Robot Control Ensemble Results

This document is to elaborate on the “RobotControlEnsemble1.slx” file and what its characteristics are.

As can be seen in the Simulink model, there is 2 control blocks, one for the robot going forward and one for the robot turning. Each block has an input of a step function signal applied to it as a set displacement and an output of the corresponding velocity and displacement the block sees throughout time. These outputs are hooked up to scopes, and outputs of the scopes for varying values of the step input are shown below.

Inside each block is a feedback loop with a PD controller and another inner block. The input to this outer block is the step function, and the output of the outer block is the current displacement and velocity of the system. The input to the inner block is the error between the set and current displacement signal modified by the PD controller. The output of the block is a discrete signal giving the velocity of the robot. The PD controller is discrete and produces a discrete signal with sampling time of 20 ms. There is an integrator that takes the velocity output and passes it as the current displacement to the summation port.

Inside each inner block is a feedback loop with a P controller, a saturation block, a gain block, a dead zone block, a summation block to potentially add random errors in voltage applied to the motors, the robot’s transfer function, and then a feedback path with a summation block to potentially add random errors pathing to a summation block between the set velocity and the current velocity producing the error in velocity. Currently, the random errors have been turned off. The block takes as input the set velocity. The saturation block is to model the self-imposed restraints put on the Arduino to avoid spinning out in the wheels or other undesirable behavior, and restricts the max speed appliable to the motors to 65 counts. The gain then converts the counts to voltages actually applied to the voltages. Then, reflecting that there appears a minimum required voltage to turn the motors, a dead zone is implemented. Then, in the robot’s motors, the voltage is converted to a velocity of the robot, which is then output from the block and also sent back as the current velocity.

The following are sets of graphs for step input values of 1, 10, and 100 applied to the robot’s forward motion feedback loop and the robot’s angular motion feedback loop. Those feedback loops encompass the transfer function, the inner (velocity) feedback loop and controller, and the outer (displacement) feedback loop and controller. The graphs show the response of the corresponding graph’s metric over time for the corresponding robot feedback loop.

|  |  |
| --- | --- |
| Step Input Value | Robot Forward Displacement Graph |
| 1 |  |
| 10 |  |
| 100 |  |

|  |  |
| --- | --- |
| Step Input Value | Robot Forward Velocity Graph |
| 1 |  |
| 10 |  |
| 100 |  |

|  |  |
| --- | --- |
| Step Input Value | Robot Angular Displacement Graph |
| 1 |  |
| 10 |  |
| 100 |  |

|  |  |
| --- | --- |
| Step Input Value | Robot Angular Velocity Graph |
| 1 |  |
| 10 |  |
| 100 |  |