Department of Electronic and Telecommunication Engineering, University of Moratuwa

EN2532 Robot Design and Competition
Laboratory Sheet-Practical No: 1

Indexes:	220399B, 220619D, 220491B, 220626V, 220502M	Date:	06 / 10 / 2024
Name:	Mecharuders	Group No:	10

1. What does PWM stand for?

Pulse Width Modulation

2. Main parameters to consider generating a PWM?

PWM Frequency, Duty cycle & resolution.

3. Describe the importance of selecting the PWM Frequency

- If it is too low, cogging will take effect.
- If it is too high, it might exceed the MOSFET's switching speed.
- PWM Frequency will affect the sound of the motor & The power transistor's switching speed. Choosing a PWM frequency greater than 16kHz helps reduce the humming sound heard while the motor is running.

4. What will happen when we change the PWM Duty cycle?

Changing the PWM duty cycle will change the average voltage across the motor, which changes the motor's speed.

5. What are the two type encoders?

- Relative encoder (Incremental)
- Absolute encoder

6. Why closed loop designs are heavily used in motor controlling

Closed-loop designs are heavily used in motor control because they provide precise control by continuously adjusting the motor's output based on feedback. This allows for real-time error correction, adaptability to changing loads, and improved efficiency. As a result, they ensure stable and accurate motor performance in dynamic conditions.

7. List down the modules(sensors) which can be used to get following feedbacks from a DC motor

    a. Rotation speed

encoder (optical encoder)

    b. Direction of rotation

encoder (Quadrature encoder)

    c. Torque

current sensor (motor current ∝ torque), Strain gauge.

8. If the PWM frequency is 5khz and duty cycle resolution is 10bit. Sketch the PWM signal when duty cycle value is set to 511 in a specific micro controller.

PWM freq. = 5 kHz ⇒ Period = $\frac{1}{5000}$ = 200 µs

Duty cycle resolution = 10-bit → Max. value = 1023 (since 2^{10} = 1024 levels)

Duty cycle value = 511 → Duty cycle = $\frac{511}{1023}$ × 100 = 49.95 %.

PWM signal (v)

100.1µs

99.9µs 100.1µs 99.9µs

t