

Experiment3

PID Gain 값

- $K_i=0.05$
- $K_p=3$
- $K_d=0.5$

가속 시간

- $Ta_3 = 0.05s$

```
import pandas as pdimport matplotlib.pyplot as plt
```

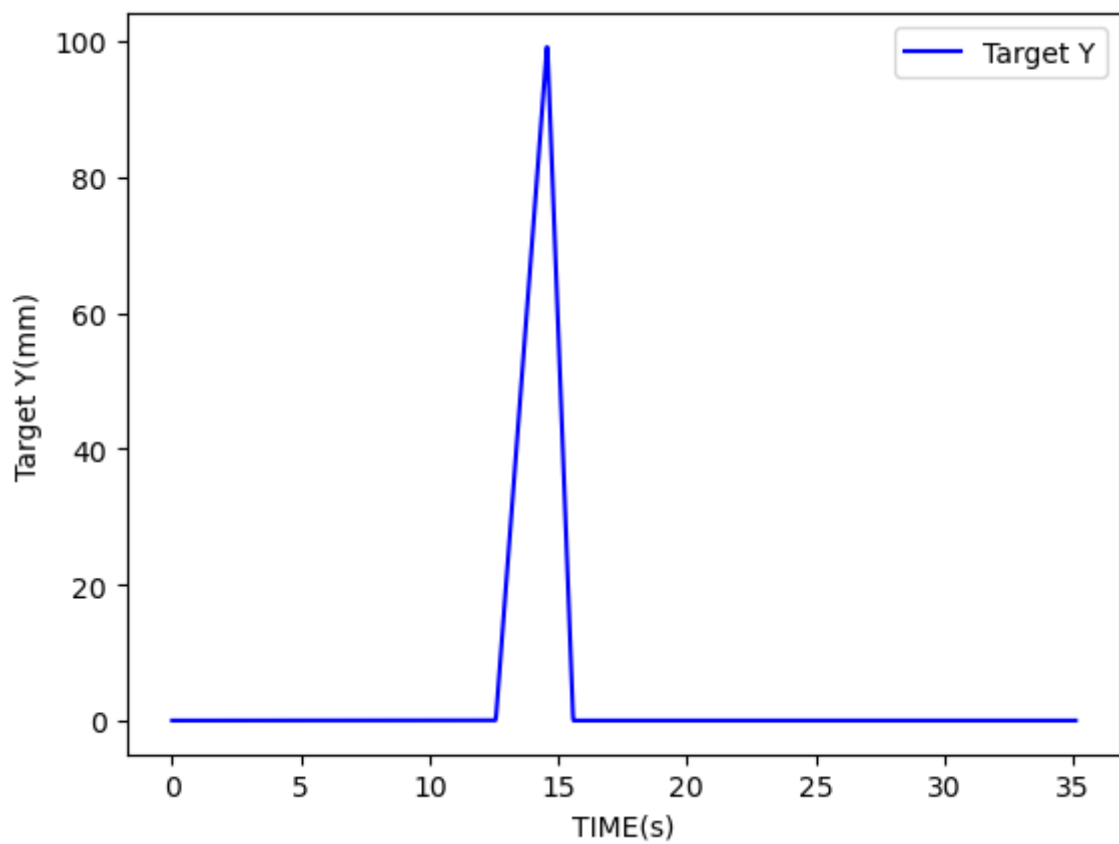
```
data3 = pd.read_csv("Experiment3.csv")
```

data3

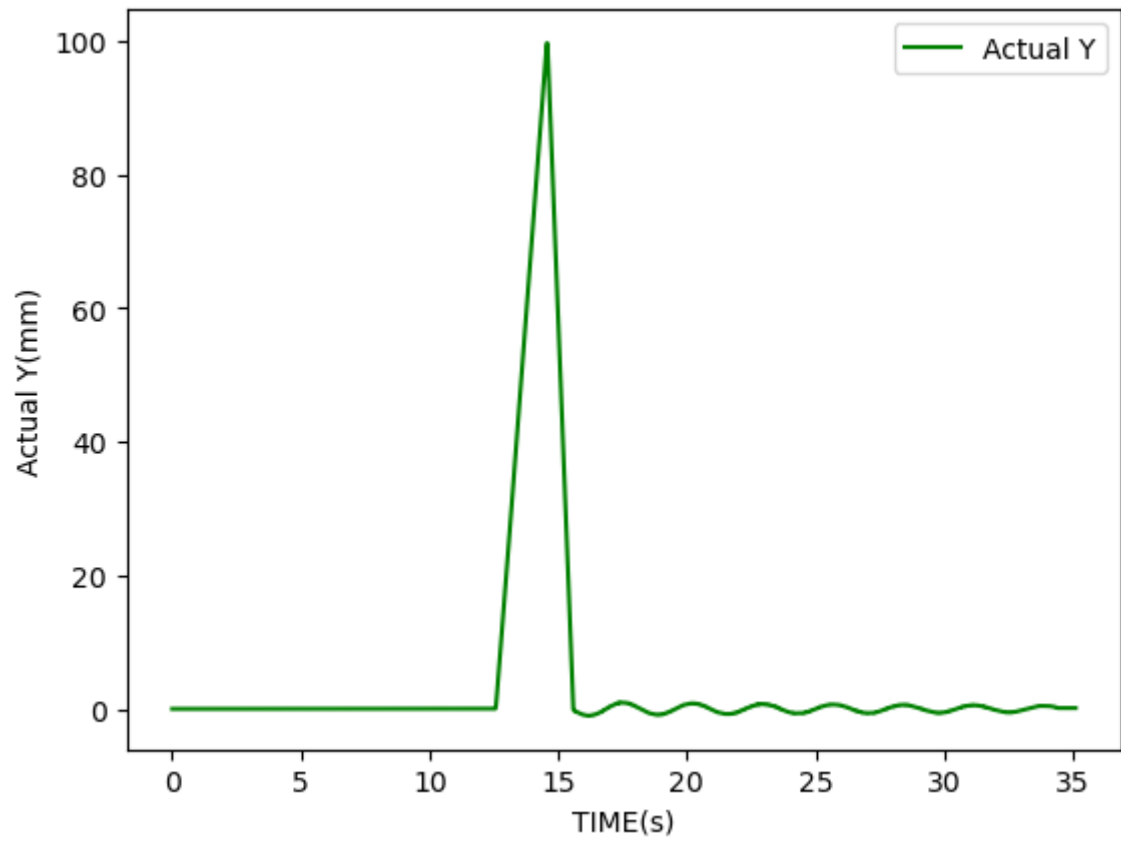
	TIME	Target Y	Actual Y	Following Error
0	0.00000	0.000000e+00	0.0000	0.0000
1	0.00010	0.000000e+00	0.0000	0.0000
2	0.00020	0.000000e+00	0.0000	0.0000
3	0.00030	0.000000e+00	0.0000	0.0000
4	0.00040	0.000000e+00	0.0000	0.0000
...
351063	35.10697	-3.030000e-11	0.1282	-0.1282
351064	35.10707	-3.030000e-11	0.1282	-0.1282
351065	35.10717	-3.030000e-11	0.1282	-0.1282
351066	35.10727	-3.030000e-11	0.1282	-0.1282
351067	35.10737	-3.030000e-11	0.1282	-0.1282

351068 rows × 4 columns

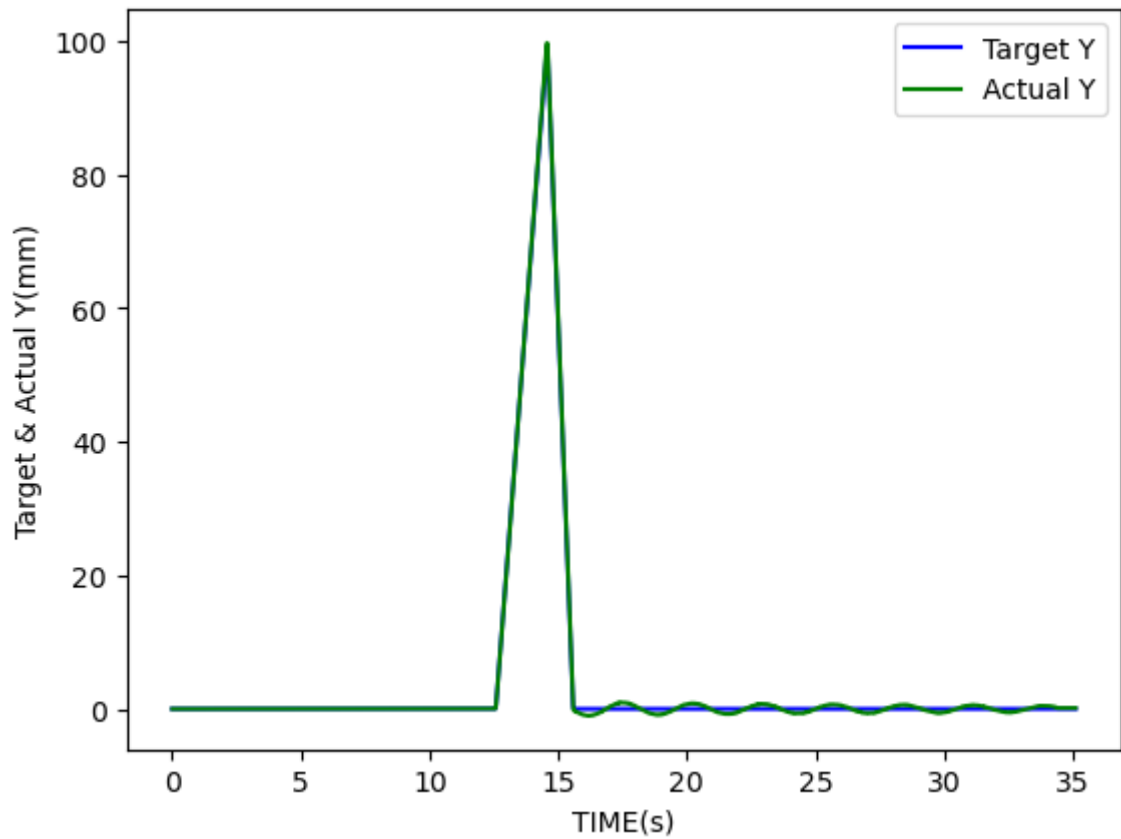
```
x = data3["TIME"]
y1 = data3["Target Y"]
plt.plot(x, y1, 'b', label = "Target Y")
plt.xlabel("TIME(s)")
plt.ylabel("Target Y(mm)")
plt.legend(loc="best")
plt.show()
```



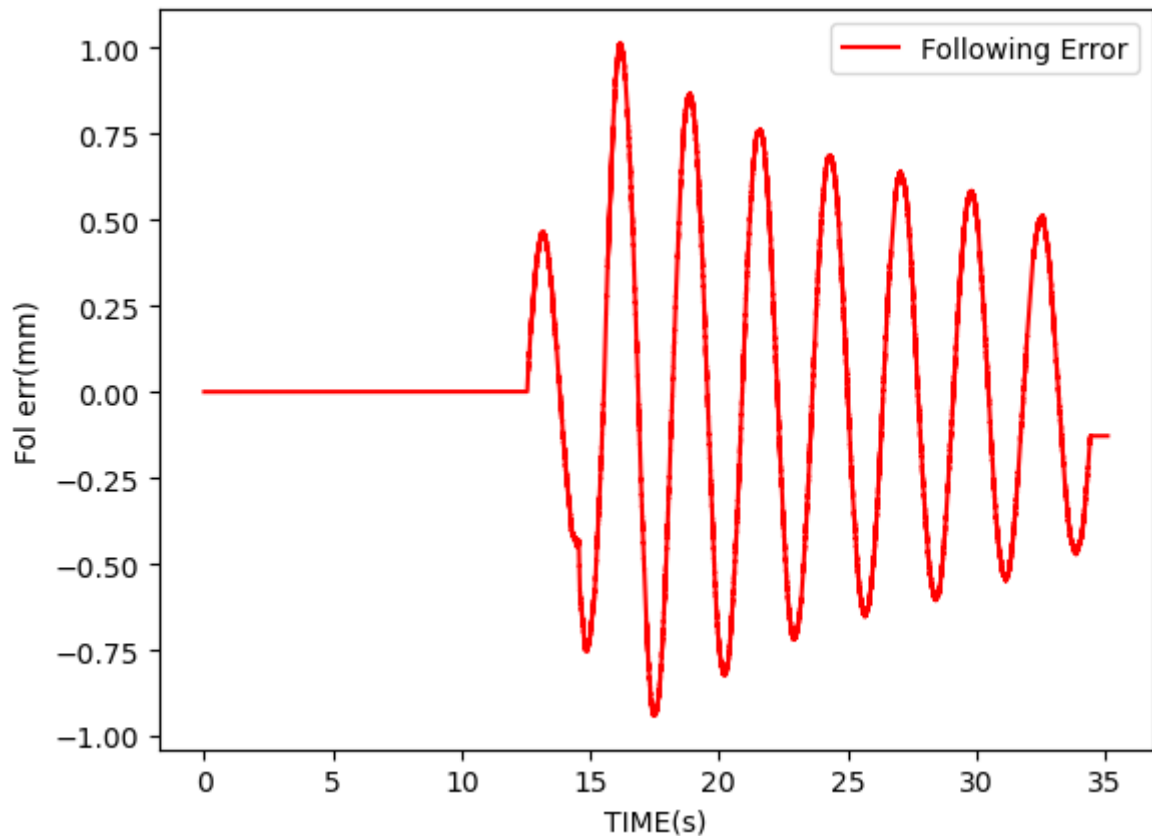
```
y2 = data3["Actual Y"]
plt.plot(x, y2, 'g', label = "Actual Y")
plt.xlabel("TIME(s)")
plt.ylabel("Actual Y(mm)")
plt.legend(loc="best")
plt.show()
```



```
plt.plot(x, y1, 'b', label = "Target Y")
plt.plot(x, y2, 'g', label = "Actual Y")
plt.xlabel("TIME(s)")
plt.ylabel("Target & Actual Y(mm)")
plt.legend(loc="best")
plt.show()
```



```
y3 = data3["Following Error"]  
plt.plot(x, y3, 'r', label = "Following Error")  
plt.xlabel("TIME(s)")  
plt.ylabel("Fol err(mm)")  
plt.legend(loc="best")  
plt.show()
```



분석

```
print("목표 변위의 최대값: ", max(y1), "mm")
print("실제 변위의 최대값: ", max(y2), "mm")
```

목표 변위의 최대값: 99.16667 mm

실제 변위의 최대값: 99.6482 mm

목표 변위가 0이고 시간이 15초 보다 작을 때

```
data3[(data3["Target Y"]==0) & (data3["TIME"]<15)]
```

	TIME	Target Y	Actual Y	Following Error
0	0.000000	0.0	0.0	0.0

1	0.000100	0.0	0.0	0.0
2	0.000200	0.0	0.0	0.0
3	0.000300	0.0	0.0	0.0
4	0.000400	0.0	0.0	0.0
...
125491	12.549340	0.0	0.0	0.0
125492	12.549440	0.0	0.0	0.0
125493	12.549541	0.0	0.0	0.0
125494	12.549641	0.0	0.0	0.0
125495	12.549741	0.0	0.0	0.0

125496 rows × 4 columns

=> 12.55초 이후에 이송 시작

목표 변위가 대략 0이고 시간이 15초 보다 클 때

```
data3[(data3["Target Y"]>=0) & (data3["TIME"]>15)]
```

	TIME	Target Y	Actual Y	Following Error
149998	15.000082	57.46500	58.1736	-0.70860
149999	15.000182	57.45500	58.1640	-0.70900
150000	15.000282	57.44500	58.1543	-0.70930
150001	15.000382	57.43500	58.1444	-0.70940
150002	15.000482	57.42500	58.1346	-0.70960
...
155989	15.599191	0.00030	-0.1887	0.18900
155990	15.599291	0.00020	-0.1894	0.18960
155991	15.599391	0.00012	-0.1898	0.18992
155992	15.599491	0.00006	-0.1903	0.19036
155993	15.599591	0.00002	-0.1906	0.19062

5996 rows × 4 columns

=> 약 15.6s 에 목표변위가 0이라고 할 수 있다.

15.6초 이후에, 그러니까 모터가 원위치에 도착한 후에도 모터가 진동한다.

그래서 추종오차가 지속적으로 변화하다가 수렴한다.

수렴한 추종 오차 값(Steady state error)는 대략 -0.125mm이다.