Homework 01 - due Sunday March 21st, 2021.

The goal of this homework is to get acquainted with the use of the performance weights $w_S(s)$, $w_U(s)$ and $w_T(s)$ in the definition of the closed loop specifications.

You should take an armature controlled DC motor linear model (a possible block scheme is reported in Fig. 1).

- Choose the motor parameters (put the reference of where you take the data from).

- Understand what the load torque represents and define possible situations to be explored next (e.g., constant unknown load torque, sinusoidal, what does it represent, ...).

- In your design discussion, you should first consider a *velocity control* problem (you want to guarantee that the rotor and the unknown load rotate at steady state at a given angular velocity) and then a *position control* problem (stop the motor at a given angular position).
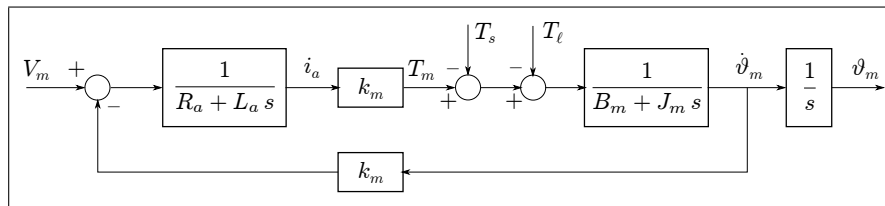

Figure 1: DC motor: T_s is a stiction torque while T_ℓ is the load torque

1. First explore, using only a weight $w_S(s)$ on the sensitivity function, what reasonable performance you are able to achieve and compare the obtained results with a standard controller (PI, LQR or other of your choice).

2. Add a control sensitivity weight $w_U(s)$ and analyze the consequences.

3. Justify the introduction of an extra weight $w_T(s)$ on the complementary sensitivity.

Comments:

- there is a lot of flexibility in the choices you can make, be as clear as possible in explaining what you do.

- Do not fall into the trap of doing hundreds of simulations without any previous thoughts of what you should expect and stop to analyze why you have obtained a different result than the one planned.