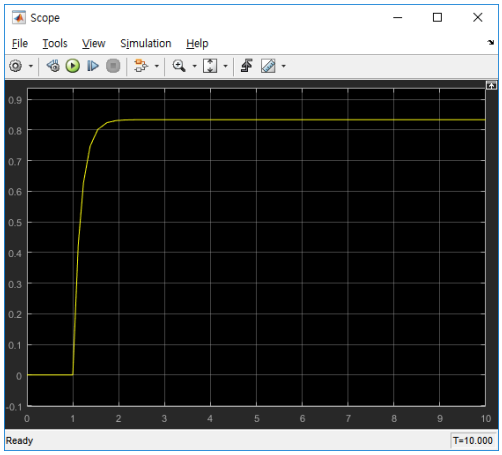


P제어

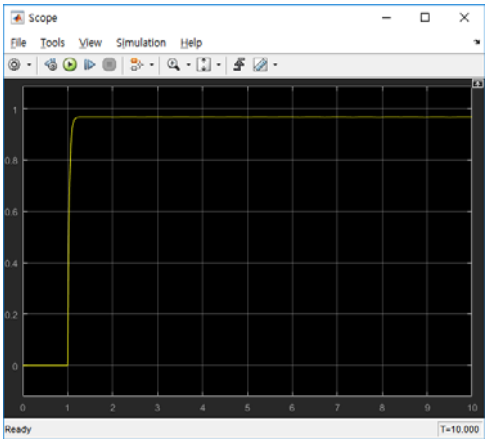
- 대상 시스템



P=5

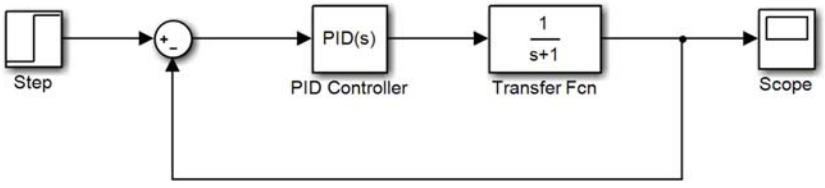


P=30

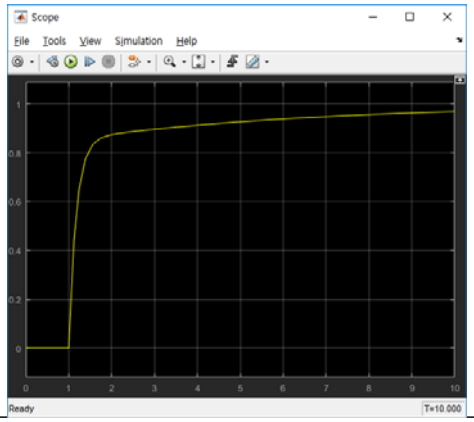


PI제어

- 대상 시스템



P=5
I=1



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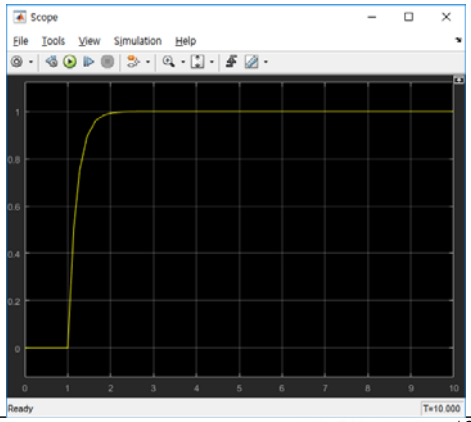
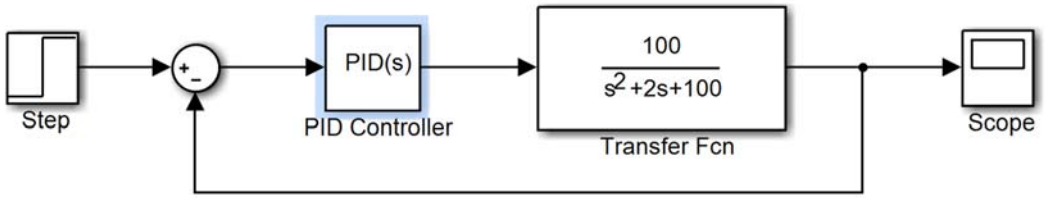


PID 제어 (2차시스템)

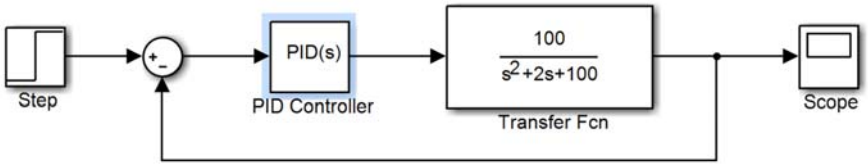
- 대상 시스템

$$G(s) = \frac{\omega_n^2}{s^2 + 2\varsigma\omega_n s + \omega_n^2} \qquad \omega_n^2 = 100,\ 2\varsigma\omega_n = 2$$

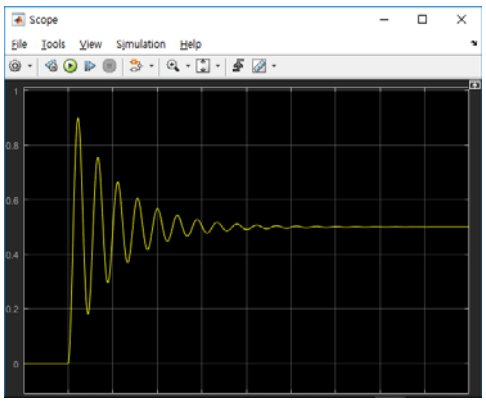


P제어

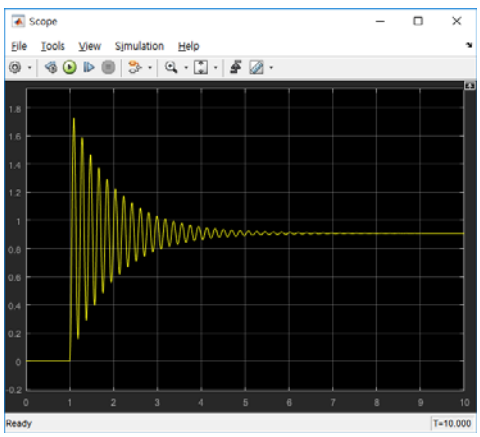
- 대상 시스템



P=1

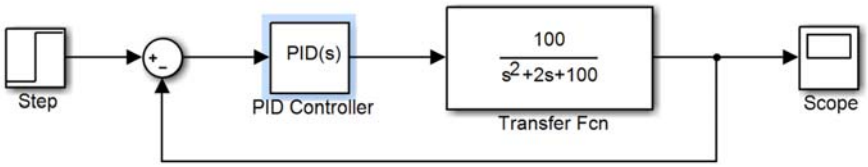


P=10



PI제어

- 대상 시스템



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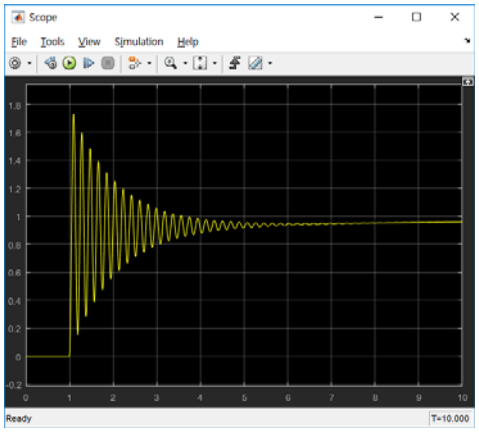
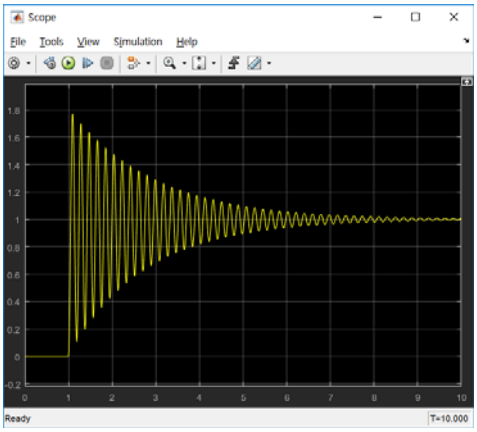
I=1

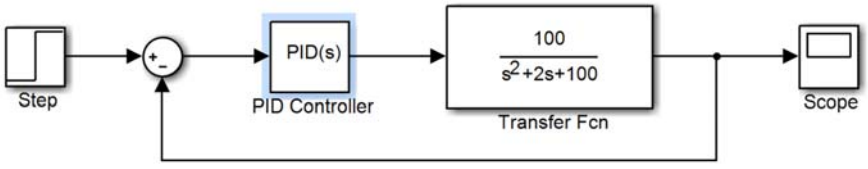


P=10
I=10



PD제어

- 대상 시스템



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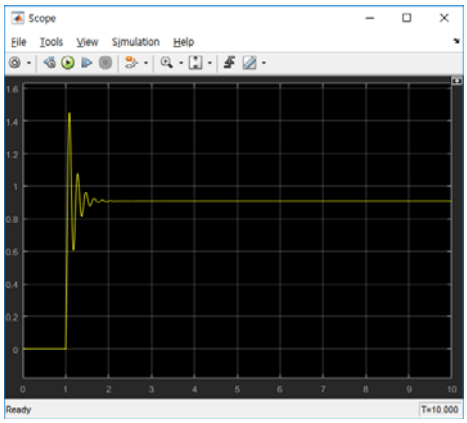
D=0.1



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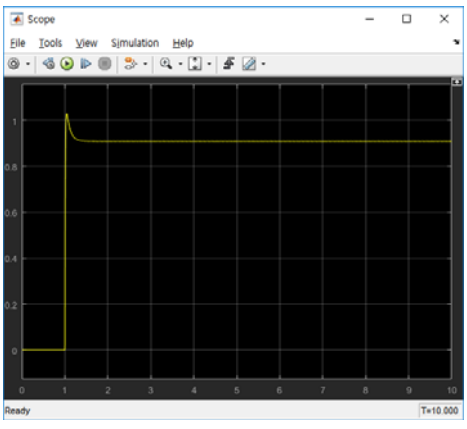
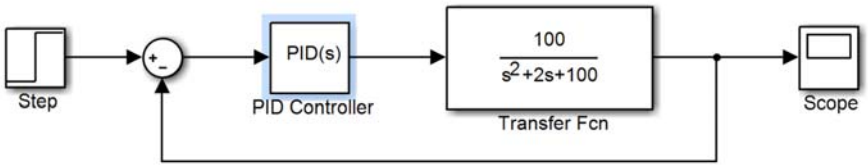
D=1

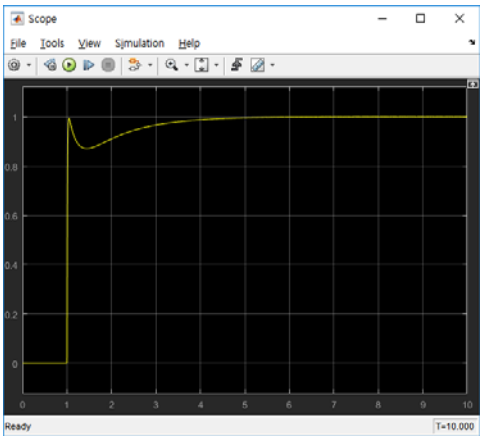


PID제어

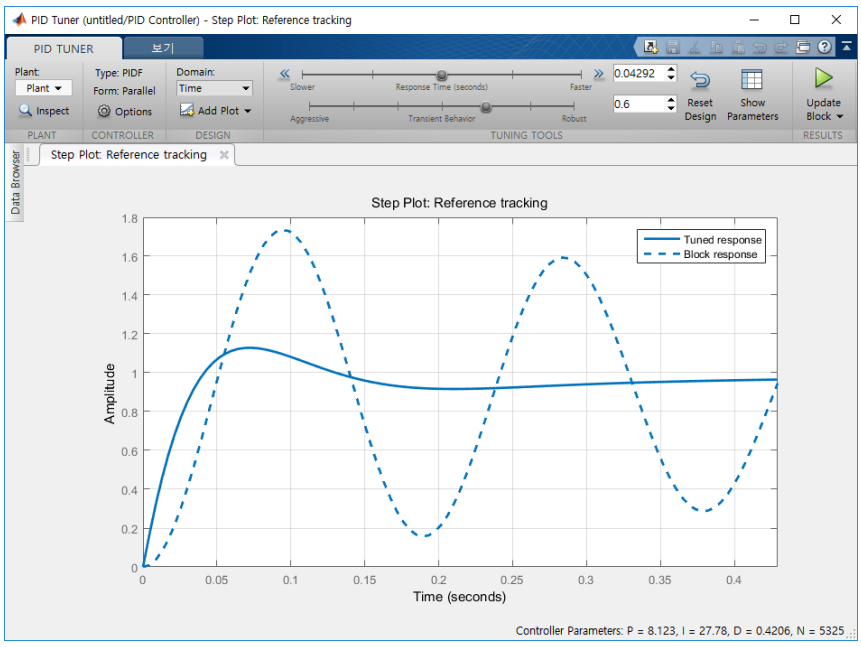
- 대상 시스템



P=5
I=5
D=1

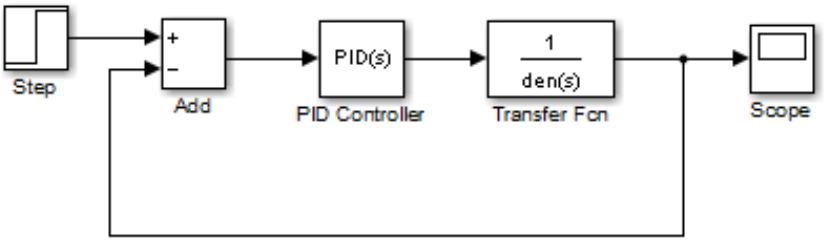


PID 자동 튜닝



(예제 5) 고차 시스템 시뮬레이션

$$G(s) = \frac{1}{s^3 + 2s^2 + 2s + 3}$$



고차 시스템에 대해 비례-적분-미분 게인을 변화시키면서 제어 특성을 분석하시오.