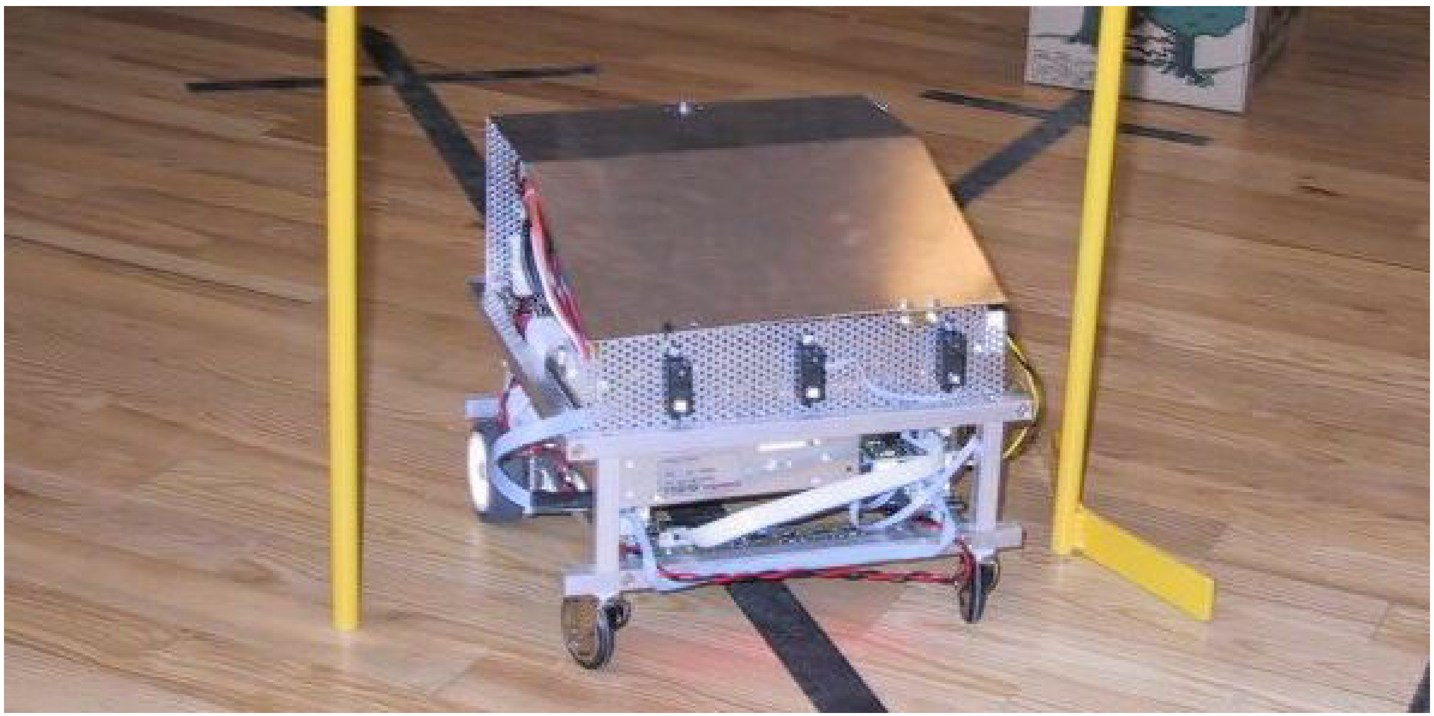
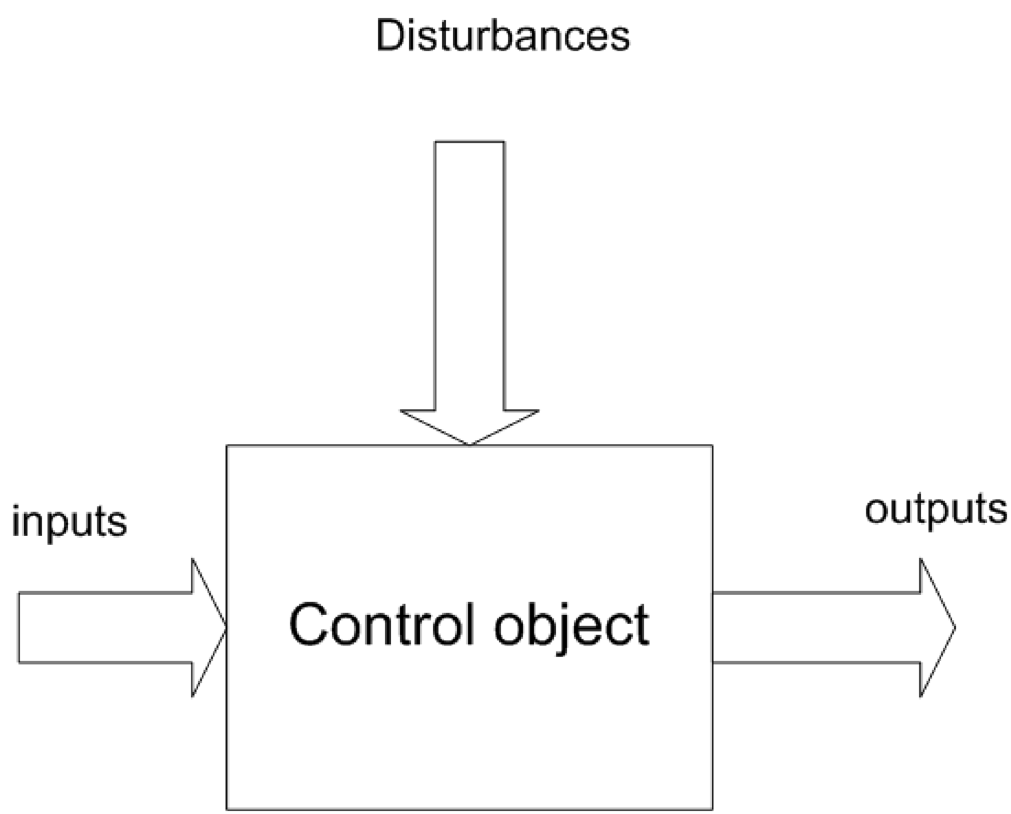
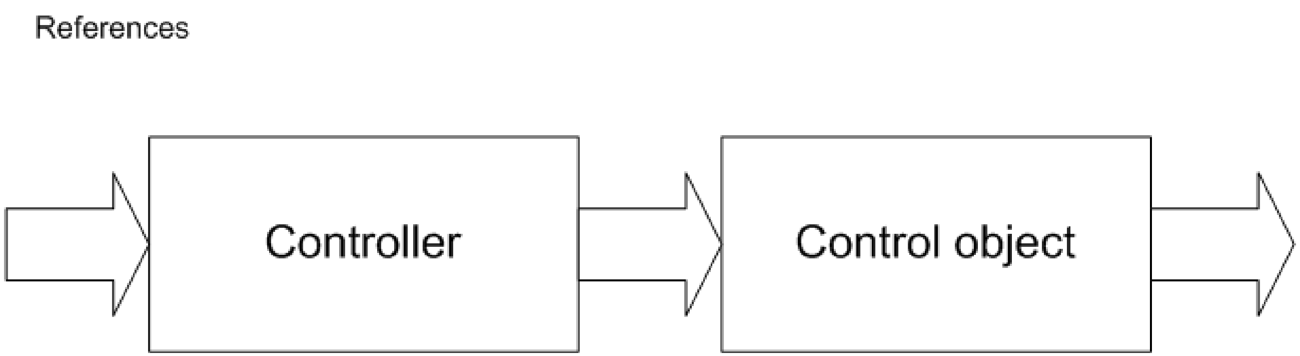
CONTROL





Model:
relationship between inputs and outputs
for example:
differential equations
transfer functions

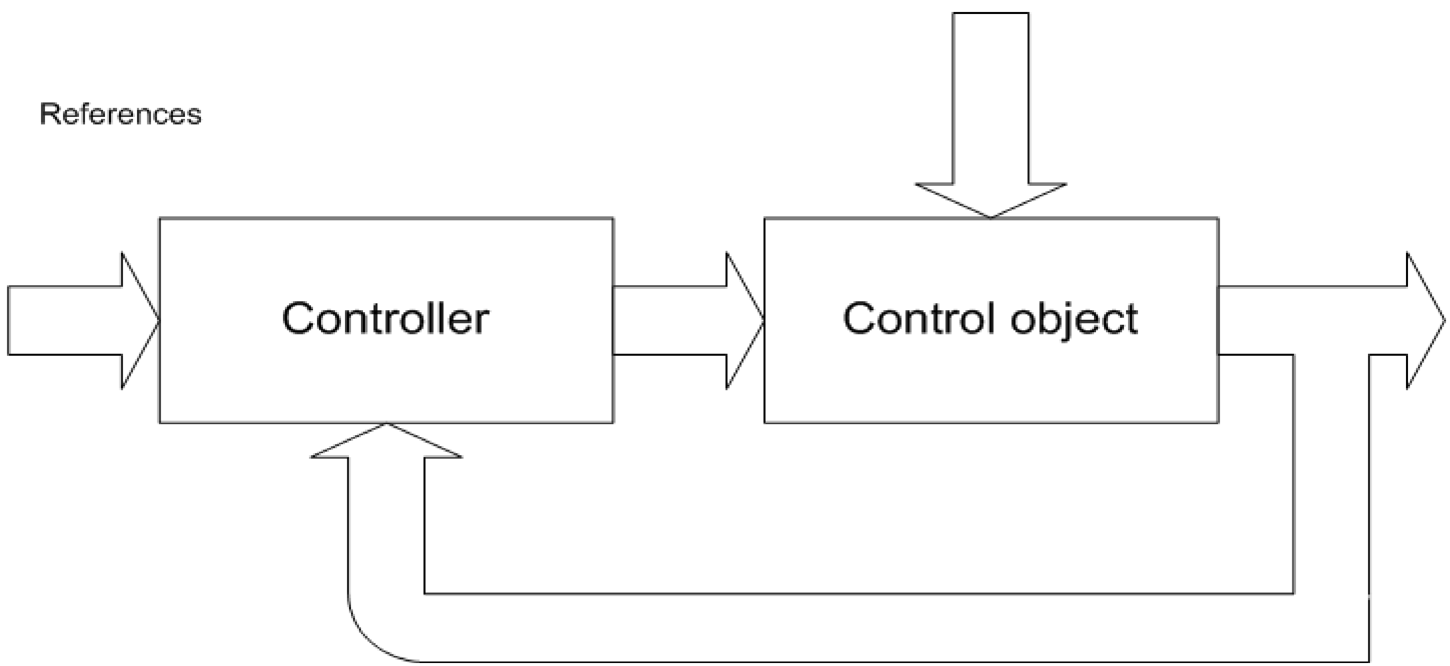
Open loop control



sensitive to model errors and disturbances

accuracy determined by control object model

Closed loop control



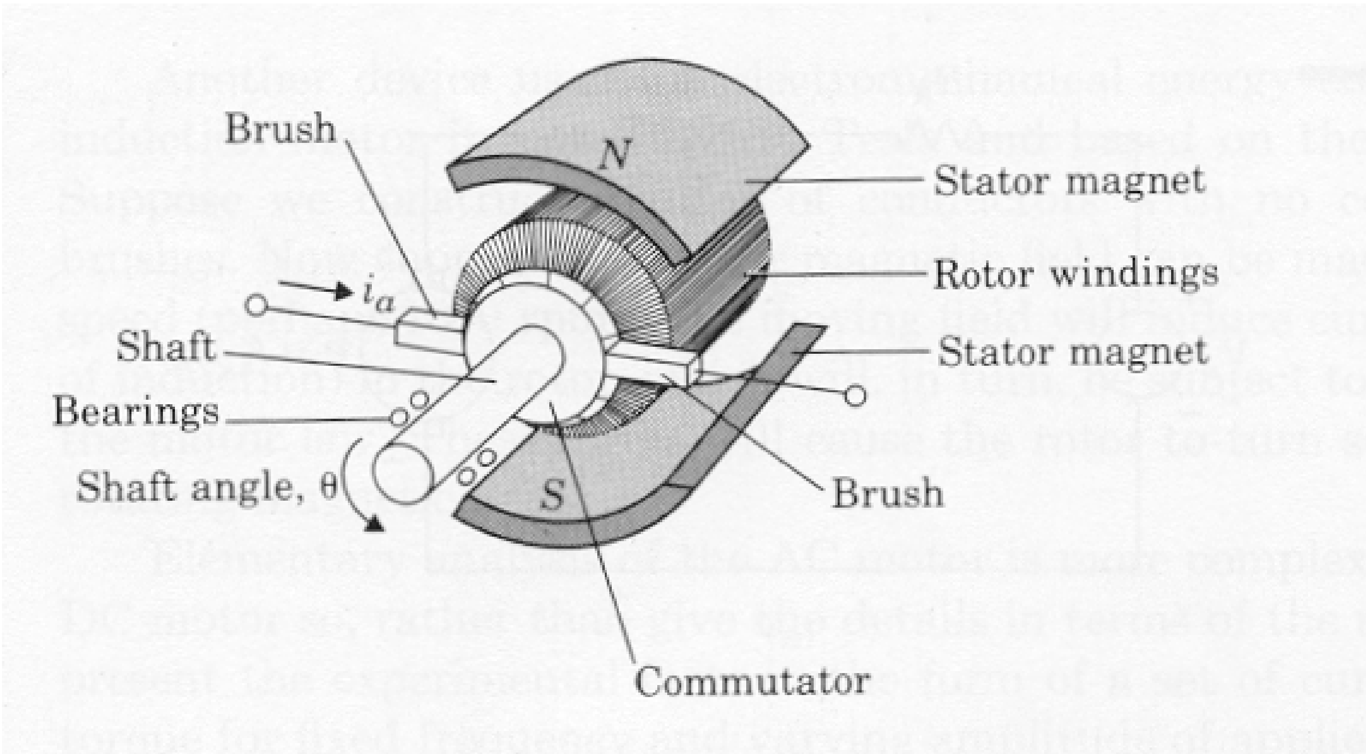
Stability

Accuracy determined by sensor accuracy

Classic Controllers

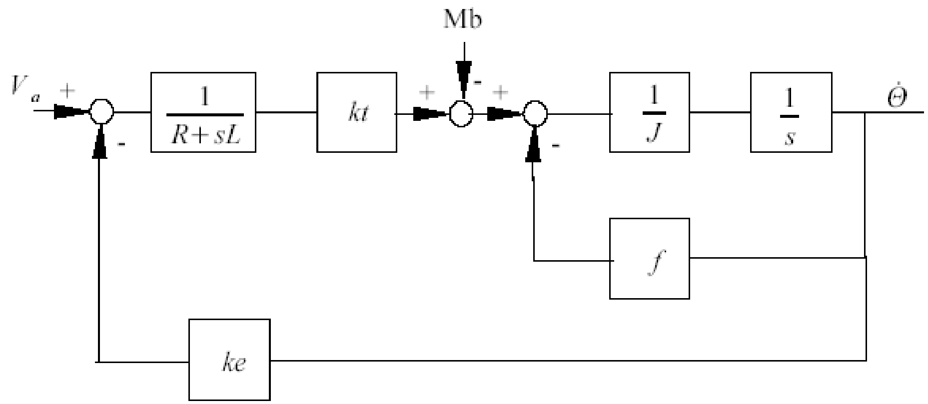
- P-controller
- I-controller
- D-controller
- PI-controller
- PD-controller
- PID-controller

DC-MOTOR



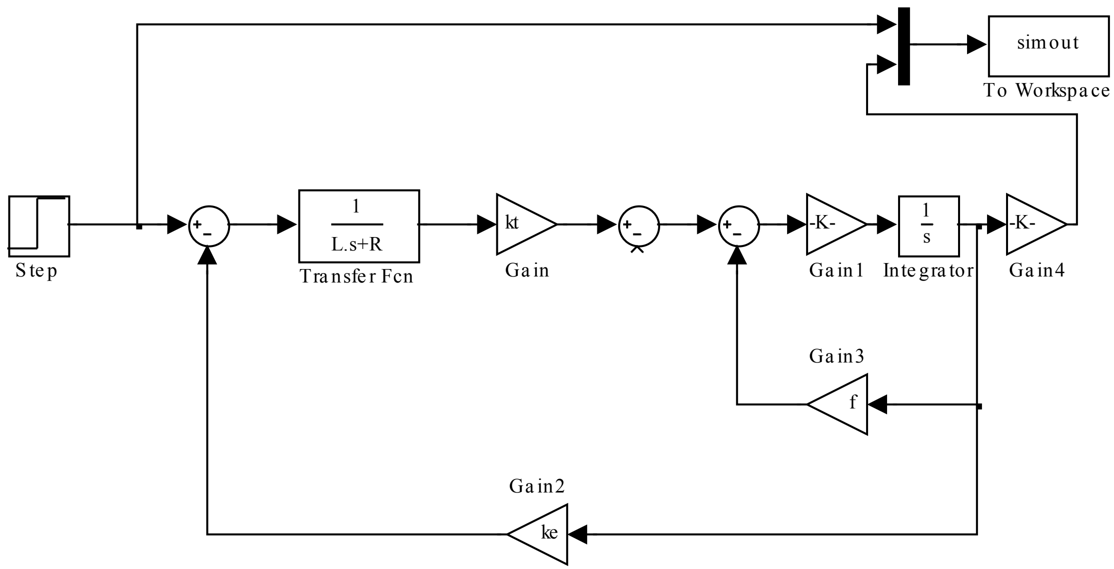
Brush
N
Stator magnet
Rotor windings
i_a
Shaft
Stator magnet
Bearings
Shaft angle, θ
S
Brush
Commutator

Linear DC-motor Model

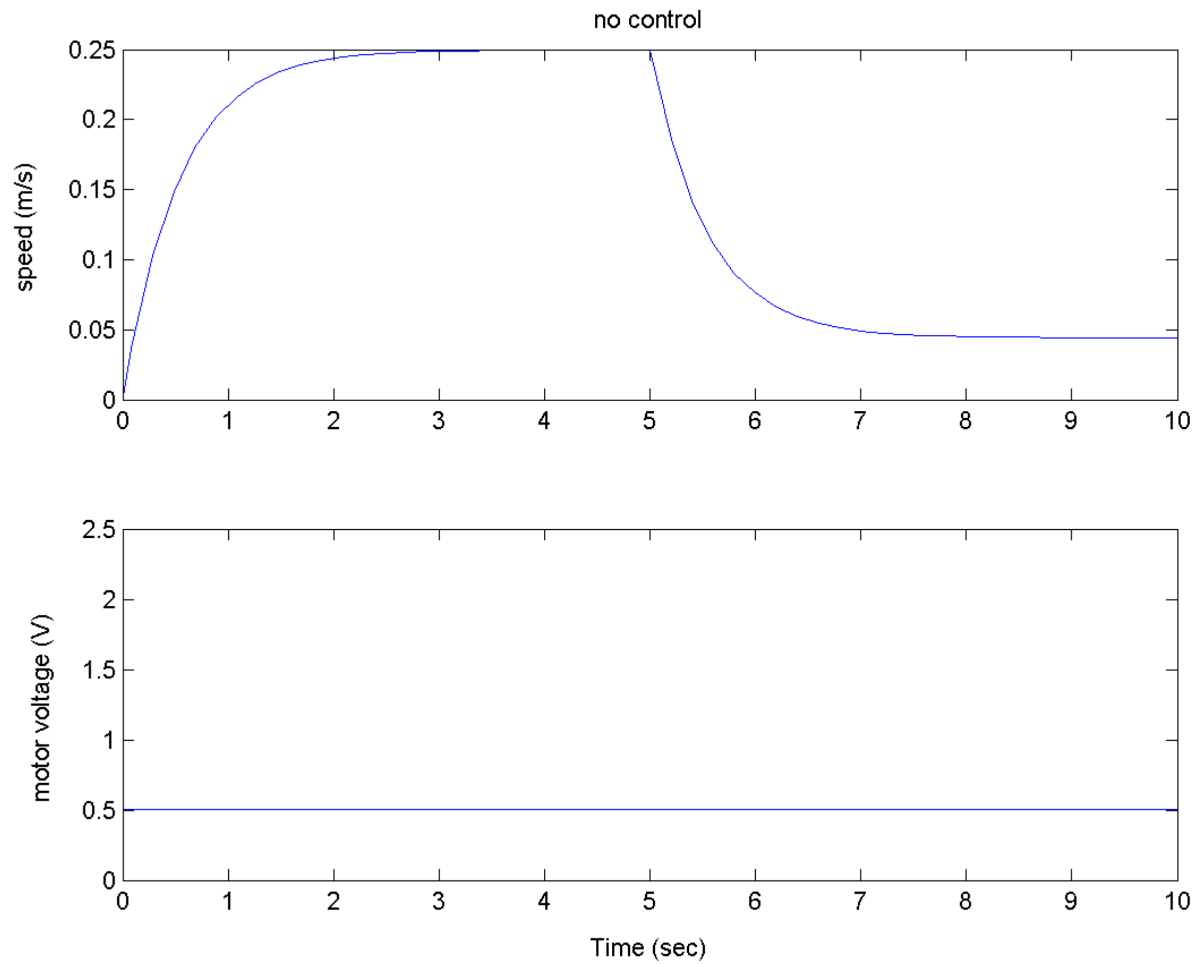


V_a	armature voltage
R	armature resistance
L	armature inductance
kt	torque constant
J	rotor inertia
f	viscous friction
ke	back EMF constant

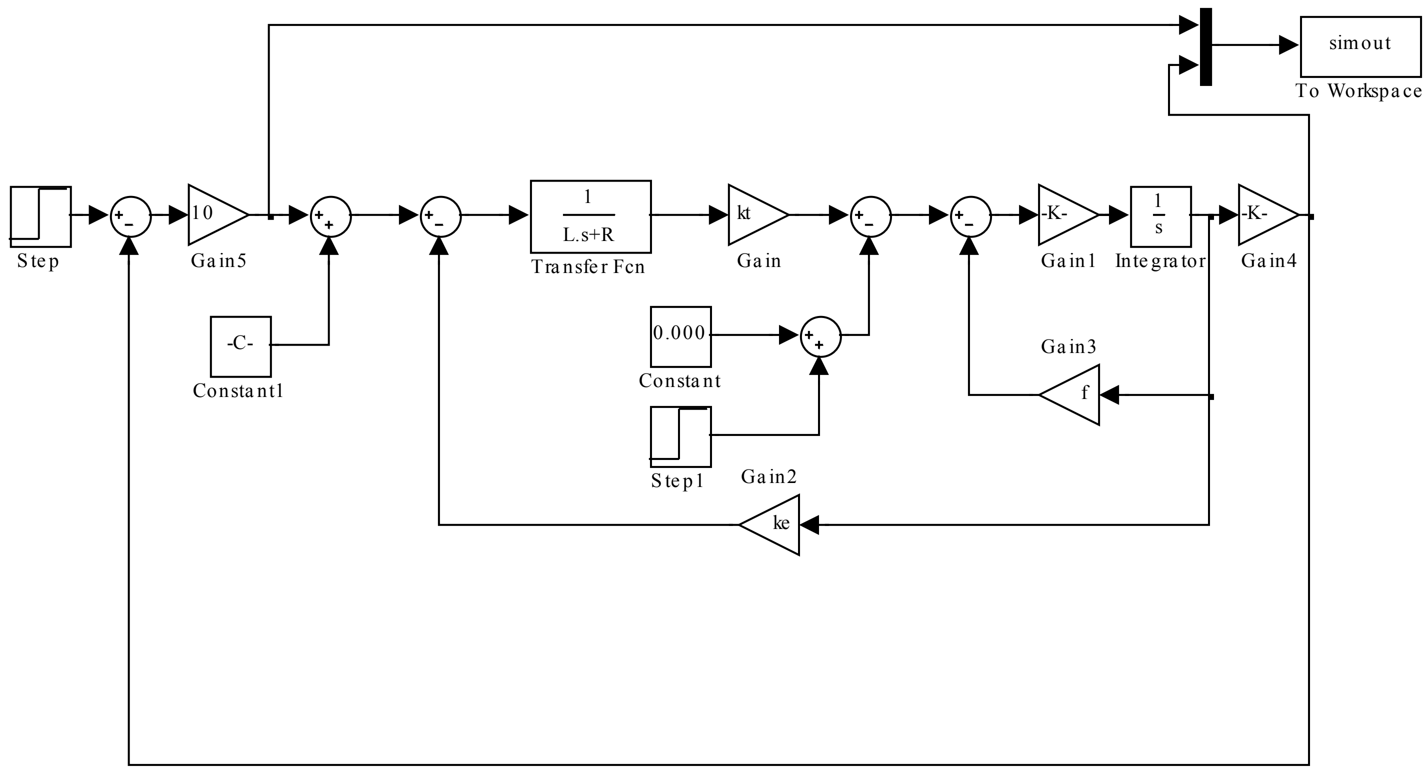
Open loop motor control



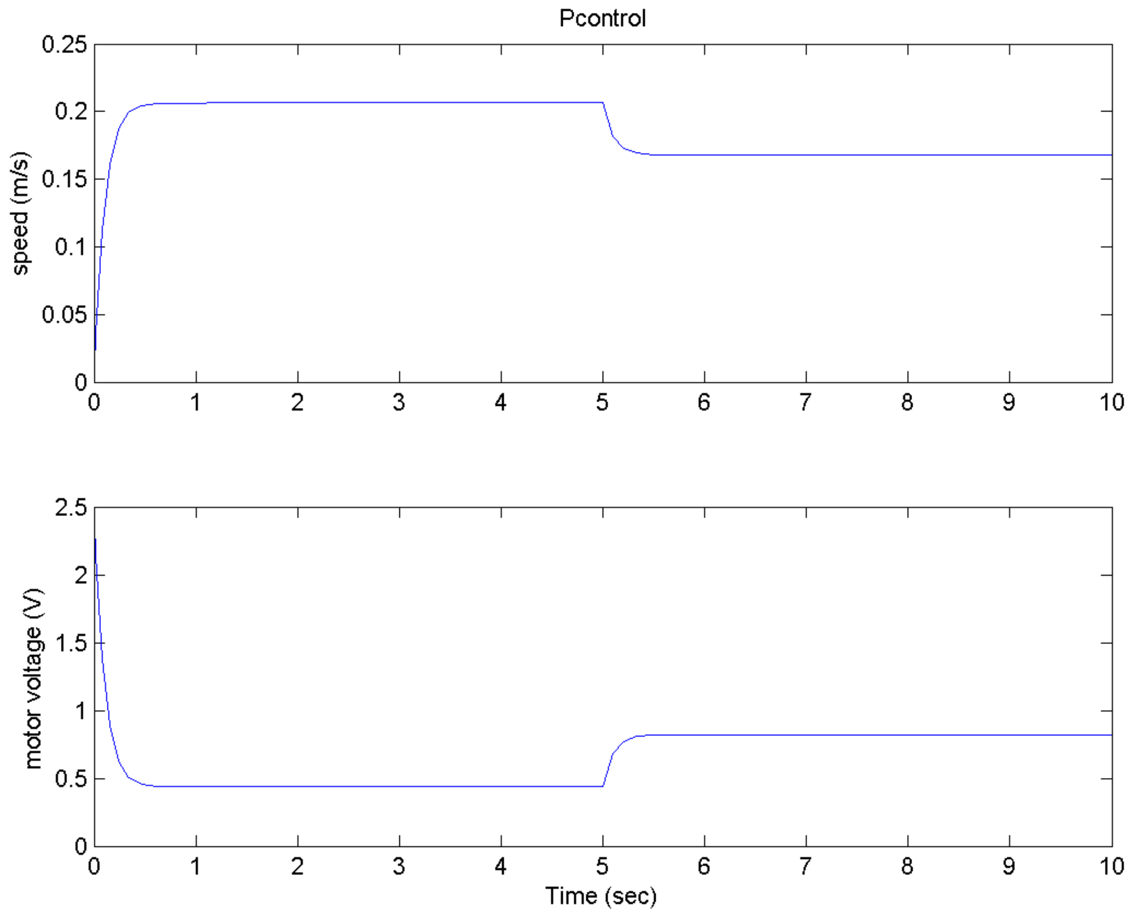
Step response open loop



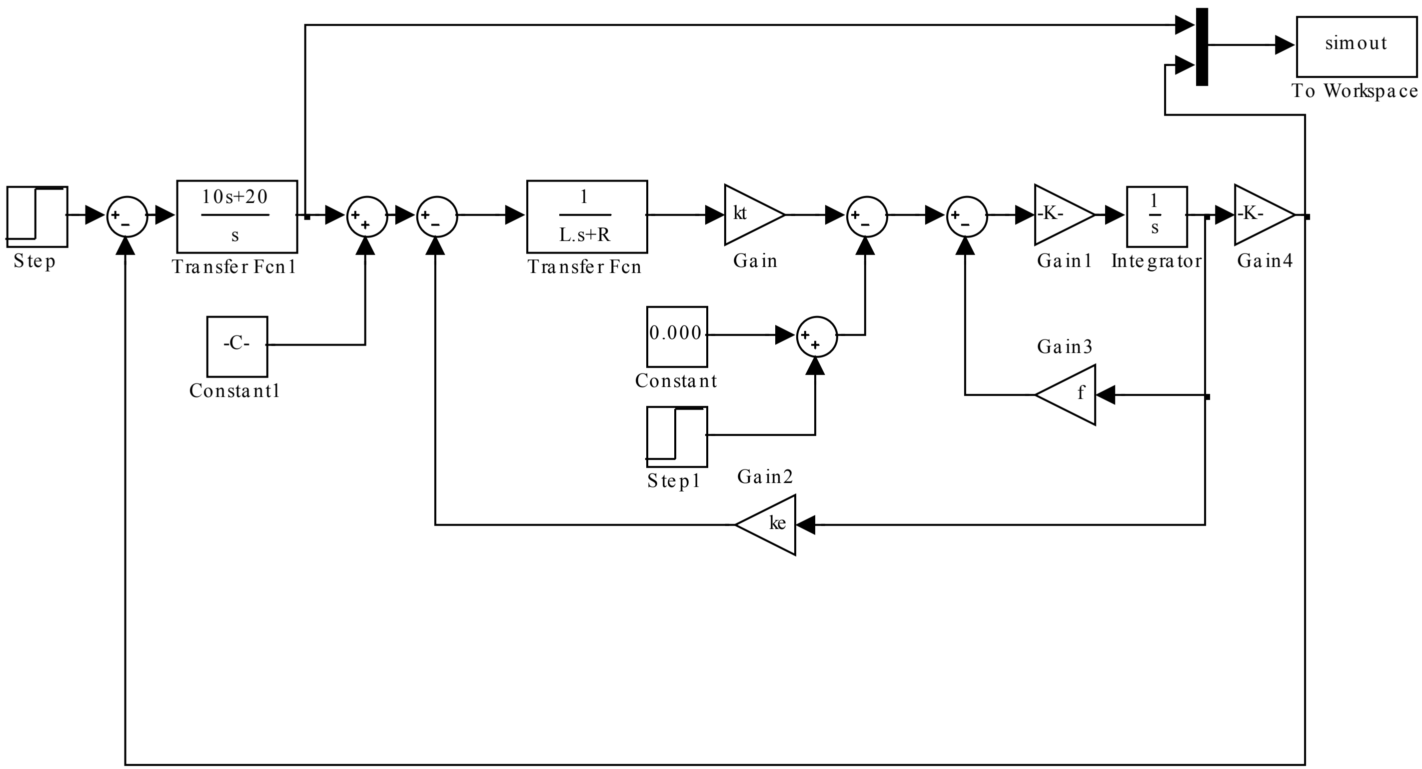
P-control of motor



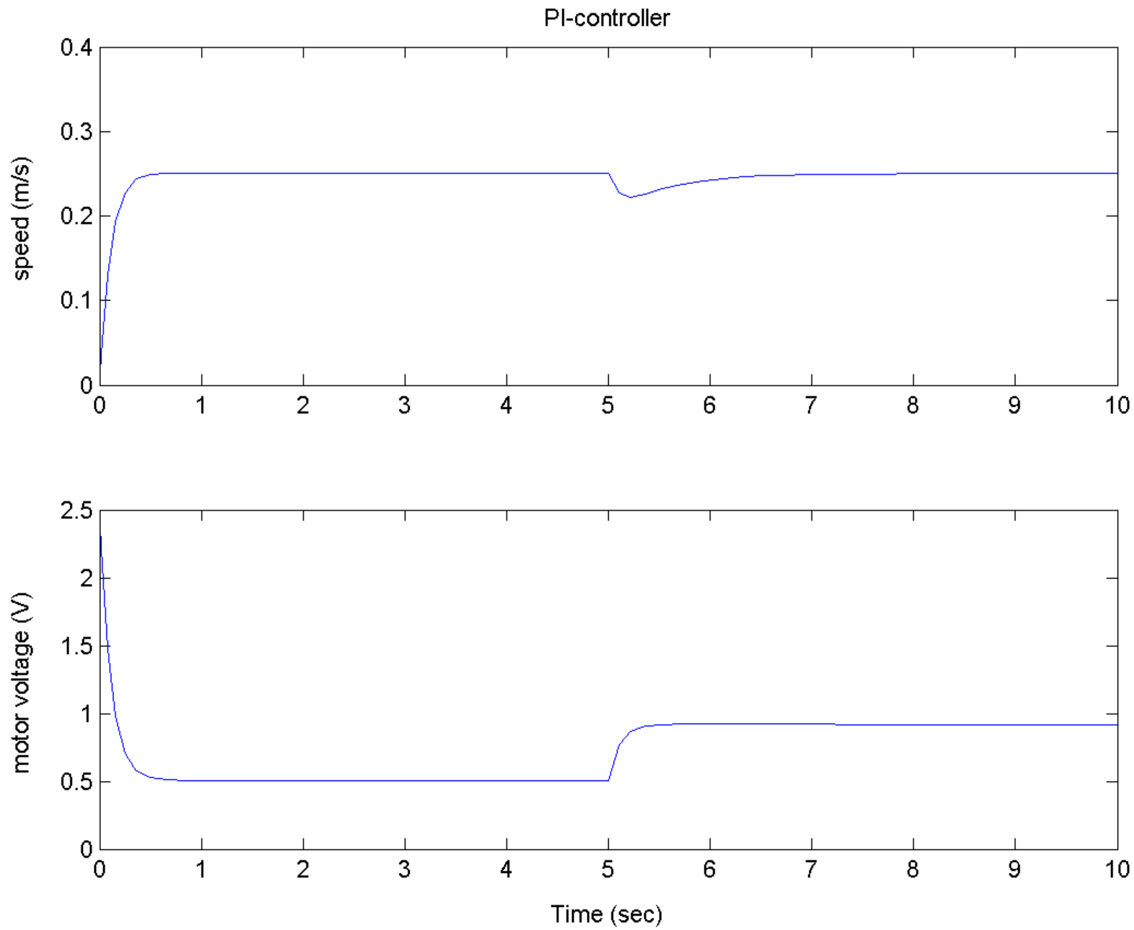
Step response P-control



PI-control of motor



Step response PI-control



Direction control of vehicle

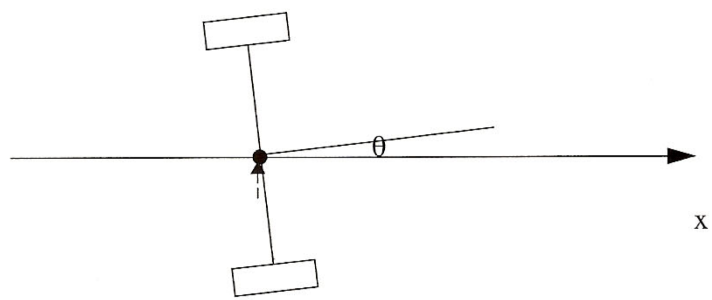


Figure 1. Vehicle

(1)

The angle θ is calculated using odometry. The vehicle direction is controlled by a proportional controller:

$\omega = k(\theta - \theta_r)$, where ω is the angular velocity of the vehicle

Line control of vehicle

Driving along the x axis with distance l and angle θ the line sensor value is given a

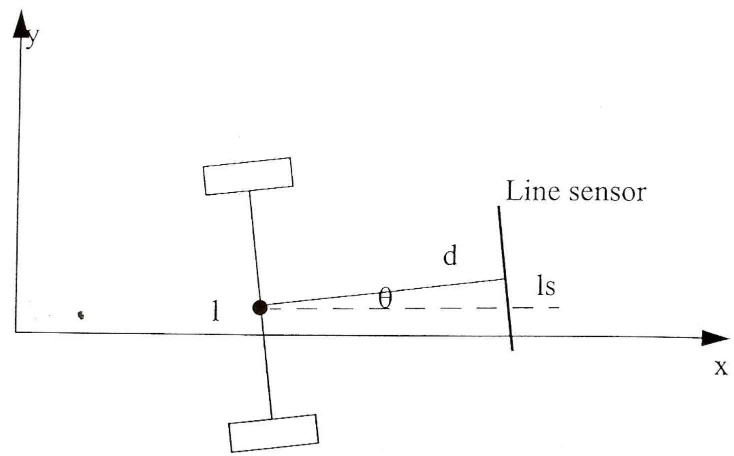


Figure 9. Line sensor kinematics

$$ls = -(d\sin(\theta) + l)/\cos(\theta)$$

for $-90^{o} < \theta < 90^{o}$

where d is the distance from the line sensor to the turning centre of the smr, ls is the
the line sensor.

Test the validity of the expression by

a) putting the vehicle on the line and
b) setting θ to 0.

Line sensor control

$\theta' = K * ls$ and constant forward speed