Robotics
Problem Sheet 4

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Notes

The homework serves as preparation for the exams. It is strongly recommended that you solve them before the given deadline - but you do not need to hand them in. Feel free to work on the problems as a group - this is even recommended.

1 Problem

Given a DC-motor with

- no-load speed N_0: 6,000 rpm

- stall torque T_s: 0.5 gr·cm

What is the maximum mechanical power of the motor (in Watt)?

2 Problem

Given a rotational sensor in form of an incremental quadrature encoder with accordingly 2 channels c_1 and c_2, which each generate 1,024 pulses per revolution (PPR).

- What is the maximum resolution for angular velocity that we can get when using counts per revolution (CPR), i.e., when checking for the flanks of the square waves?

- What is the maximum resolution of measuring the sense of direction?

3 Problem

Given an absolute encoder with 16 channels $c_1, ..., c_{16}$, i.e., 16 bit encoding. What is the maximum angular resolution it can measure?

Suppose the encoder is once implemented with binary numbers and once with Gray code. What is the minimum and the maximum Hamming-distance between two sectors of the encoder in each case?

4 Problem

Given a spur gear train with 3 axes a_1 to a_3. On each axis a_i is a gear or two gears $g_{i.x}, x \in \{a, b\}$ with following numbers of teeth

- $g_{1.a}$: 10
- $g_{2.a}$: 20
- $g_{2.b}$: 50
- $g_{3.a}$: 100

Gear $g_{1.a}$ drives $g_{2.a}$, $g_{2.b}$ drives $g_{3.a}$. Given input speed or torque on a_1 calculate the according output on a_3

- input torque a_1: 10 Nm; output torque a_3?
- input speed a_1: 100 rpm; output speed a_3?

5 Problem

Given a worm gear G_w with $z_w = 100$ teeth on the worm wheel. What is its gear ratio?

6 Problem

Given a planetary gear G_p with

- 4 planet gears
- $z_p = 50$ teeth on each planet
- $z_i = 200$ teeth on the internal gear
- $z_s = 10$ teeth on the sun

What is its gear ratio?

7 Problem

A double-start lead-screw with a diameter of $d = 15mm$ and pitch $p = 2mm$ is driven by a geared DC-motor with angular velocity $\omega = 10\frac{rad}{s}$ and torque $T = 0.15N$. The efficiency η of the lead-srew is 87%. What is the velocity v of the nut, respectively its load f?