September 5, 2024

Háskólinn í Reykjavík, Embedded Systems Programming, **Project 1**
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Part 1

To keep things convenient for engineering students, pulse rate was defined as the number of positive edges per second, which has the unit Hz.

Max pulse rate

The maximum pulse rate of the motor was found using the following formula:

$$\text{max pulse rate} = \frac{\text{motor speed in rpm} \cdot \text{max pulses per revolution}}{60s}$$

which yielded

$$\text{max pulse rate} = \frac{155rpm \cdot (7 \cdot 2 \cdot 100)ppr}{60s} \approx 3617Hz$$

Max time between samples

The minimum sample rate was found using the Shannon Sampling Theorem, which states that the sample rate must be at least twice the bandwidth of the signal to avoid aliasing. Consequently, the maximum time between samples can be determined via

$$\text{max time between samples} = \frac{1}{2 * \text{sample rate in Hz}} = \frac{1}{2 \,.\, \frac{2.1 \cdot 10^7 ppm}{60s}} = 1.429\mu s$$

Max response time

To detect direction, a second encoder signal which is shifted by 90° is added and so, to correctly determine the direction, the response time must be at maximum half of the max time between samples, i.e. $\frac{1.429\mu s}{2} = 0.715\mu s$. The corresponding sampling rate can be calculated as

$$\text{sampling rate} = \frac{1}{1.429\mu s} Hz = 699.8kHz$$

The response time was verified on the oscilloscope by adding delays to the input signal, on each side of the threshold, verifying that delays under $0.715\mu s$ yielded a signal proportionate to the rotation of the motor, while delays over $0.715\mu s$ yielded a signal which were inversely proportional to the rotation of the motor.