

Introduction to Automotive
Report
Lab 2: Braking System with PI Controller



Student Name	Ahmed Mohsen Abd El Fattah
ID	1901061

Brake System with PI Controller:

Proportional Integral is a type of controller that decreases the rising time making the system faster and decreases the steady state error. The PI controller is used to control the slipping percent of the front wheels, aiming to keep it at 10% at which peak force occurs, to decrease the stopping distance as much as possible while making sure the vehicle tires will not slip on the ground.

MATLAB Snippets:

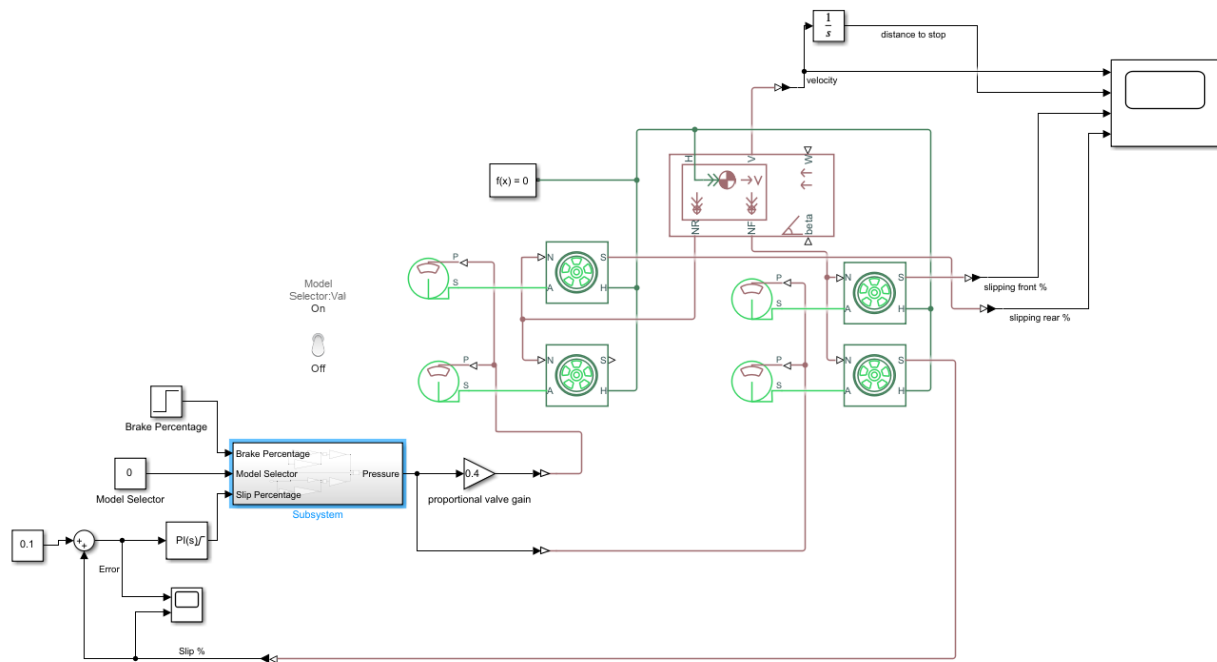


Figure 1 MATLAB Model

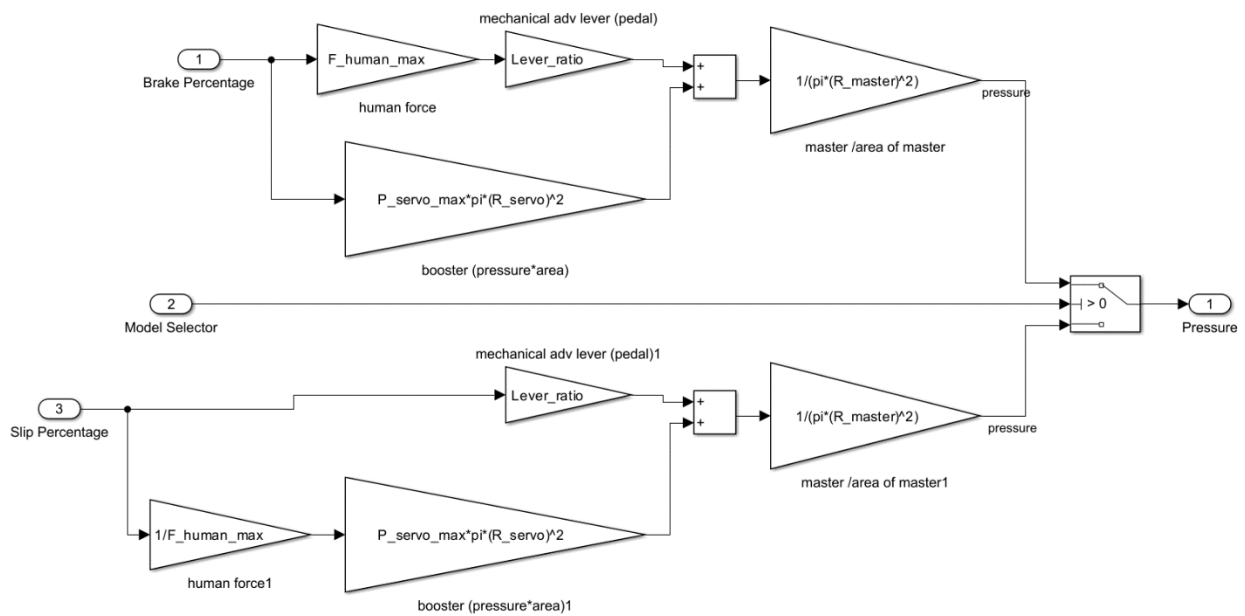



Figure 2 Human to Disk

 Block Parameters: Brake Percentage

×

Step

Output a step.

Main

Signal Attributes

Step time:

0

⋮

Initial value:

0

⋮

Final value:

0.5

⋮

Figure 3 Max Human Force no Slip

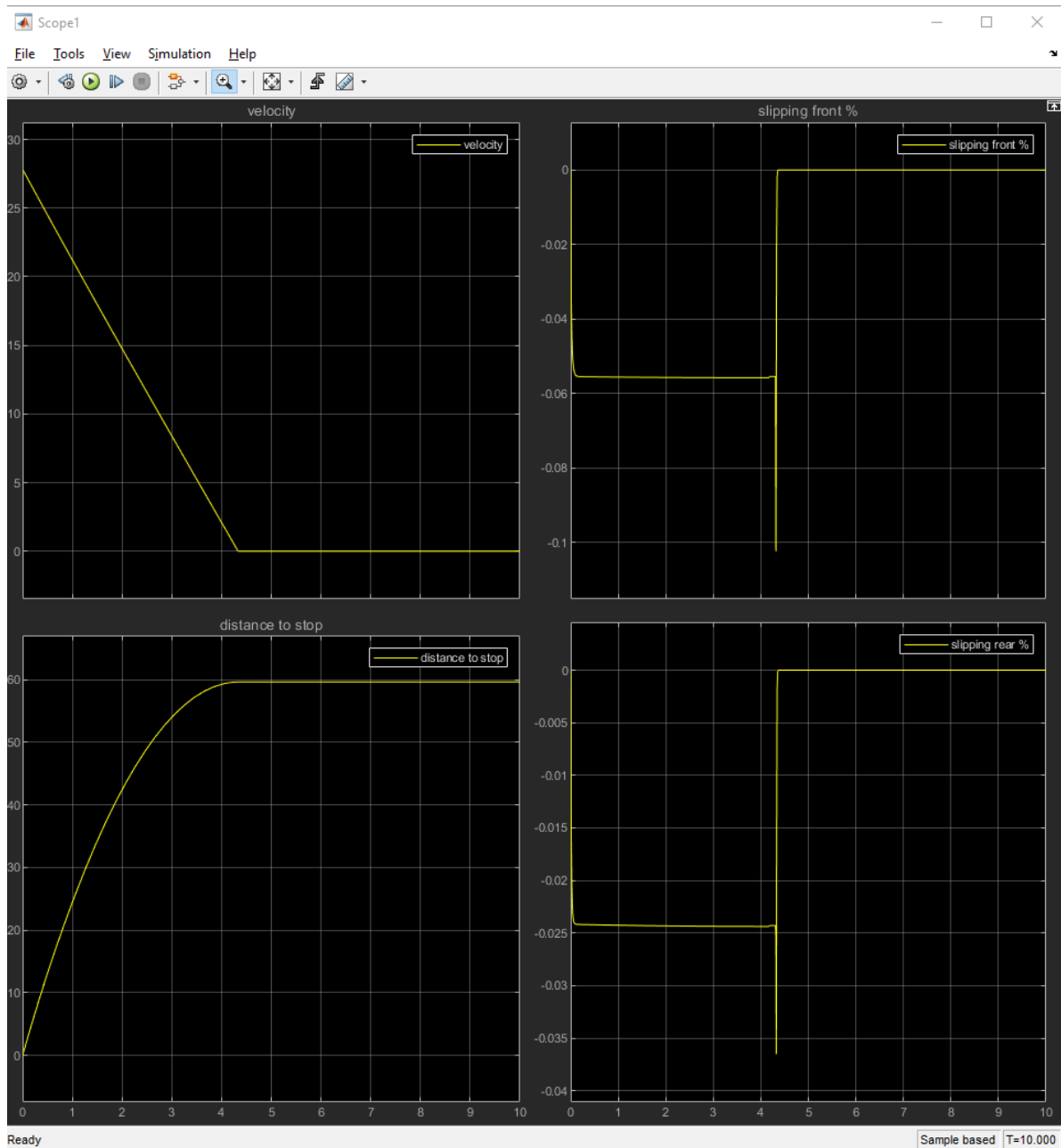



Figure 4 Result Lowest Distance no Slip

 Block Parameters: Brake Percentage ×


Step

Output a step.


Main

Signal Attributes

Step time:



Initial value:



Final value:




Figure 5 Lowest Human Force no Slip

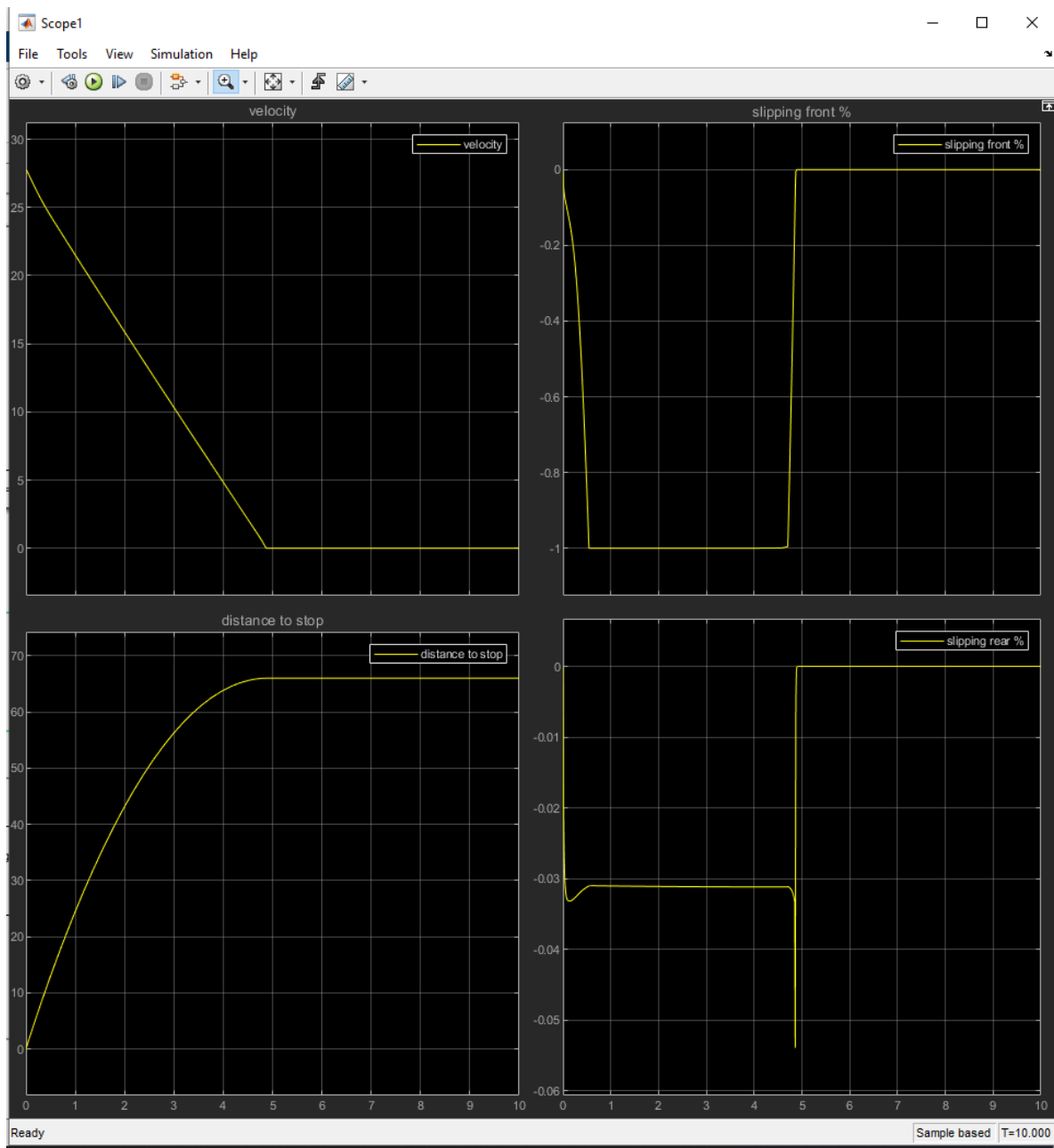


Figure 6 Result

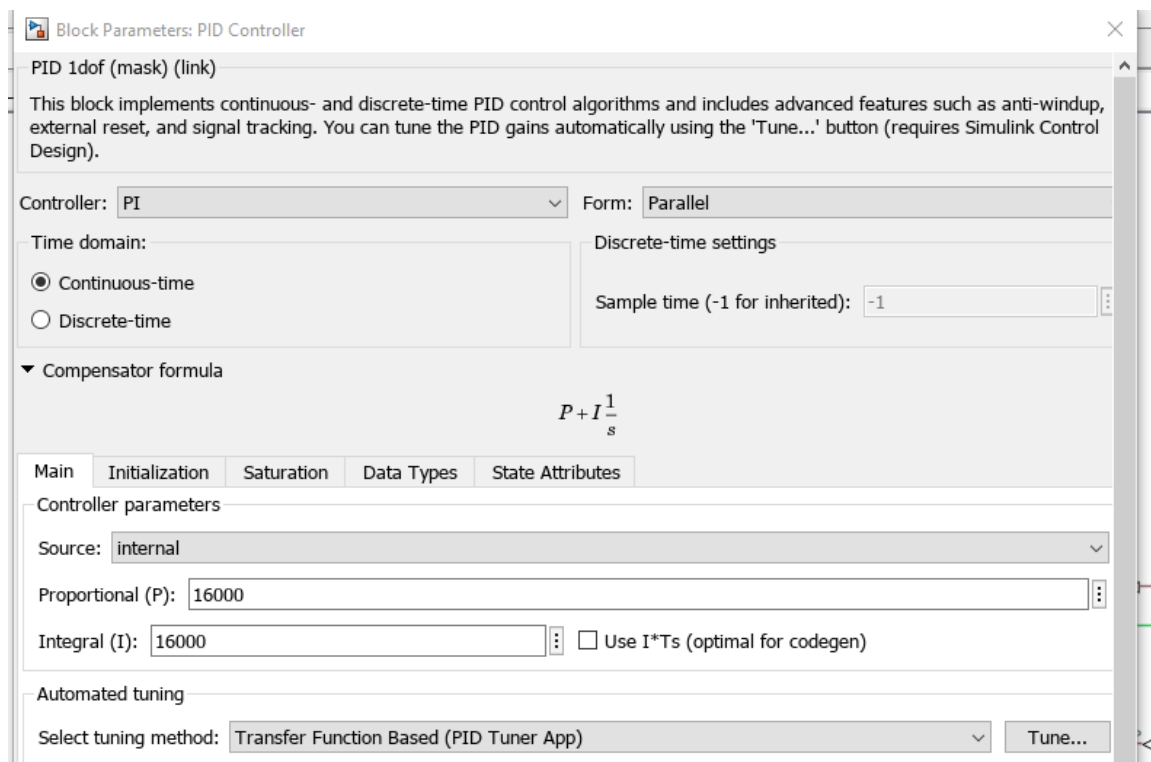


Figure 7 PI Controller

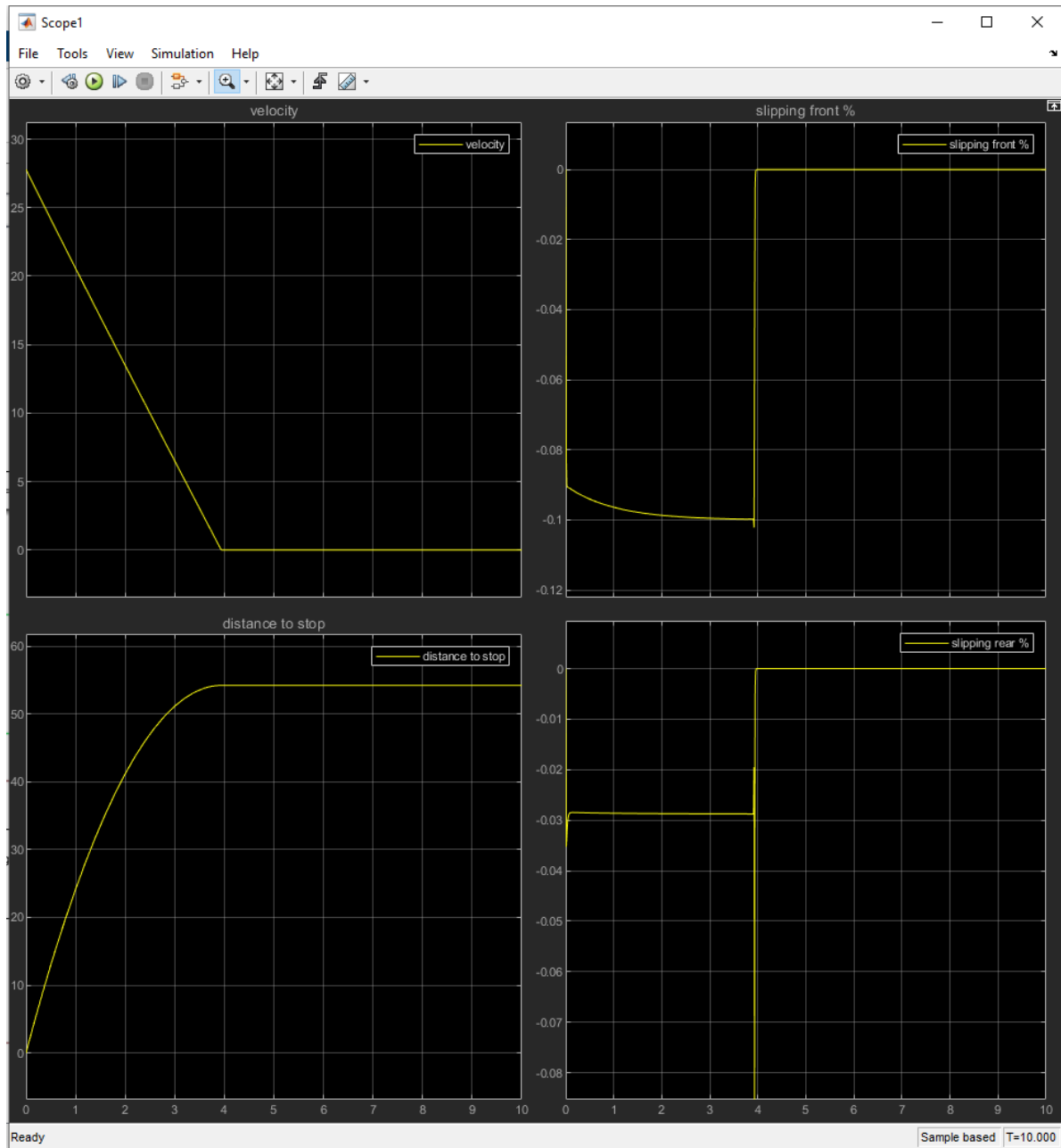


Figure 8 Result of PI Controller

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descretization.mlx ✕ motor_selection_and_dynamics

```
1 F_human_max=300; %Newton
2 Lever_ratio=6;
3 P_servo_max=95000; %Pa
4 R_servo=0.12; %m
5 R_master=0.01111; %m

Disc Brake

6 R_disk=189; %mm
7 D_cylinder=20.32; %mm
8 Visc_coeff=0.001; %N*m*s/rad

Wheel

9 F_rated_wheel=4750; %N
10 s_rated_wheel=0.8;
11 R_wheel=0.2596; %m
12 NO_brake_pads=2;

Vehicle

13 V_initial=100; %kph
14 m_vehicle=1100; %kg
15 f_CG=1.7; %m
16 r_CG=1.94; %m
17 h_CG=0.5; %m
18 Drag_coeff=0.34;
```

Workspace	
Name ▲	Value
D_cylinder	20.3200
Drag_coeff	0.3400
f_CG	1.7000
F_human_max	300
F_rated_wheel	4750
h_CG	0.5000
Lever_ratio	6
m_vehicle	1100
NO_brake_pads	2
out	1x1 Simulation
P_servo_max	95000
r_CG	1.9400
R_disk	189
R_master	0.0111
R_servo	0.1200
R_wheel	0.2596
s_rated_wheel	0.8000
V_initial	100
Visc_coeff	1.0000e-03

Figure 9 MATLAB Live Script

Comments:

- The resulting stop distance with PI controller is lowest as the controller controls and tries to hold the slipping percent of front wheel at 0.1.
- If slipping occurs even if on one wheel the stopping distance increases.