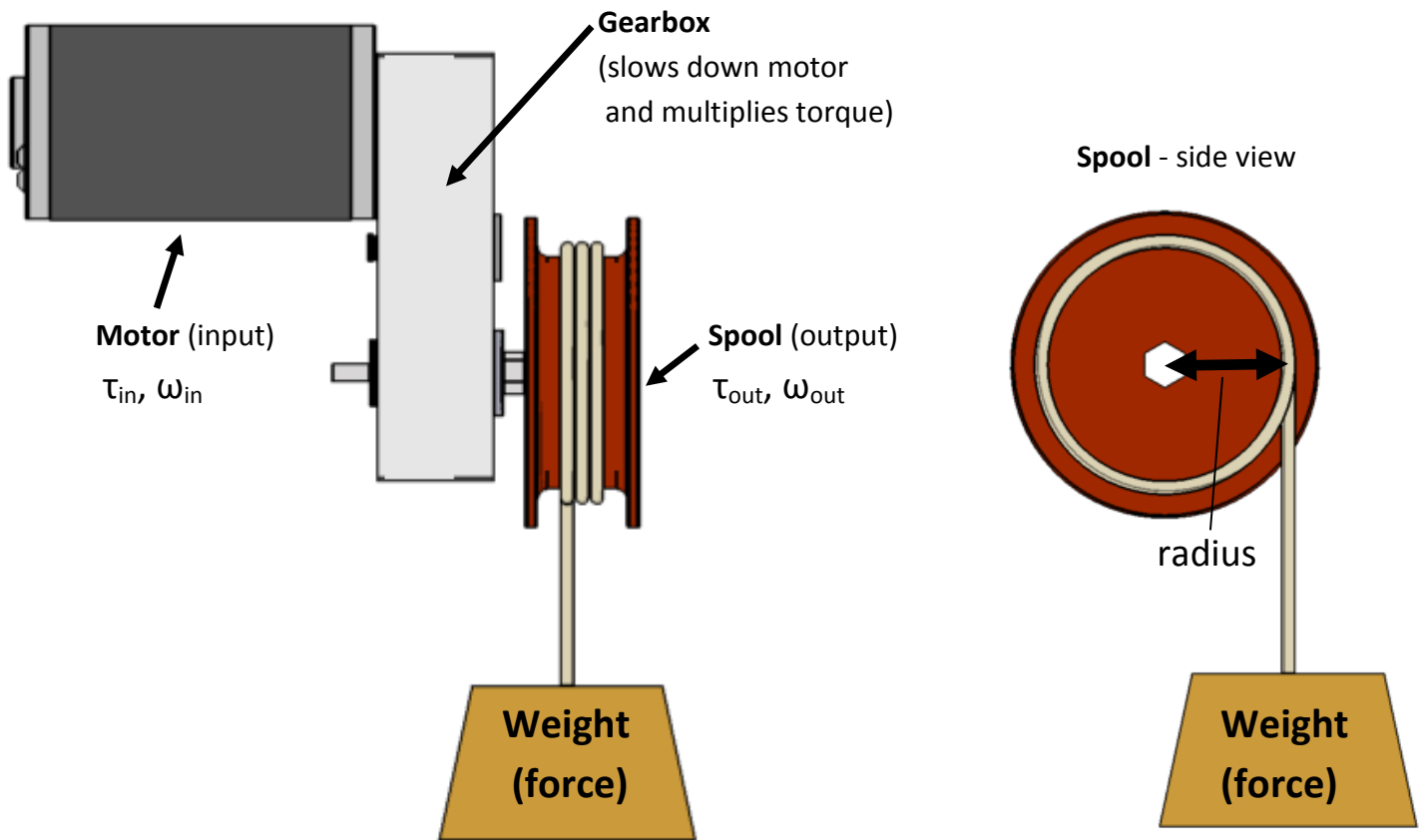


Robot Winch Design Problem



Assignment Overview

Your job is to design a winch system for lifting a certain weight at a certain speed. You will select a motor, gearbox, and spool combination that meets the project requirements listed below.

First, you will create a custom calculator in an Excel spreadsheet. It will accept the information you have and output the performance calculations that you need. Once you have that spreadsheet created, you will be able to quickly test every possible combination of motor, gearbox, and spool to find the optimal solution. Tweak one number in your spreadsheet, and all of your calculations will update themselves automatically.

Robot Winch Design – continued

Constraints

- Robot winch must lift 24 lb
- Speed should be approximately 2 ft/sec (does not need to be exact)
- Use a motor from the motor curves PDF document.
- Motor is powered by a 12 V battery
- Motor should operate between 10-40% of its stall torque (torque at 0 RPM) when lifting
 - If the motor operates higher than that, it might burn out; if it's under that, then you're probably selecting a bigger motor than you need (wasting money).
- The only gearboxes available are 20:1, 64:1, and 128:1
- Spool diameter must be 1", 2", 3", or 4"

Turn in the following information:

- 1) Which motor, gearbox, and spool do you recommend?
- 2) Include your engineering calculations for the final set of parts (see strategy below).
 - Option A: turn in a hand written copy of your calculations
 - Option B: turn in your spreadsheet, but include the calculations in separate boxes for each step in your process. It is not sufficient to print the numbers alone, and printing the excel equations (e.g. $A1*B2/C5$) is difficult to read, so you will need to list the equations with the actual variables.
- 3) How much mechanical power will the motor provide? You can double check your answer by reading the power off the motor curve.
- 4) How much electrical power will it consume? (use the Amps from the motor curve)
- 5) What is the efficiency of the motor? (calculate it and compare your answer with the efficiency from the motor curve)

Suggested Strategy: cycle through these calculations in this order

Choose a motor, gearbox, and spool (take your best guess the first time through).

Calculate the spool's torque.

Calculate the torque at the motor (use gear ratio calculations).

Use a motor speed curve calculation to find the motor speed.

Calculate the spool speed.

Calculate the vertical lift speed (spool diameter x gearbox RPM; convert units accordingly).

Check if your vertical lift speed and % torque meet your constraints.

Choose a new combination of motor, gearbox, and winch diameter and repeat.