Brian Jin
Rafael Pelles
Mechatronics Team 14

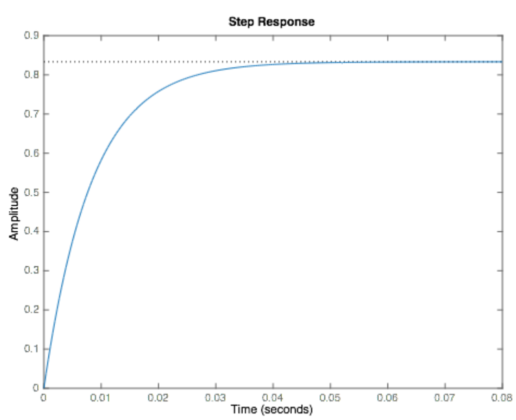
1. Why should there be a difference between the time required for a 200 step per revolution stepper motor to take its first step from a stopped position and the time required to take its 400th step (i.e. after making 2 full revolutions) in a 4 revolution motion?

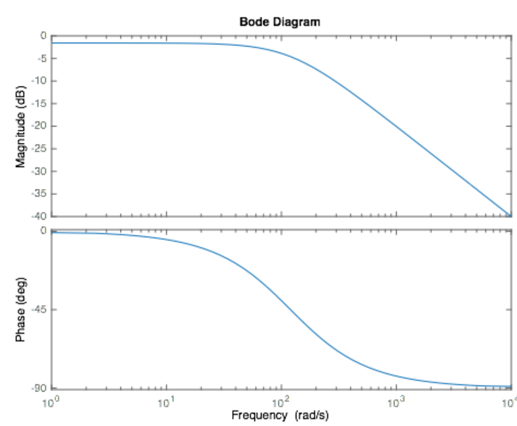
There should be a difference between the time required for the motor to take its first step from a stopped position and the time required for the motor to take its 400th step because of the inertia of the motor. From a stopped position the motor will need to accelerate from rest on it's first step, however on its 400th step the motor will already be in motion assuming the stepper motor is operating in continuous motion, so there will be less acceleration required to continue moving and as a result the time required to make its step will be lesser.

2. Assuming that the equivalent circuit for the stepper motor winding is simply an inductor and resistor in series, write the differential equation which relates the current to the applied voltage (i.e. assume that the voltage is the input and the current is the output). Write the transfer function for this (i.e. derive the admittance, the inverse of impedance) and the frequency response.

$$L \cdot \frac{di(t)}{dt} + R \cdot i(t) = V(t)$$

$$\frac{I(s)}{V(s)} = \frac{1}{Ls+R}$$





3. List five examples of stepper motor control applications in consumer products or industrial processes (it is fair to check the internet).

Five examples of stepper motor control applications in consumer products are computer printers, CNC milling machines, CD drives, slot machines, and 3D printing/rapid prototyping machines.

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4. One possible fault in stepper motor systems is that something is preventing the motors from turning. In words, discuss how you would modify the mode 3 code to detect this fault and stop the process.

The mode 3 code could be modified to detect a motor stall fault by storing a variable which keeps the number of steps the motor has attempted to take in a given direction (clockwise or counterclockwise) and indicating a fault if the number of attempted steps has exceeded a full rotation (plus a buffer) without triggering the optical interrupter. For example, in mode 3 the unipolar motor starts at the vertical optical interrupter and the bipolar motor starts at the horizontal home position. When the red button is pressed the motors begin to turn counterclockwise and a variable could be introduced to store the number of steps each motor has attempted to take in the counterclockwise direction. That way if a motor is prevented from turning the counter would continue to increase regardless of the actual motion of the motor. If this counter exceeds 100 (say, for an 100 step/rev stepper motor) plus a buffer of 10 steps without triggering the optical interrupter we can infer that the motor has been prevented from rotating.

5. List sources that you checked outside of the lectures to complete the programs for this case study (such as the Microchip web site or references for C).

http://ww1.microchip.com/downloads/en/DeviceDoc/50002053E.pdf
http://ww1.microchip.com/downloads/en/DeviceDoc/30498D.pdf
http://www.learncpp.com/
http://stackoverflow.com/questions/1371460/state-machines-tutorials