Sensors and Motor Control Lab Quiz

1. Reading a datasheet. Refer to the ADXL335 accelerometer datasheet (<https://www.sparkfun.com/datasheets/Components/SMD/adxl335.pdf>) to answer the below questions.
   * What is the sensor’s range?
   * What is the sensor’s dynamic range?
   * What is the purpose of the capacitor CDC on the LHS of the functional block diagram on p. 1? How does it achieve this?
   * Write an equation for the sensor’s transfer function.
   * What is the largest expected nonlinearity error in g?
   * What is the sensor’s bandwidth for the X- and Y-axes?
   * How much noise do you expect in the X- and Y-axis sensor signals when your measurement bandwidth is 25 Hz?
   * If you didn’t have the datasheet, how would you determine the RMS noise experimentally? State any assumptions and list the steps you would take.
2. Signal conditioning
   * Filtering
     + Name at least two problems you might have in using a moving average filter.
     + Name at least two problems you might have in using a median filter.
   * Opamps
     + - In the following questions, you want to calibrate a linear sensor using the circuit in Fig. 1 so that its output range is 0 to 5V. Identify in each case: 1) which of V1 and V2 will be the input voltage and which the reference voltage; 2) the values of the ratio Rf/Ri and the reference voltage. If the calibration can’t be done with this circuit, explain why.
       - Your uncalibrated sensor has a range of -1.5 to 1.0V (-1.5V should give a 0V output and 1.0V should give a 5V output).
     + Your uncalibrated sensor has a range of -2.5 to 2.5V (-2.5V should give a 0V output and 2.5V should give a 5V output).



Fig. 1. Opamp gain and offset circuit

1. Control
   * If you want to control a DC motor to go to a desired position, describe how to form a digital input for each of the PID (Proportional, Integral, Derivative) terms.
   * If the system you want to control is sluggish, which PID term(s) will you use and why?
   * After applying the control in the previous question, if the system still has significant steady-state error, which PID term(s) will you use and why?
   * After applying the control in the previous question, if the system still has overshoot, which PID term(s) will you apply and why?