Mechanics and Machines, Lecture 5

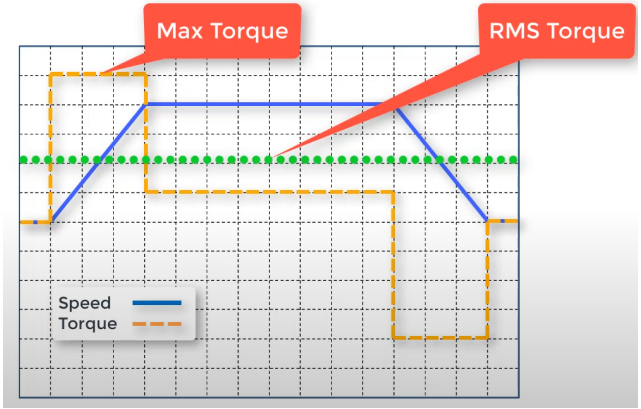
Motor sizing (selection)

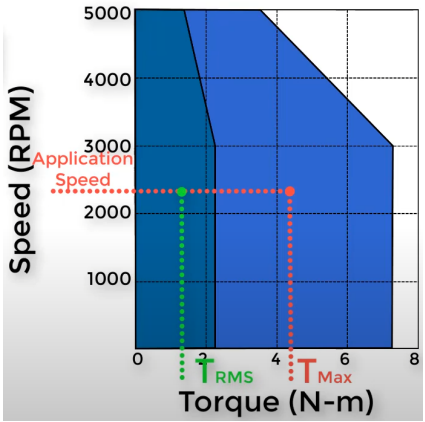
INNOPOLIS UNIVERSITY

Four Key Sizing Factors

1. Inertia Ratio: Load Inertia / Motor Inertia (A measurement of how difficult to change the rotating velocity of an object). Nice ratio: (5-10):1
2. Speed
3. Max Torque for particular Speed
4. RMS Torque for particular Speed

Profiles


Max Torque
RMS Torque
Speed
Torque


5000
4000
3000
2000
1000
Speed (RPM)
Application Speed
0
2
4
6
8
T RMS
T Max
Torque (N-m)

Motor Selection guideline (Using Simulation)

1. Determine, what do you want to receive in the end (for instance, a particular R.O. linear velocity and etc).
2. Create a CAD and Motion Analysis model. Find a load inertia related to a motor axis of rotation.
3. Define your motion (for example, using table function).
4. Solve the simulation.
5. Create plots: $\tau(t)$, $\omega(t)$, others if needed to check the correctness of simulation.
6. Calculate the power of motor in several position and take the average $P = \omega\tau$ and multiply on some coefficient for reduce sim. error.
7. Based on the power and size, you can choose the motor.
8. Start to choose a gearbox (it linearly changes your profile).
9. If you can, calculate the motor (rotor + gearbox) inertia and find inertia ratio.

Friction in simulation

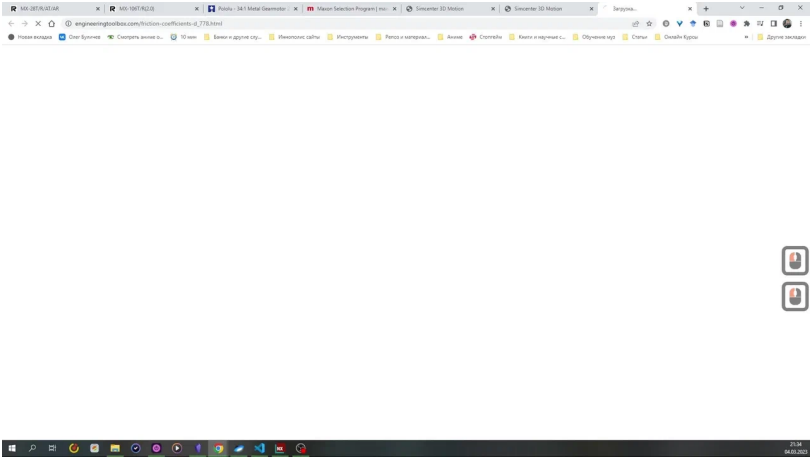
- Friction coefficients
- Documentation about 3D contact in NX
- Guidelines for contact materials

Motors

- How to read DC motor Perfomance curves
- Pololu motors (which are provided)
- Application for motor sizing from Maxon
- Dynamixel MX-28

Motor Selection case study

Video



Reference material

1. Servo Motor Sizing Basics Part 1 - Core Concepts (video)
2. Servo Motor Sizing for Robotic Applications (video)

Deserve “A” grade!

– Oleg Bulichev

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Room 105 (Underground robotics lab)