

FRA231: Robotics Sensors & Actuators: Modelling & Experimentation
Homework Assignment 3: Modelling of DC-motor

You and your partner are tasked to model a specific permanent magnet brush DC motor and synthesize signal converter for the practical use. A high-level system architecture diagram is shown below.

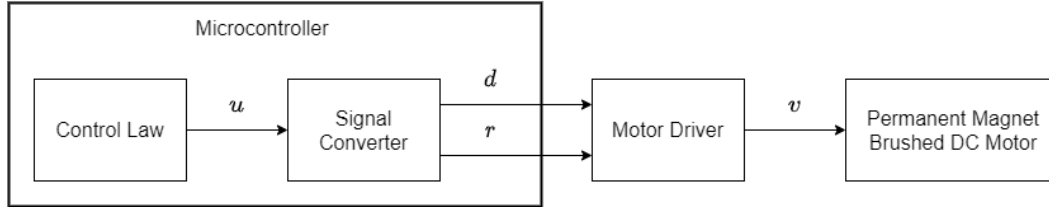


Figure 1: System Architecture Diagram

Task 1: You must model ENA-020Q3000 PMDC brush motor from Allied Motion. The datasheet of the motor can be found here.

https://www.alliedmotion.com/wp-content/uploads/documents/Endurance_20_Datasheet_R2ascrn.pdf

For this specific assignment, you **MUST** parameterize the model by stall torque & no-load speed in the Simscape's DC Motor block although the stall torque is not given in the datasheet.

Assume that the internal inductance L is 0.01 [H] and the mechanical inertia is 0.1 [g · cm²]

Task 2: You must implement a subsystem that represent a signal converter. The signal converter must do the following.

- The converter saturates the input u to the value 100. This implies that even though the input u varies beyond 100 and -100, the resulting signal will be bounded between 100 and -100 (anything above 100 will convert to 100).

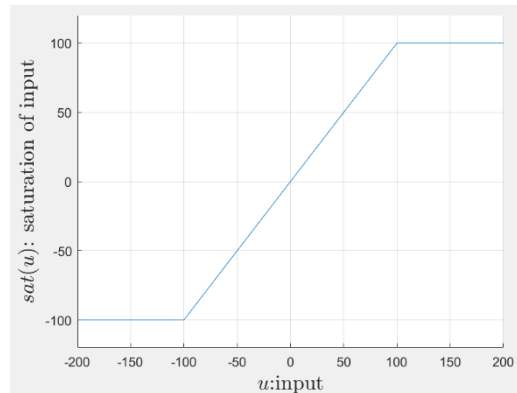


Figure 2: graph of saturation

- The saturated signal must be converted to the duty cycle of PWM d and the direction of rotation r .
- The direction signal r is a digital signal that depends on the sign of the input u .

$$r = \begin{cases} 0, & u \geq 0 \\ 1, & u < 0 \end{cases}$$

- The duty cycle of the output PWM d is bounded between 0 and 100 (%), which linearly corresponds to the magnitude of u .

$$d \in \{x \in \mathbb{R}: x \in [0,100]\}$$