**Praveen Ravishankar** **Fall 2019**

**ME 4405 Section** **B**

**Lab Assignment Seven**

**Stepper Motor Control with the MSP432**

**Questions:**

1. At what frequency does the stepper motor fail to move anymore (in a predictable way)? Explain why this occurs.

The stepper motor fails to move starting at approximately **40 Hz**. This is due to the fact that the coils within the motor are energized at an excessively fast rate such that the magnet within the motor isn’t able to align with the coils fast enough.

1. What happens if two consecutive coils are energized simultaneously, i.e. if A1:B1 are energized, then B1:A2 are energized and then A2:B2 and so on (A1B1-B1A2-A2B2-B2A1-A1B1). What happens to the torque as compared to A1-B1-A2-B2-A1? What is this method of excitation called?

If two consecutive coils are energized simultaneously, then the motor would rotate at a faster rate and produce a higher torque compared to energizing each coil individually; however, energizing two consecutive coils at the same time would result in decreased precision in rotating the motor to a certain angular position. This method of excitation is called **bipolar excitation**.

1. Consider the use of half-stepping excitation. What happens to the torque in each step when using half-stepping operation with a unipolar motor?

With half-stepping excitation, the step angle of the motor is half of the step angle that would result in the motor with full-stepping excitation. As a result, using half-stepping excitation results in smoother movements of the motor and greater precision in setting the angular position of the motor (due to the increased resolution of the angle). However, half-stepping excitation additionally results in **decreased torque** in each step in comparison to the torque in each step when using full-stepping excitation.

1. What excitation method would you use to achieve greater motion resolution than possible with half-stepping? How would you implement this method using the MSP432?

In order to achieve greater motion resolution than possible with half-stepping, **microstepping excitation** can be used. This method can be implemented using the MSP432 by varying the current in small increments. Specifically, this can be accomplished by using PWM to gradually change the strength of the magnetic field of each coil (by gradually changing the duty cycle of the signal applied to each coil), thereby changing the angle of the motor’s permanent magnet.