EE6302: CONTROL SYSTEM DESIGN

LABORATORY 01

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1 Observations

Part A: Simple closed loop system

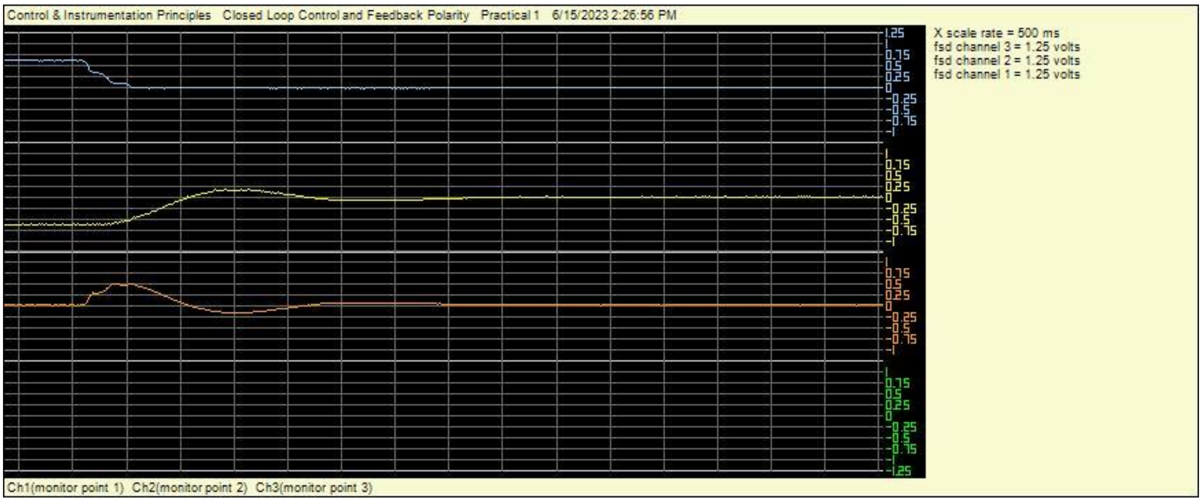

Figure 1: Data logger result just after rotating the input potentiometer by 90 degrees

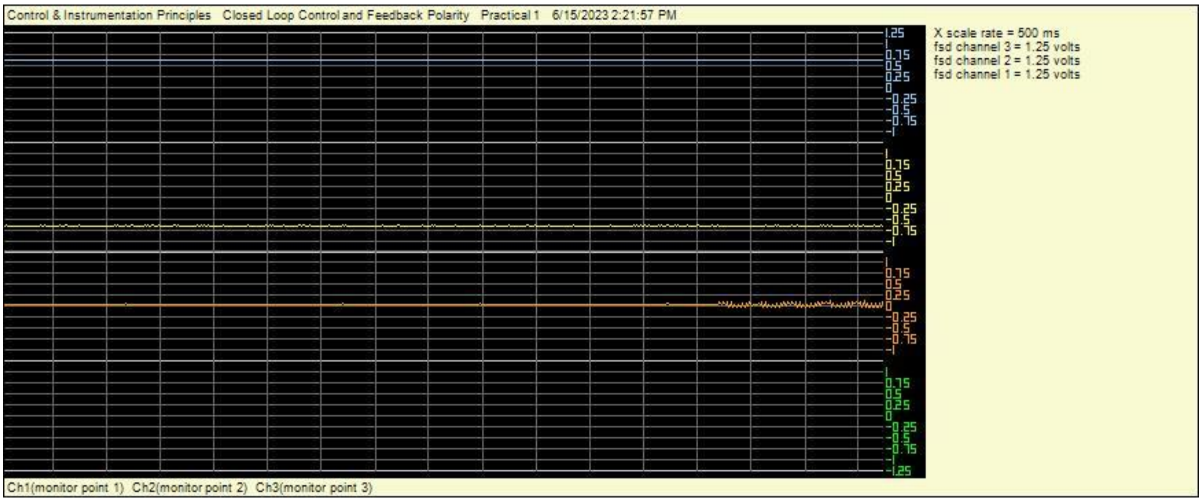

Figure 2: Data logger result after rotating the input potentiometer by 90 degrees

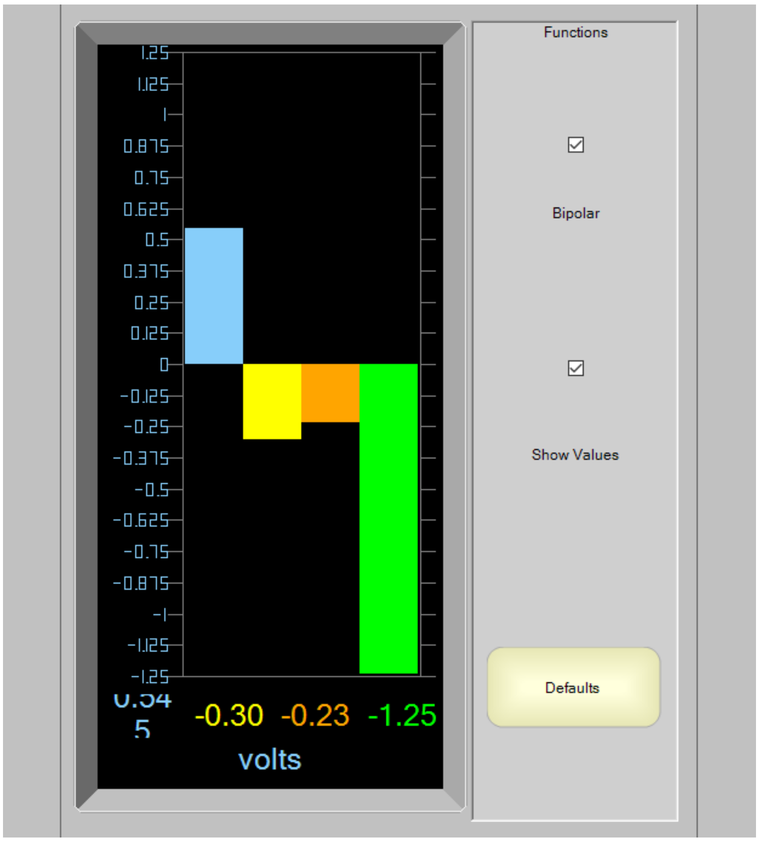

Figure 3: Bar display result after rotating the input potentiometer by 90 degrees

Part B: Feedback polarity

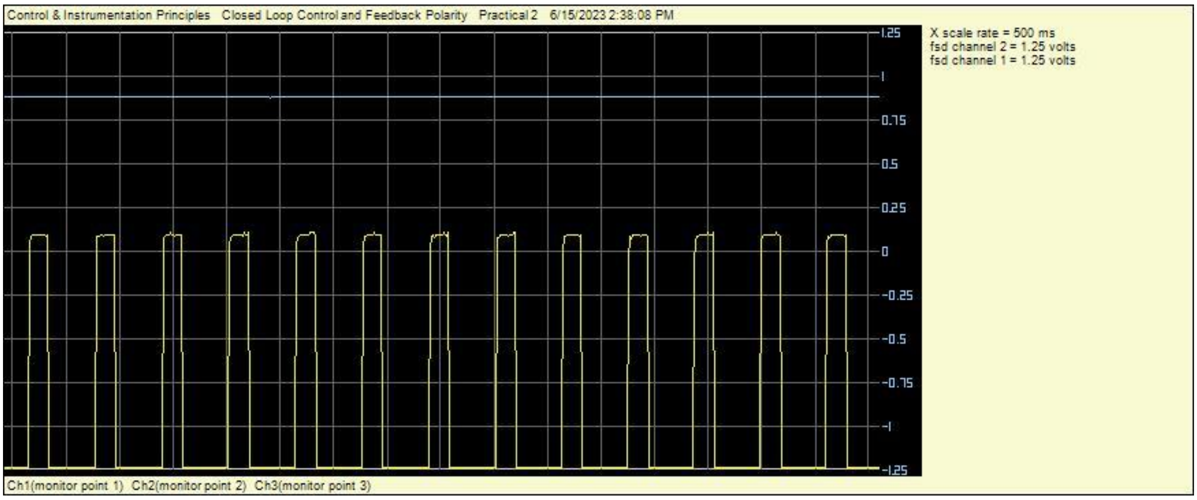

Figure 4: Data logger result for a positive feedback system after rotating the input potentiometer by 90 degrees

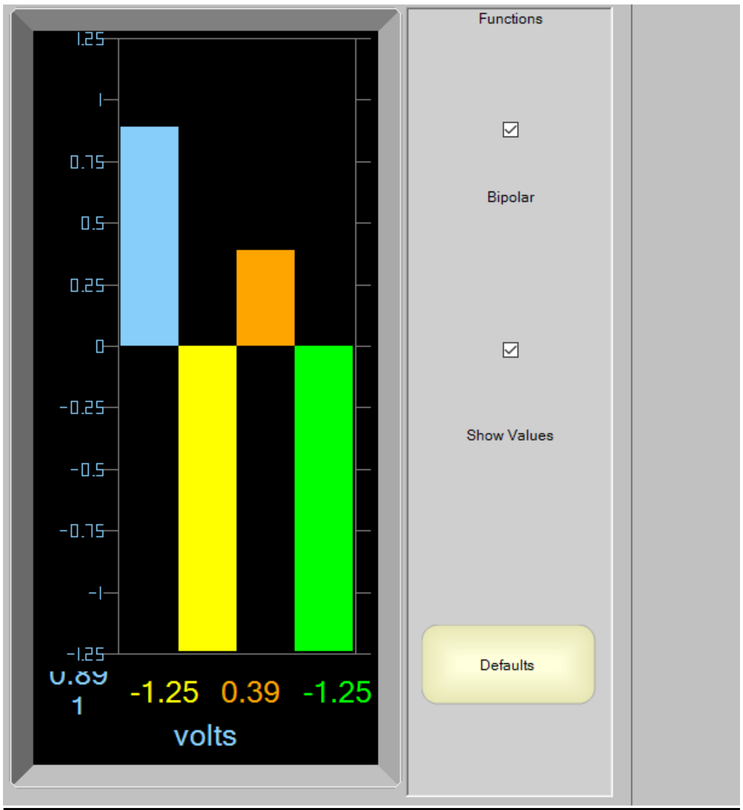

Figure 5: Bar display result for a positive feedback system after rotating the input potentiometer by 90 degrees

Part C: Input and output rotation

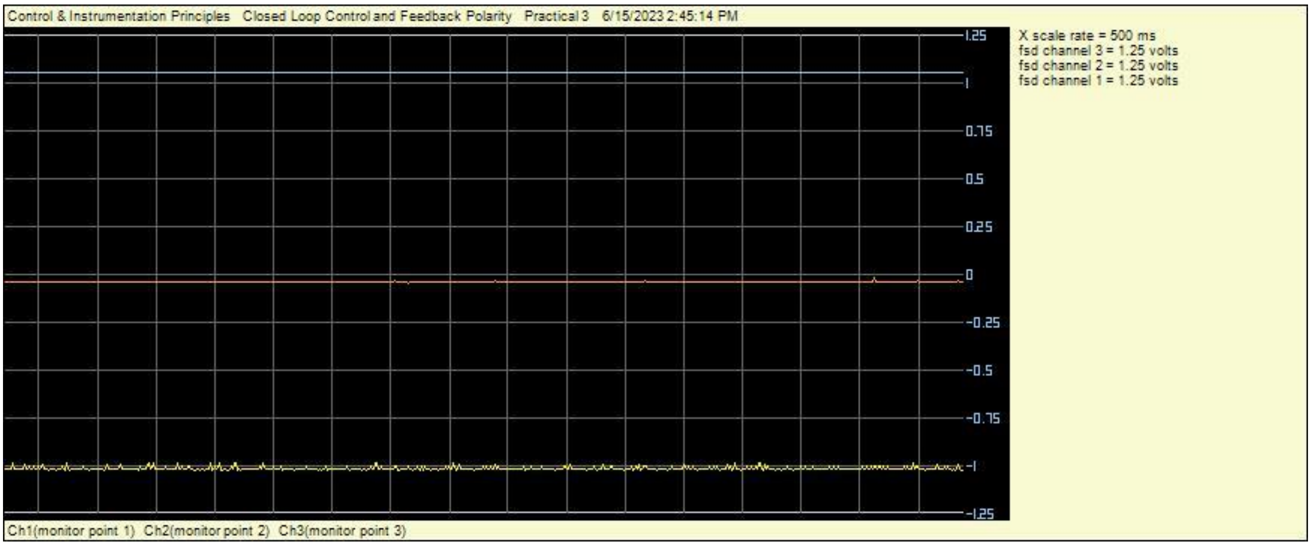

Figure 6: Data logger result when turning the input potentiometer to 90°

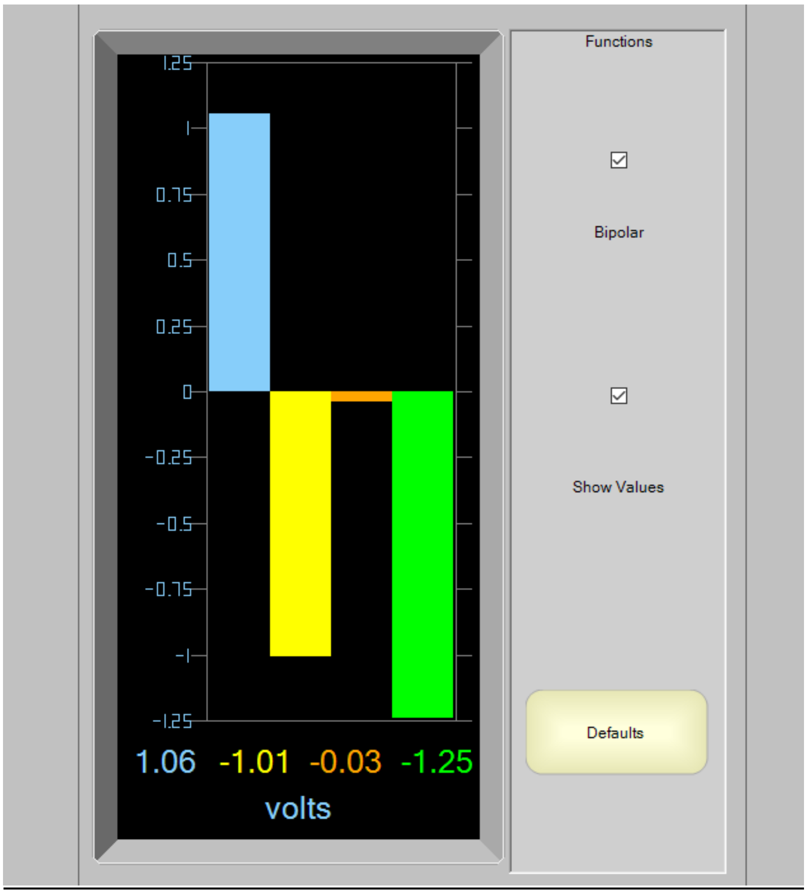

Figure 7: Bar display result when turning the input potentiometer to 90°

Part D: closed loop speed control with brake loading

Table 1: Brake settings of load, output potentiometer speed and armature current with closed loop control for g =1

Brake settings of load	Output potentiometer speed (rpm)	Armature current (A)
0	31.2	-0.25
1	30.2	-0.26
2	28.3	-0.3
3	25.3	-0.37
4	22.1	-0.46
5	19.9	-0.51
6	17.3	-0.57

Table 2: brake settings of load, output potentiometer speed and armature current with closed loop control for g =3.3

Brake settings of load	Output potentiometer speed (rpm)	Armature current (A)
0	31.2	-0.24
1	31	-0.24
2	30.3	-0.29
3	29	-0.40
4	26.9	-0.52
5	26	-0.6
6	24.6	-0.73

Table 3: Brake settings of load, output potentiometer speed and armature current with closed loop control for g =10

Brake settings of load	Output potentiometer speed (rpm)	Armature current (A)
0	31.2	-0.25
1	30.8	-0.25
2	30	-0.29
3	29.9	-0.42
4	28.7	-0.52
5	27.8	-0.69
6	27.1	-0.79

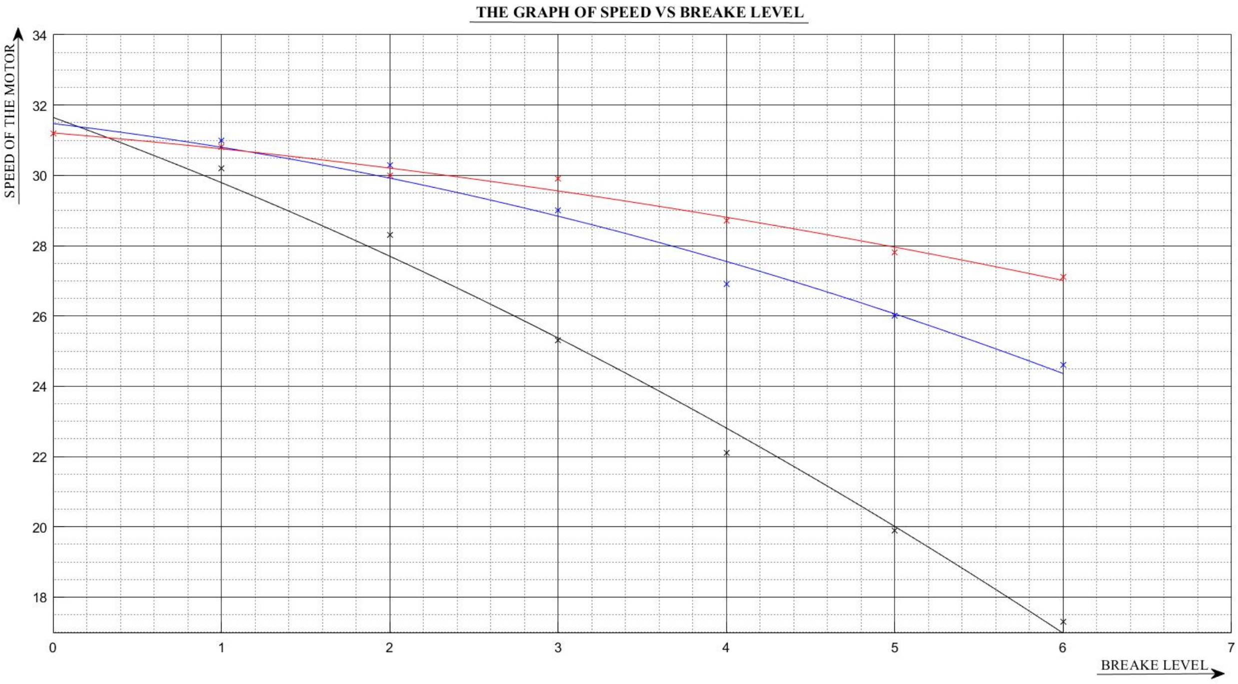

Figure 8: The graph of output potentiometer speed vs. break level

2 Discussion

PART A

Q. Considering the summing and error amplifier, explain how the system used in the practical act as a simple negative feedback closed loop system.

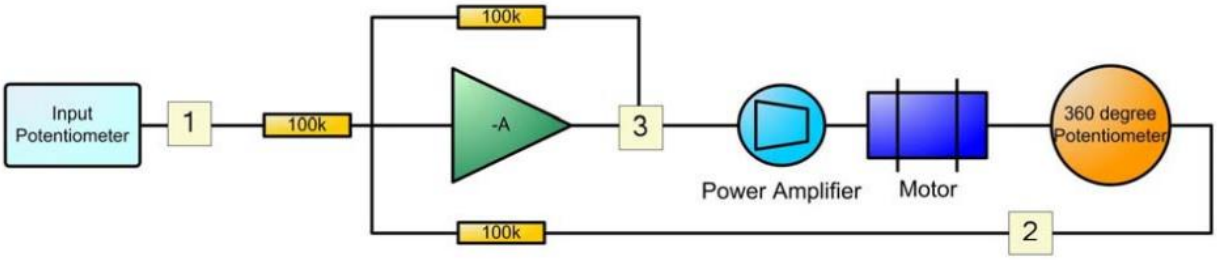

Figure 9: Simple block diagram of the closed loop system

The output shaft spins 90 degrees counterclockwise when the input potentiometer is turned 90 degrees clockwise. The error signal is the difference between the input and output shaft locations. The power amplifier amplifies this error signal, which is then utilized to power the motor. The output shaft is then rotated by the motor until the error signal is zero. The technique used here is called closed-loop control. Here, the 360-degree potentiometer sense signals are used to calculate the real value while the input potentiometer signal acts as the system's reference signal. The error signal is delivered to the amplifier's negative end as a difference using negative feedback. The mechanical unit turns 90 degrees counterclockwise when the input potentiometer rotates in the opposite direction, or anticlockwise. This behavior is a result of the error amplifier's corrective efforts, which reduce and eventually eliminate the error signal. As a result, the system fits the definition of a negative feedback system.

As a result, when the output potentiometer signal is negative and the input potentiometer signal is positive, or vice versa, the error signal is zero. This indicates that the system is a closed-loop negative feedback system.

PART B

Q. Discuss how the rotation of the input and output signals affects the negative feedback control system.

We saw in section A that the system's input and output signals rotated in the opposite directions. Here, the polarities of the reference signal and the sense signal are reversed. When the reference signal and the sense signal have the same magnitude and the opposite polarity, the error signal is zero. One of two options exists to align the rotation of the input and output signals:

1. Switch the input potentiometer's polarity.

2. Give the feedback negative unity gain.

The input and output signals will rotate in the same direction as a result of either of these modifications.