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333 Project writeup

28.4.1

1)

I will be using SPI 4, as the book is suggesting I do. It uses pins B8 and B14 for data acquisition triggering, and pins F4 and F5 to send and receive from the decoder to the PIC32.

2)

My input will be read on pin 15.

3)

For PWM I will be using Timer 3.

The following is the code is used to set it up:

```
PR3 = 3999;
TMR3 = 0;
OC1CONbits.OCM = 0b110;
OC1CONbits.ON = 1;
OC1CONbits.OCTSEL = 1;
T3CONbits.ON = 1;
```

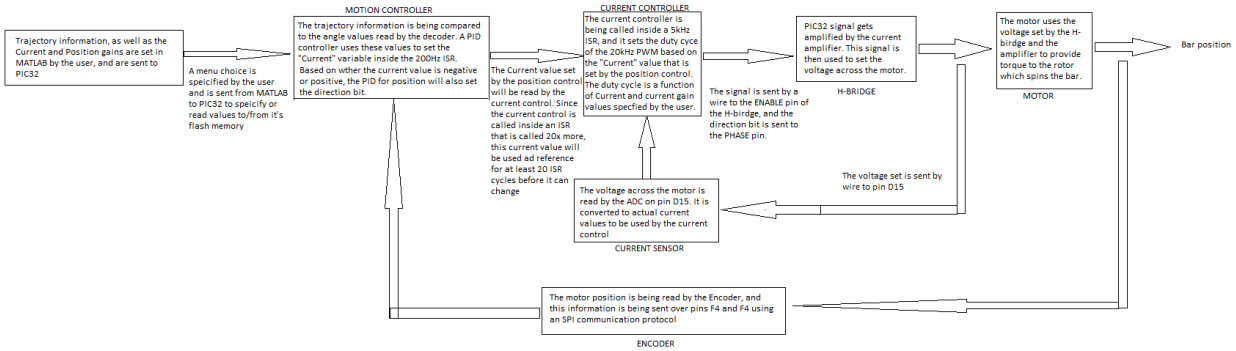
Pin D0 will be the one used to produce PWM cycle with this set-up.

For the direction bit I am using pin F1, which is actually connected to LED2. This way I can tell when My code sends the motor the commands to change the direction of motion.

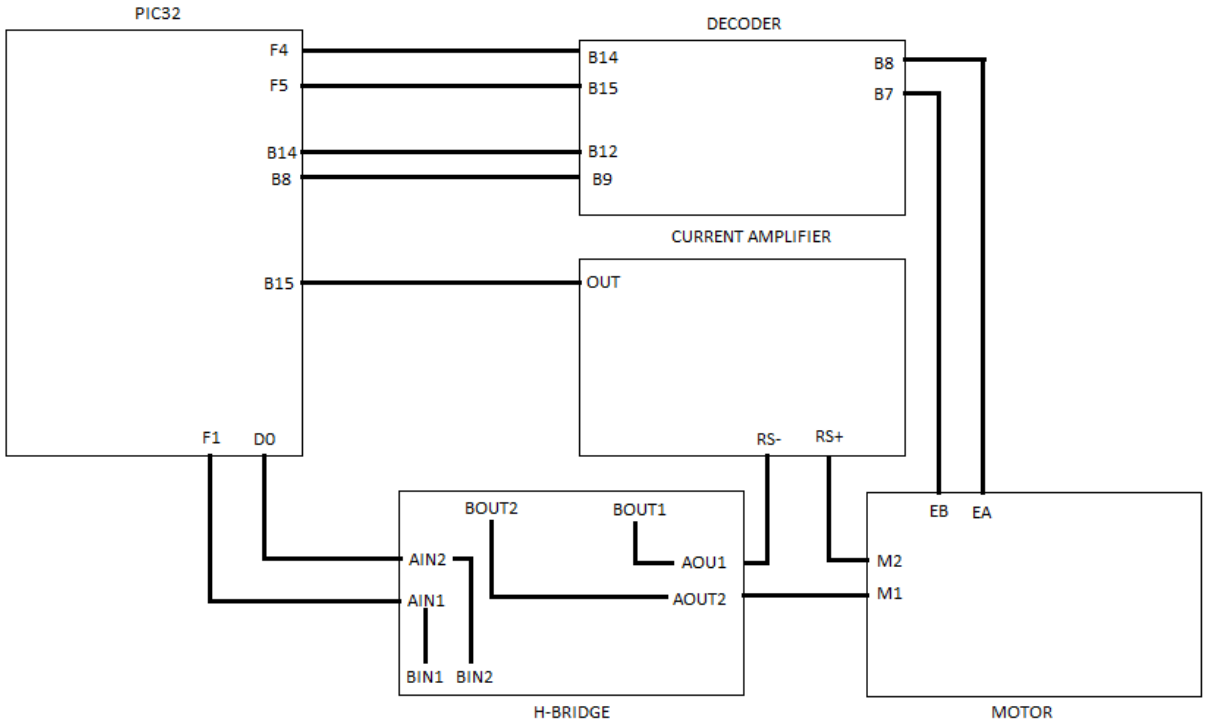
4)

I will be using Timer 2 with priority of 5 for 5kHz. I will be using Timer 4 with priority of 5 for 200 Hz.

5)


Trajectory information, as well as the Current and Position gains are set in MATLAB by the user, and are sent to PIC32
A menu choice is speicified by the user and is sent from MATLAB to PIC32 to speicify or read values to/from it's flash memory
MOTION CONTROLLER
The trajectory information is being compared to the angle values read by the decoder. A PID controller uses these values to set the "Current" variable inside the 200Hz ISR. Based on wther the current value is negative or positive, the PID for position will also set the direction bit.
The Current value set by the position control will be read by the current control. Since the current control is called inside an ISR that is called 20x more, this current value will be used ad reference for at least 20 ISR cycles before it can change
CURRENT CONTROLLER
The current controller is being called inside a 5kHz ISR, and it sets the duty cyce of the 20kHz PWM based on the "Current" value that is set by the position control. The duty cycle is a function of Current and current gain values specfied by the user.
The signal is sent by a wire to the ENABLE pin of the H-birdge, and the direction bit is sent to the PHASE pin.
PIC32 signal gets amplified by the current amplifier. This signal is then used to set the voltage across the motor.
H-BRIDGE
The motor uses the voltage set by the H-birdge and the amplifier to provide torque to the rotor which spins the bar.
MOTOR
Bar position
The voltage set is sent by wire to pin D15
The voltage across the motor is read by the ADC on pin D15. It is converted to actual current values to be used by the current control
CURRENT SENSOR
The motor position is being read by the Encoder, and this information is being sent over pins F4 and F4 using an SPI communication protocol
ENCODER

6)


PIC32
F4
F5
B14
B8
B15
F1
D0
DECODER
B14
B15
B12
B9
B8
B7
CURRENT AMPLIFIER
OUT
RS-
RS+
BOUT2
BOUT1
AIN2
AIN1
AOU1
AOUT2
BIN1
BIN2
H-BRIDGE
EB
EA
M2
M1
MOTOR

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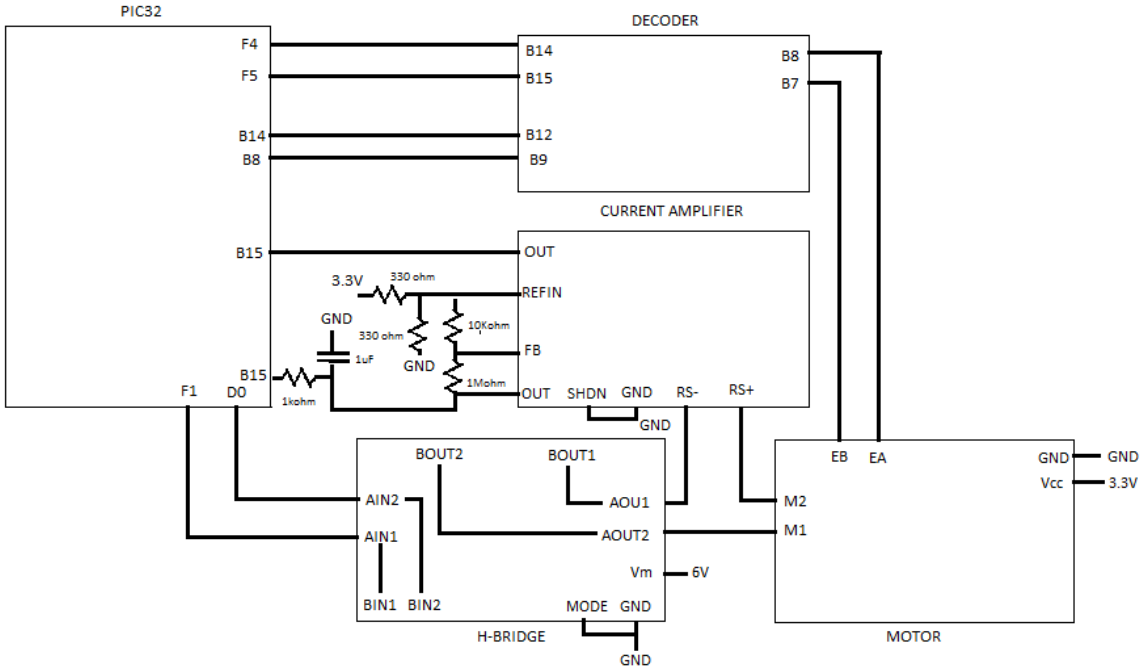
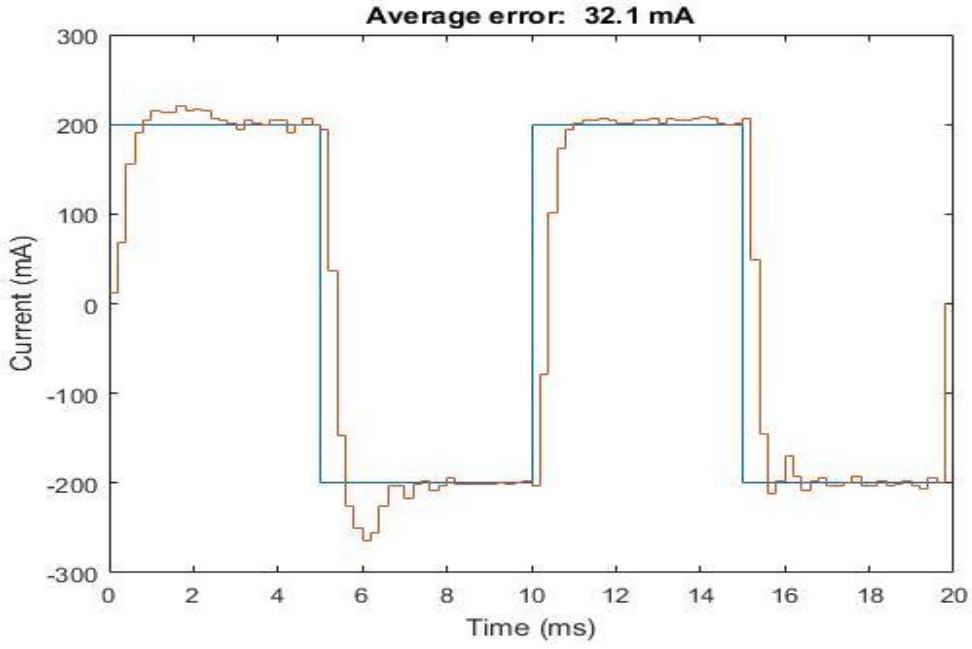
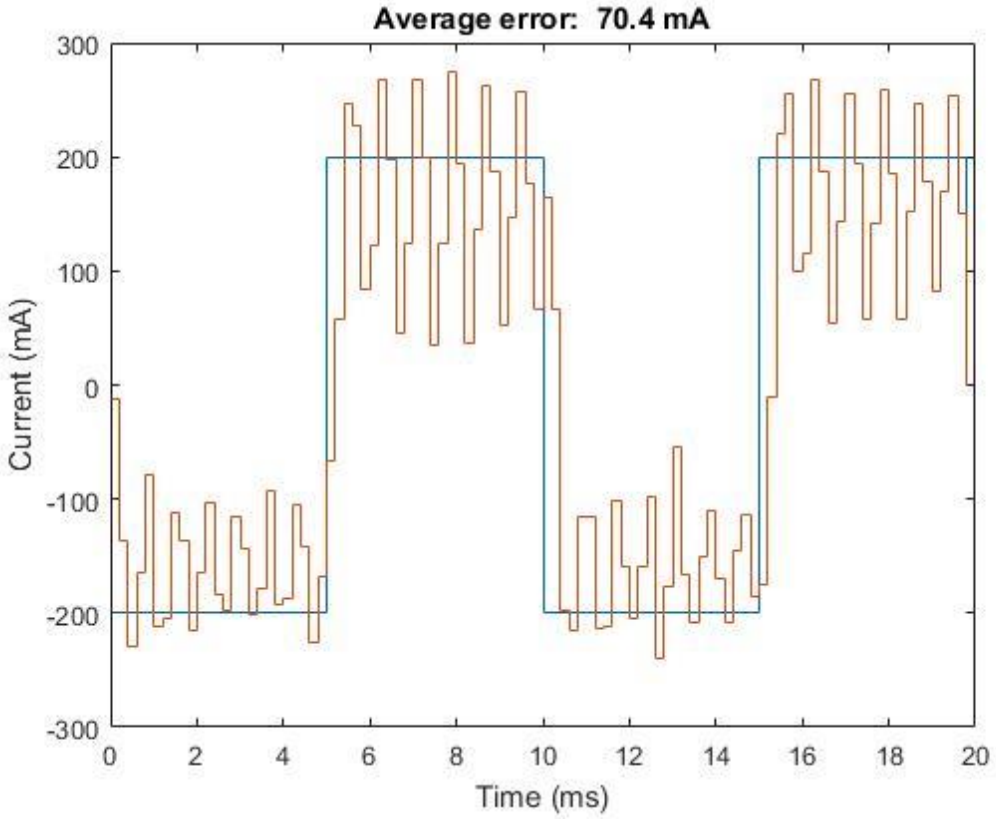

PIC32
F4
F5
B14
B8
B15
F1
D0
DECODER
B14
B15
B12
B9
B8
B7
CURRENT AMPLIFIER
OUT
REFIN
FB
OUT
SHDN
GND
RS-
RS+
3.3V
330 ohm
GND
330 ohm
10Kohm
1uF
GND
1Mohm
B15
1kohm
GND
BOUT2
BOUT1
AIN2
AOU1
AIN1
AOUT2
Vm
6V
BIN1
BIN2
MODE
GND
H-BRIDGE
GND
EB
EA
GND
GND
Vcc
3.3V
M2
M1
MOTOR

28.4.10

5)


Average error: 32.1 mA
Current (mA)
Time (ms)
300
200
100
0
-100
-200
-300
0
2
4
6
8
10
12
14
16
18
20

The following is the graph of current tracking without current integral gain.



28.4.12

5) Graphs attached, named 28_4_12_5_step1, 28_4_12_5_step2 for step references,

and 28_4_12_cubic for cubic reference.

Current: Kp = 1 (units of Duty cycle counts / mA) Ki = .3 (units of Duty cycle counts/ (mA * s)

Position: Kp = 1 (mA/encoder counts) Kd = 20 (s * mA/encoder counts) Ki = .1 (mA/(s * encoder counts))

Step tracking is with reference of [0,0;1,90;2,180;3,90;4,0;5,0] and [0,0;1,90;2,0;3,180;4,0;5,0]

Cubic tracking is with reference of [0,0;1,90;2,0;3,180;4,0;5,0]

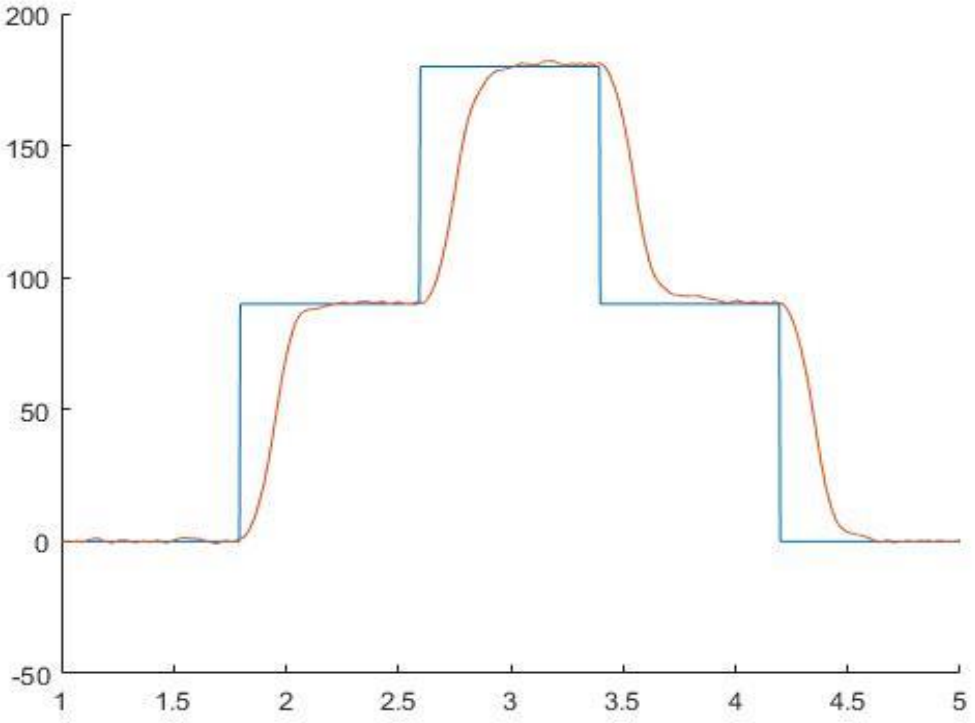


Figure 1 28_4_5_1_step1

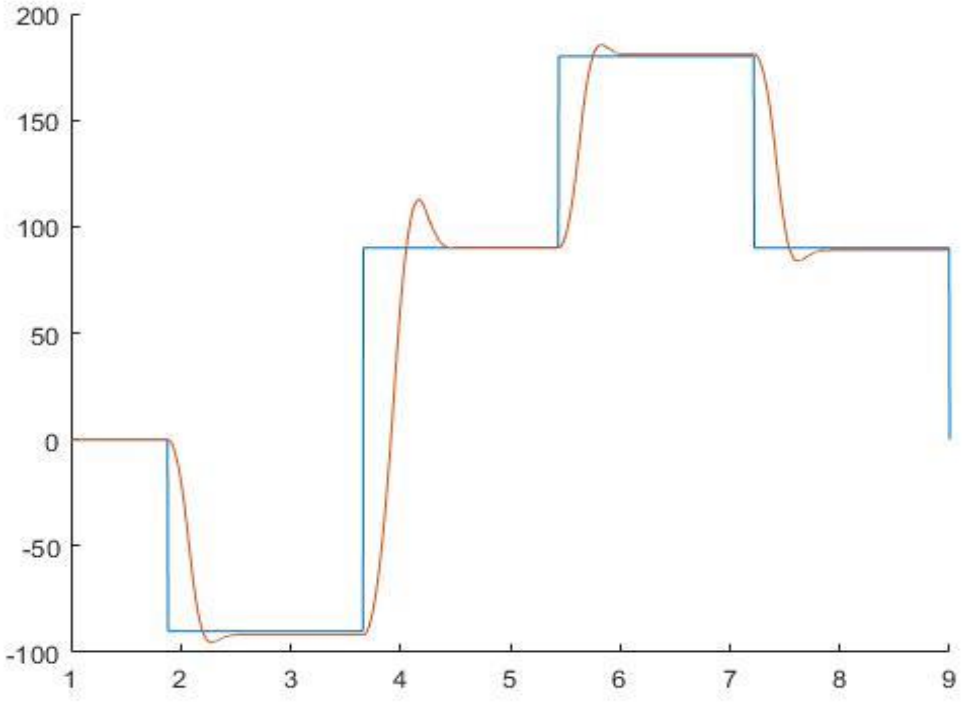


Figure 2 28_4_5_1_step2

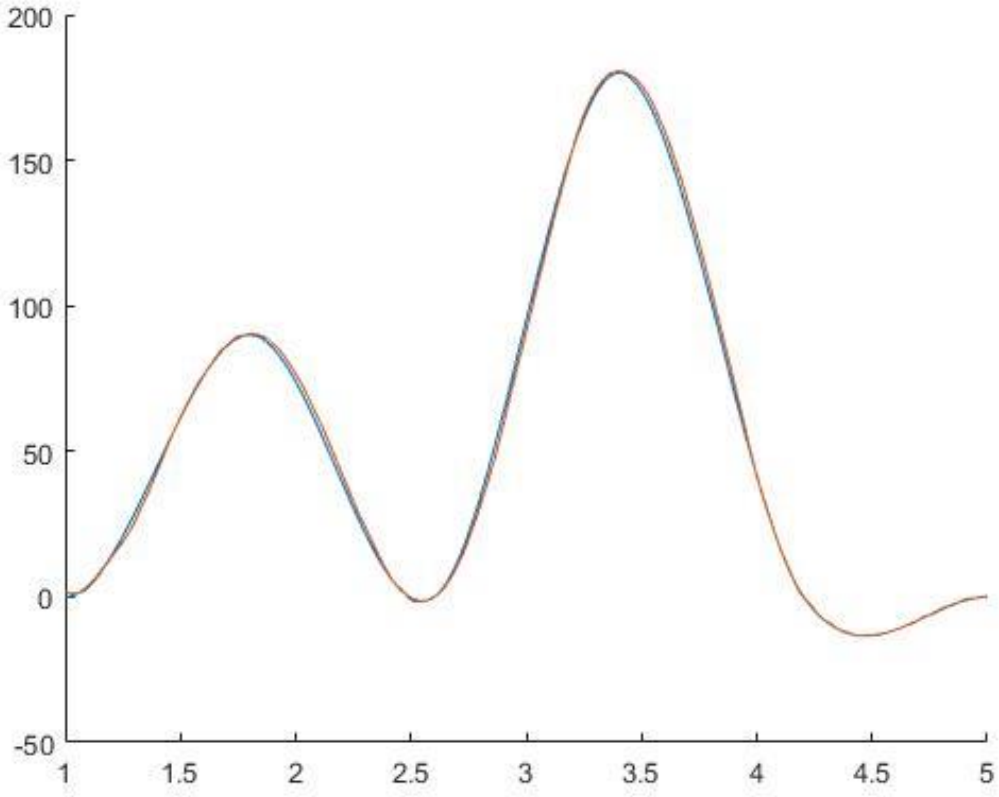


Figure 3 18_4_12_5_cubic