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6.302: Lab 1A Report
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1 Results

The following measurements were made with the equipment at Station #1. My partner was fellow classmate Charles Herder. We shared in all parts of the measurement process, but the data analysis was completed individually.

The requested motor parameters are given in Table 1.

Table 1: Motor parameters of Station #1

Name of parameter	Description	Measured value
K_{tach}	$\dot{\theta}_m = K_{tach}\dot{\theta}$	$0.0286\frac{V \cdot s}{rad}$
R_m	Armature resistance	8.6Ω
L_m	Armature inductance	$0.0063H$
K_e	$e_m = K_e\dot{\theta}$, e_m is motor back-emf	$0.0227\frac{V \cdot s}{rad}$
n	Gear ratio	6.75
K_p	$\theta_p = K_p\theta$	$3.279\frac{V}{rad}$
J_f	Flywheel inertia	$2.75 \times 10^{-5} kg \cdot m^2$
J_m	Motor inertia	$4.6 \times 10^{-6} kg \cdot m^2$
K_t	$T = K_t \cdot I$	$0.0231\frac{N \cdot m}{A}$
τ_m	Mechanical time constant	$45.2ms$

2 Questions

1. In the prelab, you found an expression for the motor time constant. How well does the measured value agree with a calculated value based upon your model parameters?

   In the pre-lab, the mechanical time constant was predicted to be $\tau_{m,pred} = \frac{JR_m}{K_t K_e} = 0.075s$, which is to be compared to the measured $\tau_{m,meas} = 0.045s$. There is only a rough agreement. However, the discrepancy is less than a factor of 2.

2. Two of your motor parameters should be the same. Which two? Why? Are they?

   We expect K_e and K_t to be the same. (It's easy to show that they actually have equivalent units.) This follows from the basic physics of DC motors, where it can be shown that $K_e = K_t = G \cdot i_f$ where G is the so-called "motor constant" depending only on the geometric construction of the motor, and i_f is the "field-current" that is responsible for maintaining a bias magnetic field that is to drive the rotor. In our measurements, we confirm this prediction.

3. How does the inertia of the flywheel compare to that of the big gear? Why?

   The moment of inertia is a purely mechanical factor depending on the mass distribution and the shape of the object. From a visual inspection in the lab, the flywheel was roughly the size of the big gear, and they both seemed to be made of aluminium. Hence, we expect the inertia of the big gear to be of the same order as that of the flywheel.