



Practical Speed Control for an Autonomous Golf Cart

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Project Overview Video



Agenda

Introduction

Hardware Modification

Circuit and Speed control system test

Tuning PID and result

Conclusion

Introduction

Introduction

Autonomous Car

Company build Autonomous car

- Tesla
- Waymo
- GM Cruise

Purpose of this research

- Control the speed at stable state
- For farther use in making autonomous vehicle such as trajectory tracking control

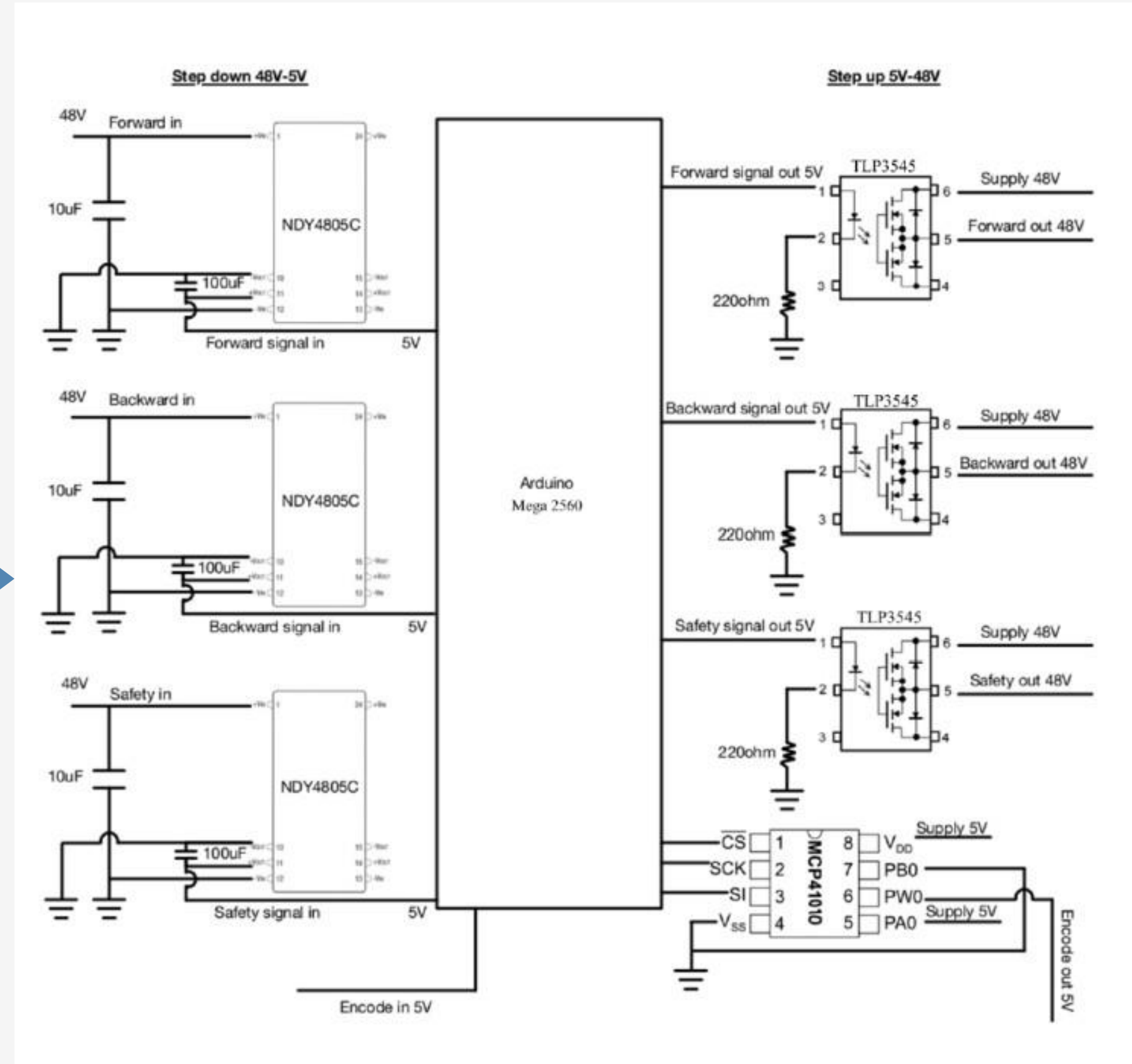
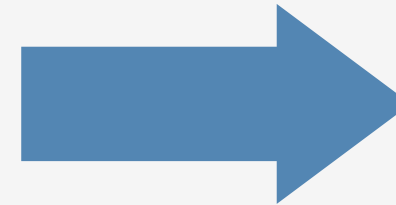
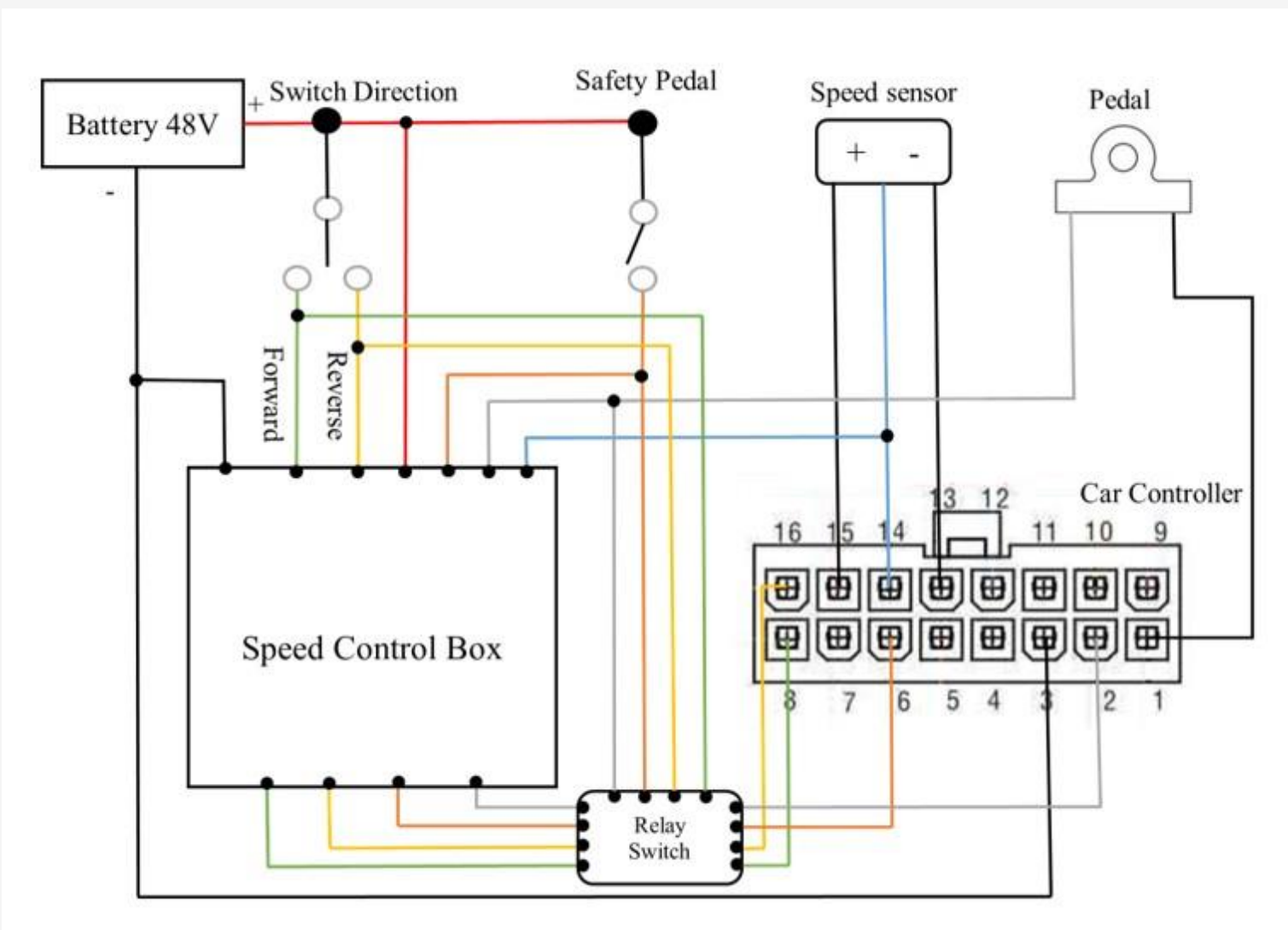


Hardware Modification

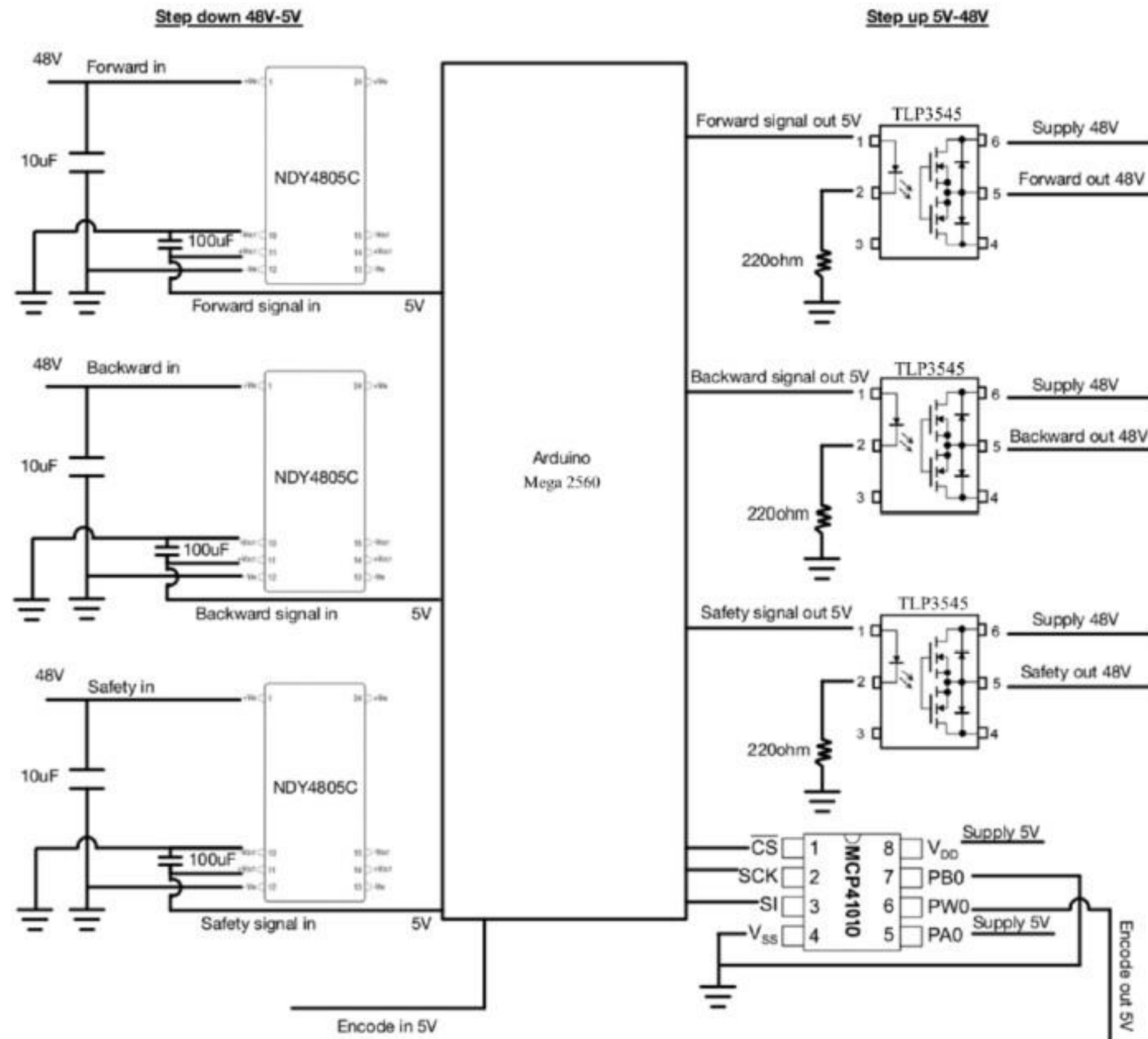
Hardware Modification

Golf cart by club car

Controller : Curtis Model 1515



Circuit Modification

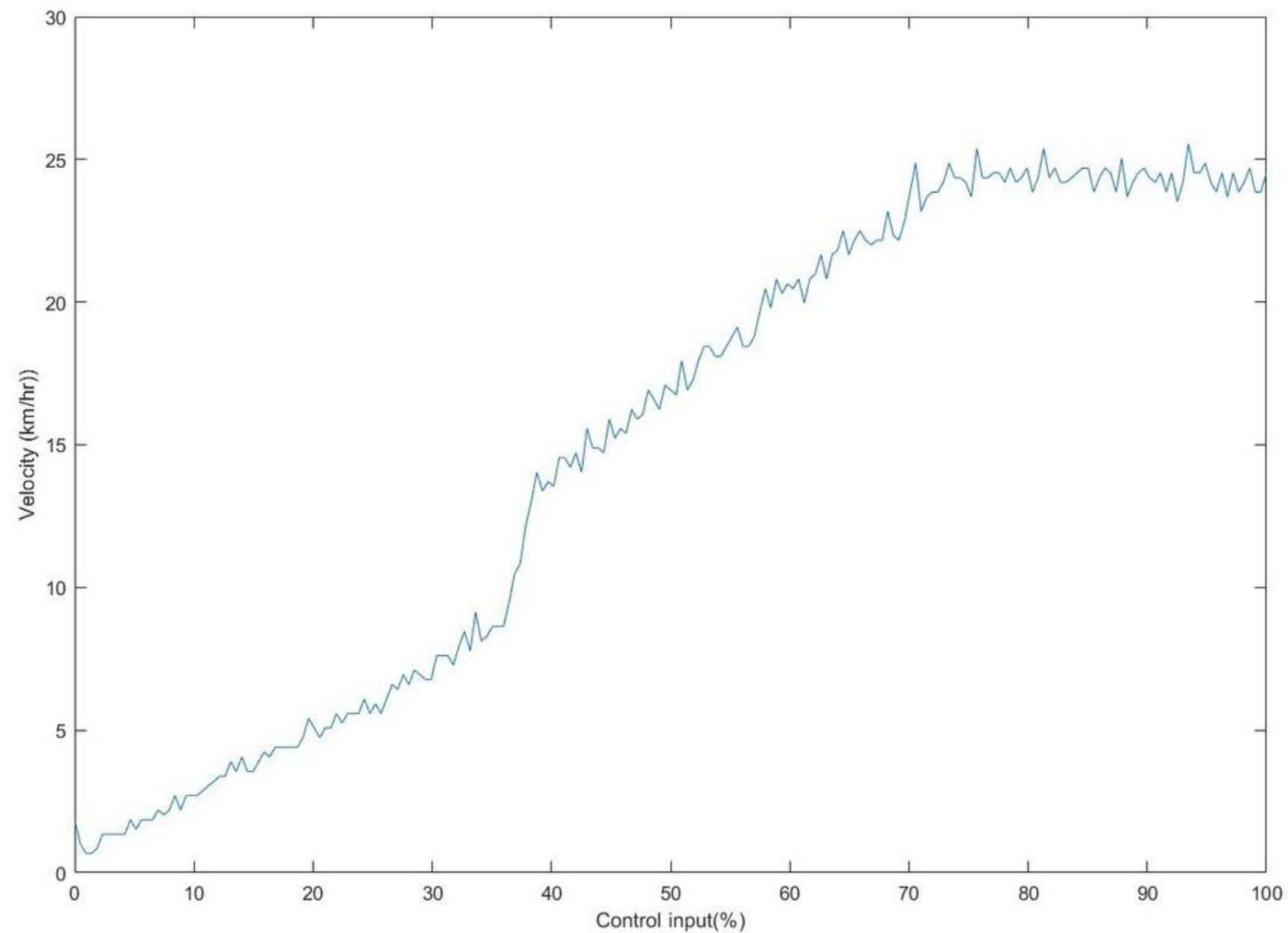


Connect to the controller

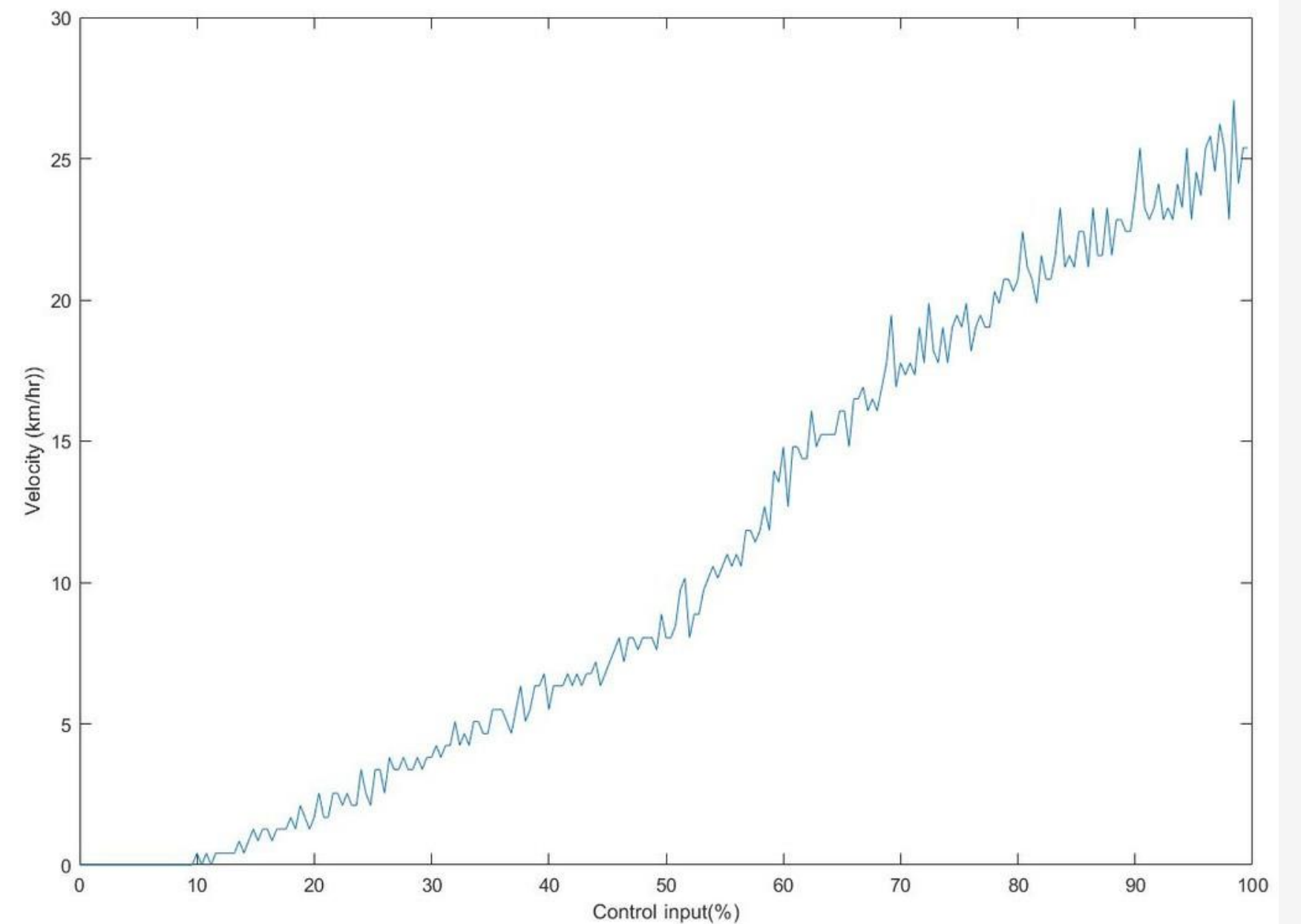
Circuit and Speed control system test

Speed Control System

Test the control output under no load condition



Test the control output under load condition



Speed Control System

Equation Of PID

$$u(k) = k_p e(k) + k_i \sum_{i=1}^k e(i) + k_d \Delta e(k)$$

(error*Kp)+(Ki*sigmaerror)+(Kd*((error-preverror)/dT))



Mapping data and send to control output

Manually adjust gain (from the test)

Kp=6

Ki= 0.0004

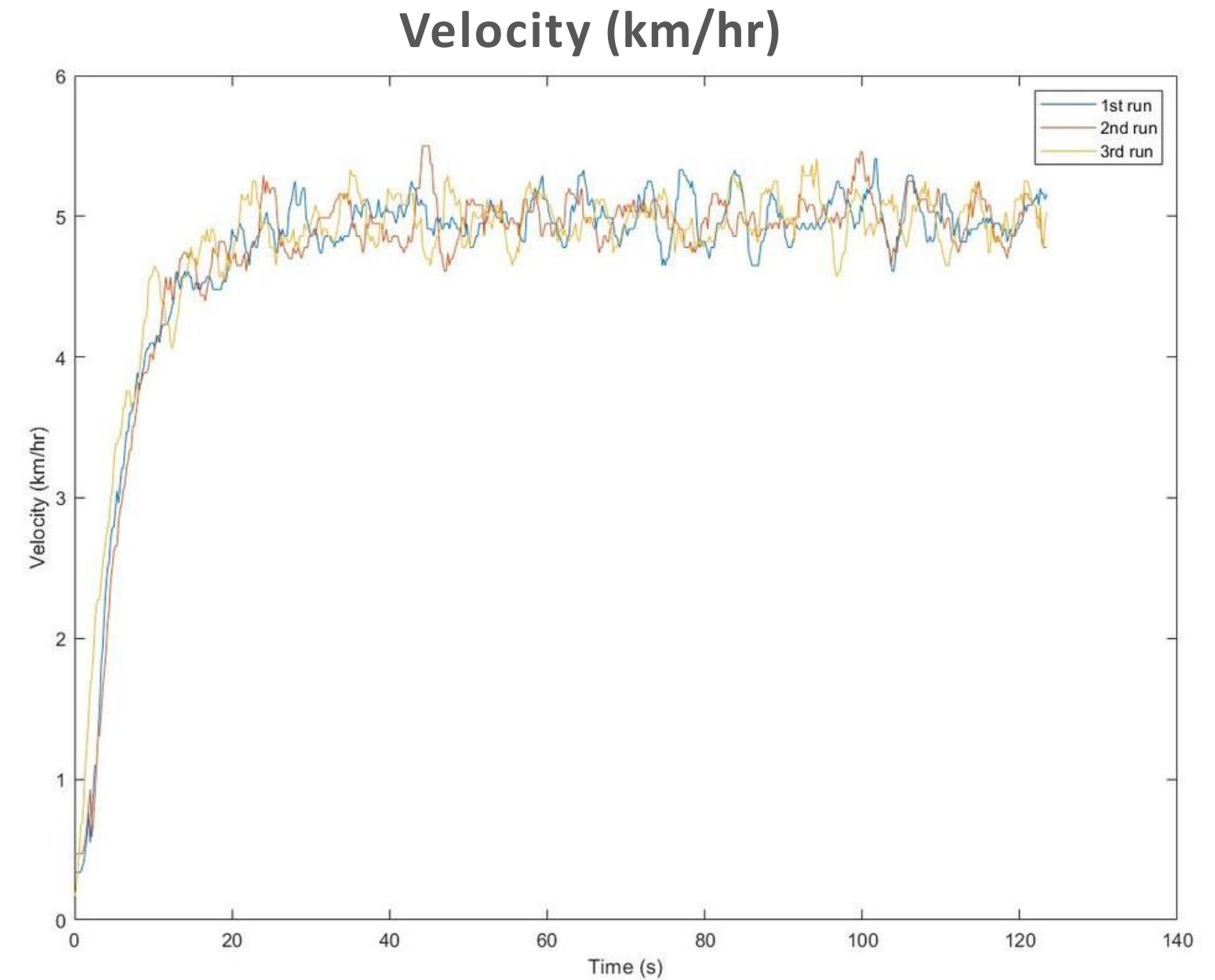
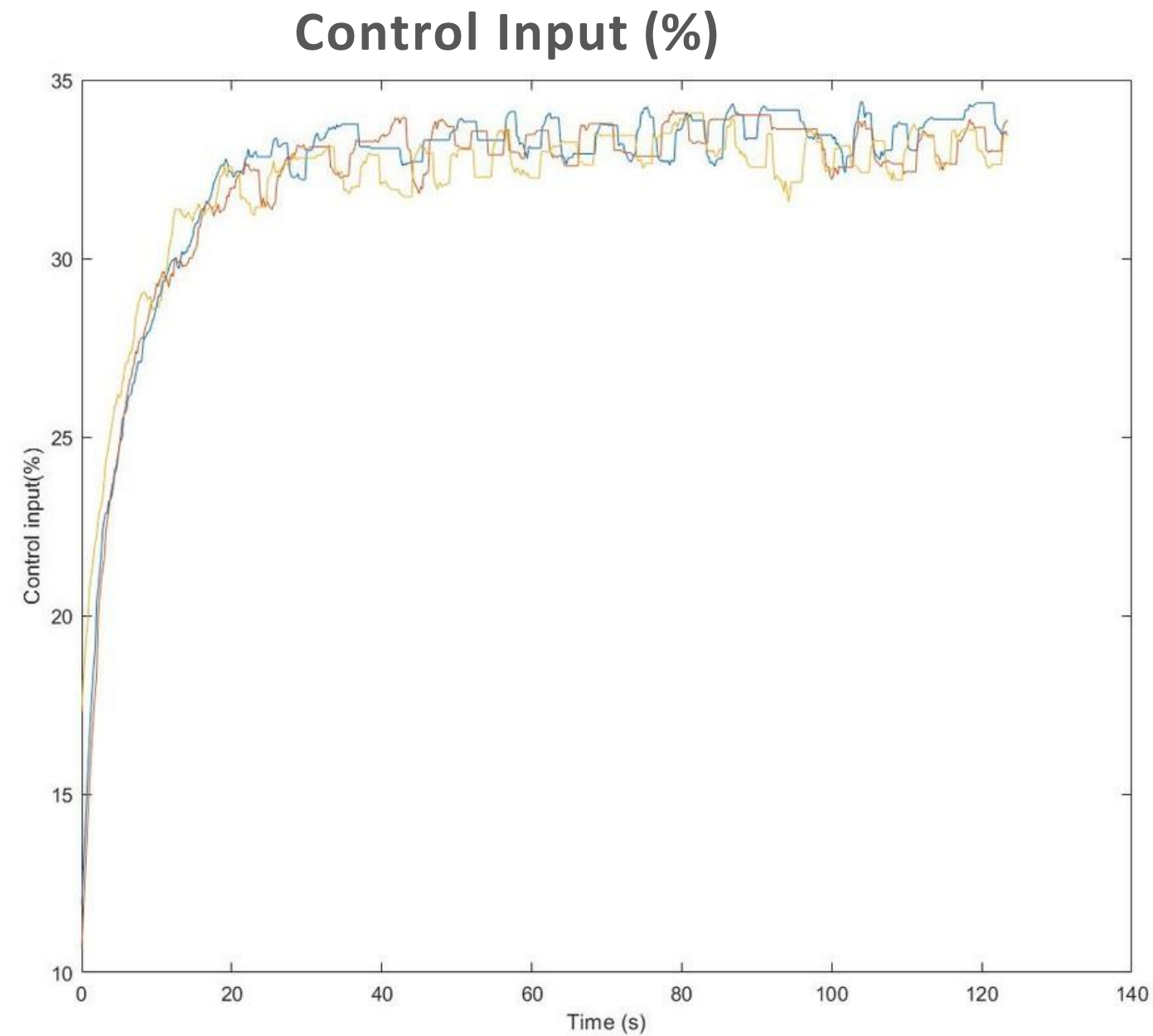
Kd =5

Tuning PID and Result

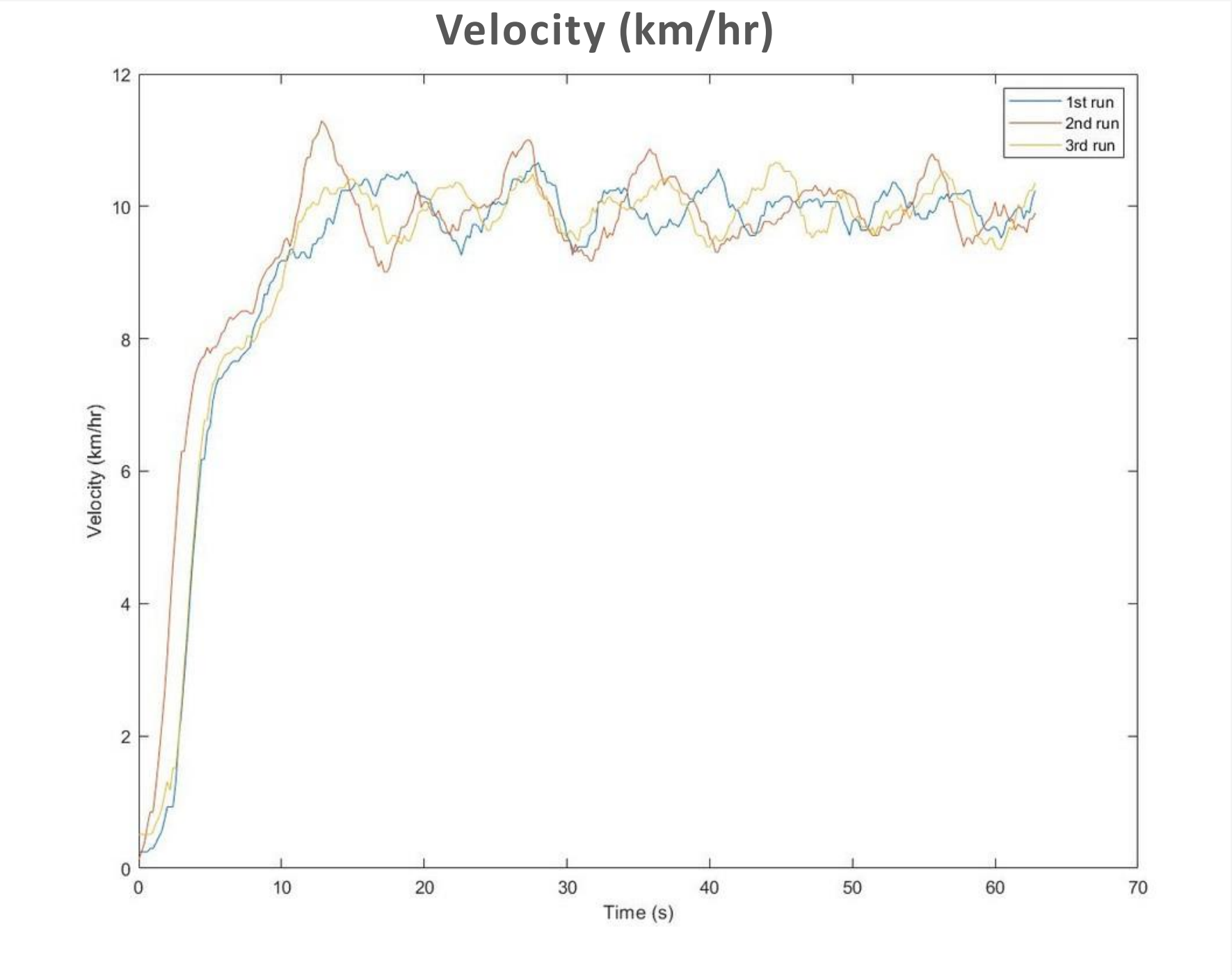
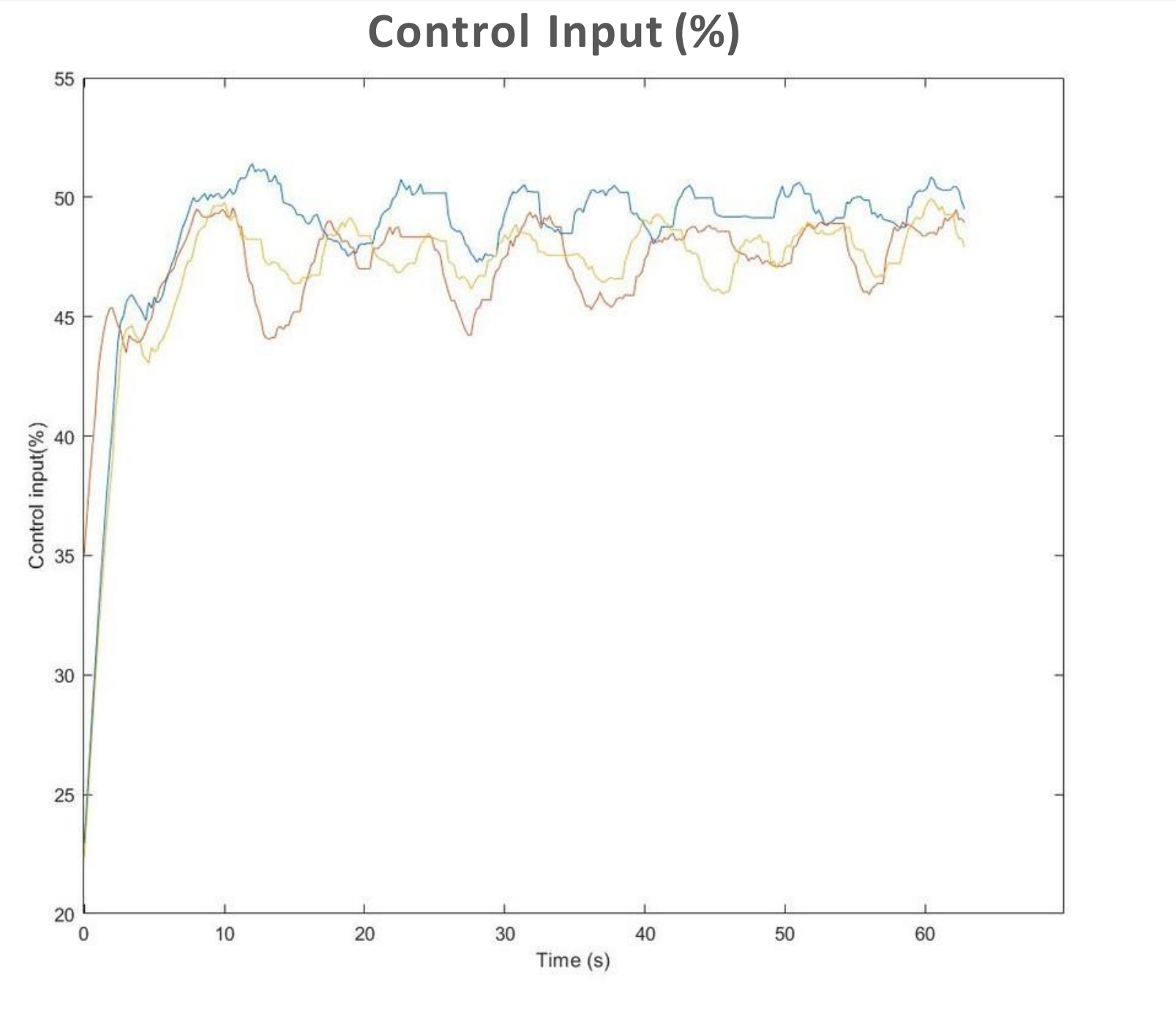
Tuning PID and Result

Velocity is coming from Golf cart Hall sensor in different Velocity and Control Input

Setting Speed at 5 km/hr

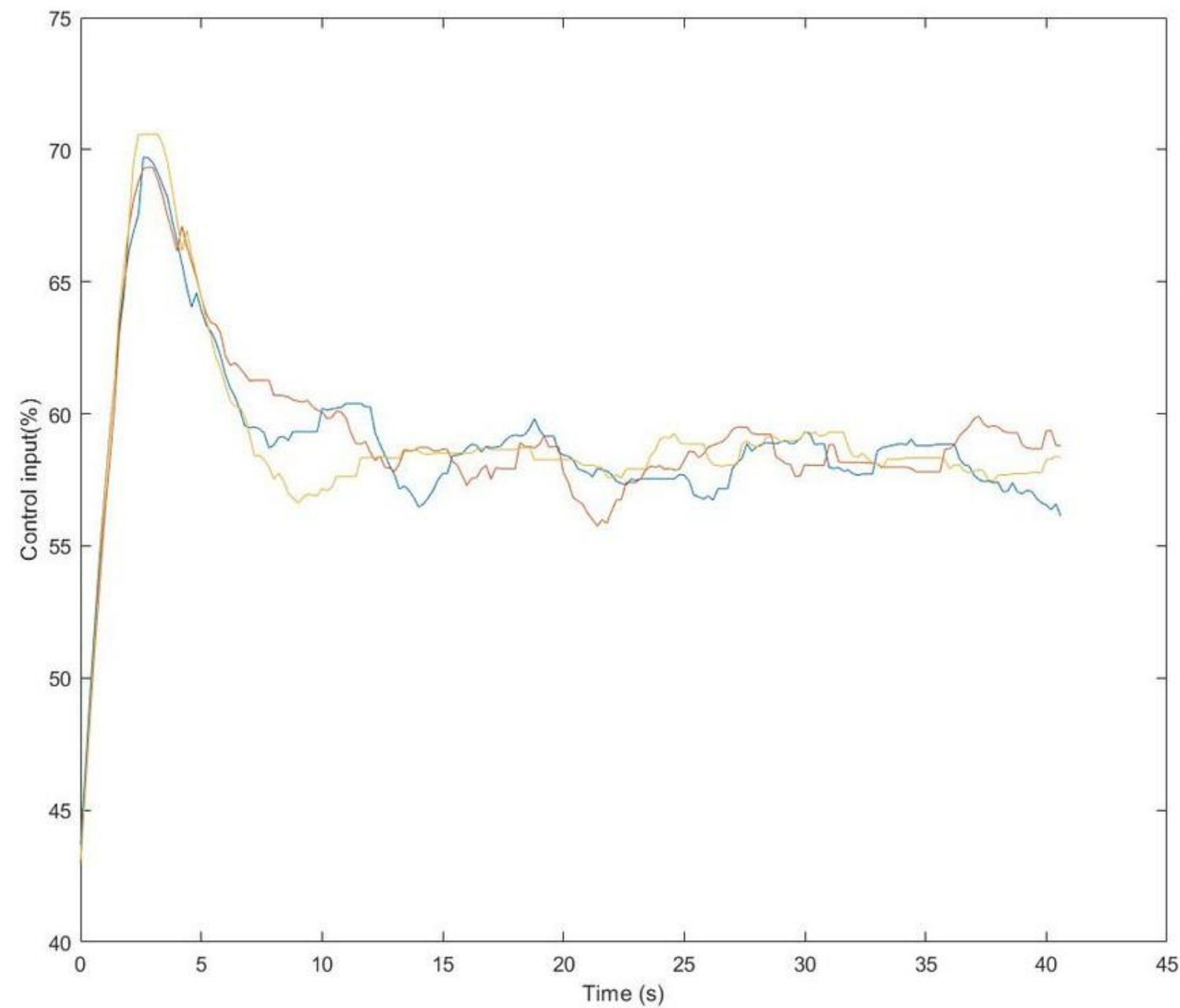


Setting Speed at 10 km/hr

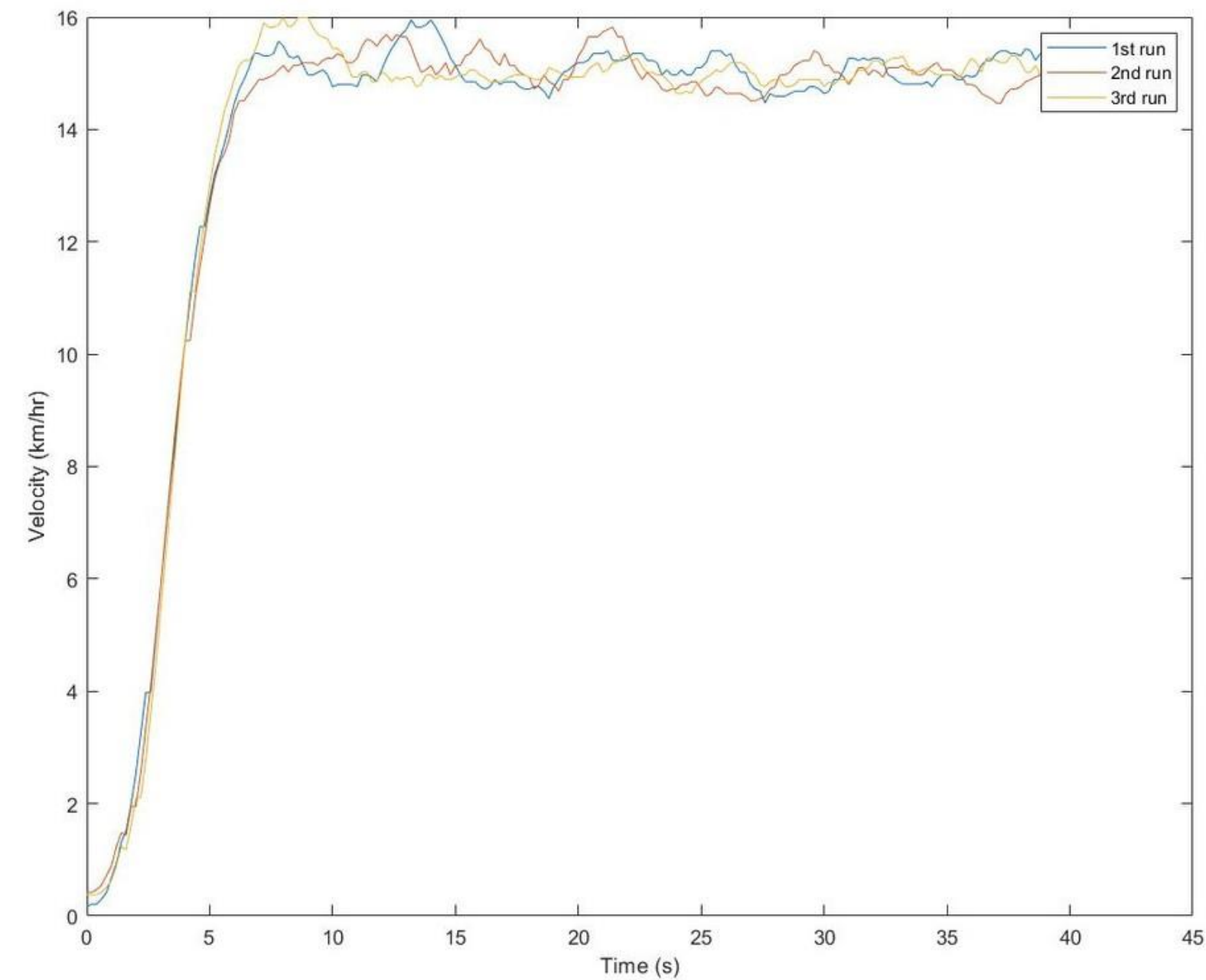


Setting Speed at 15 km/hr

Control Input (%)

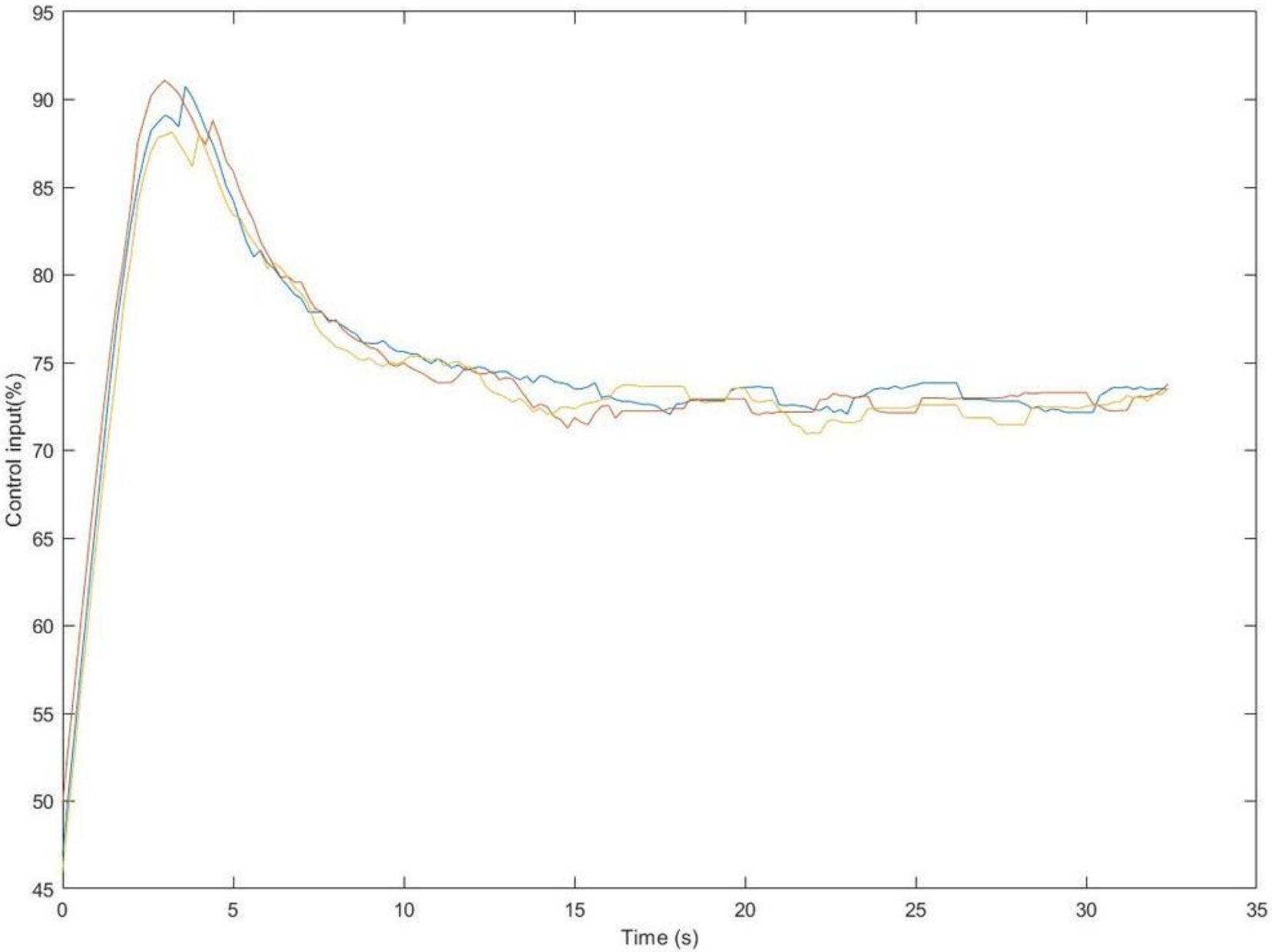


Velocity (km/hr)

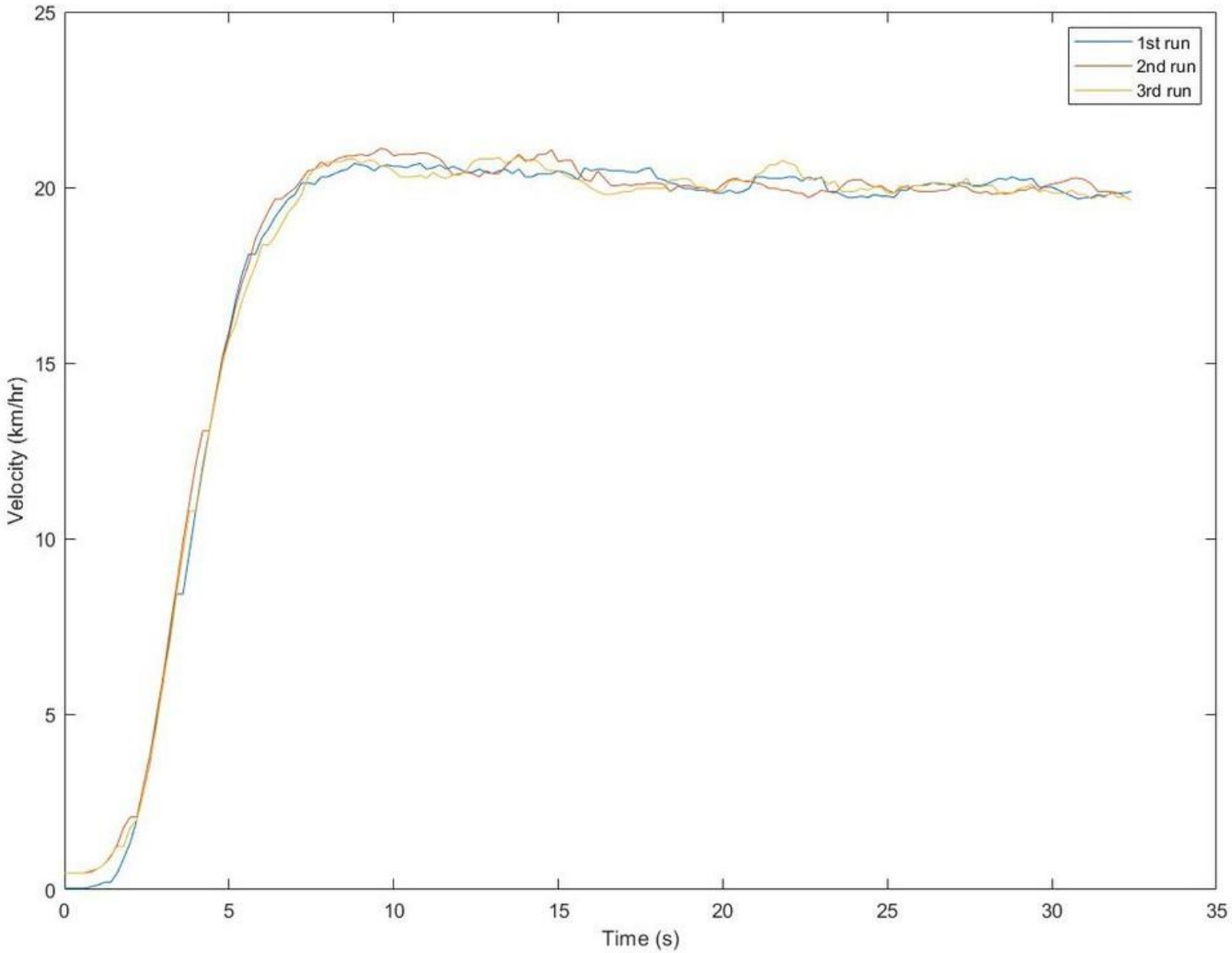


Setting Speed at 20 km/ hr

Control Input (%)

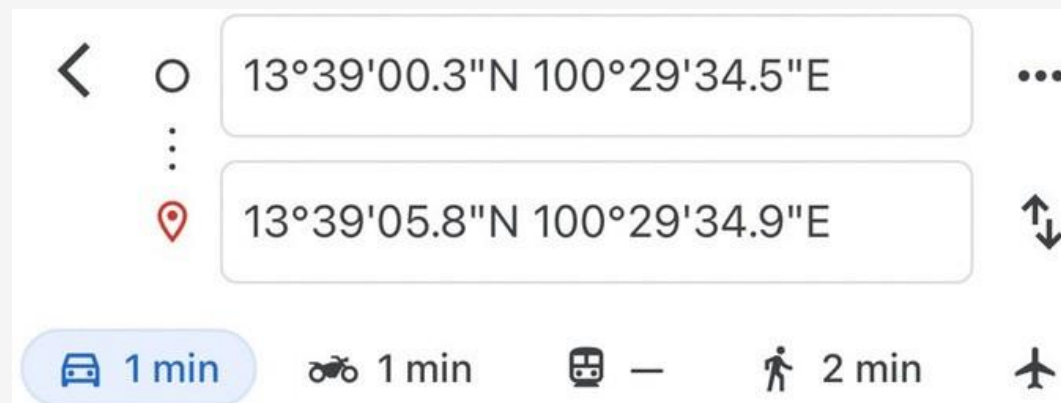


Velocity (km/hr)



Environment

Environment



1 min (170 m)

Fastest route now due to traffic conditions

Steps

Preview >>



Pin



measure distance over Google Map GPS

Overview of the road from Practical testing

Conclusion

