

# MCHE 470: Robotics

Fall 2013 – Midterm

Tuesday, October 8

- Basic I/O
  - Analog vs Digital (conceptually)
  - Analog-to-Digital Conversion
    - Effect of number of bits on resolution (8bit vs 10bit)
    - Basic equation/relationship between analog and digital in ADC
  - What pins on the RedBoard are analog? Digital?
  - Digital I/O
    - Switches, etc that are on/off (0 or 5V typically)
    - PWM
      - How does it approximate analog?
      - What is duty cycle?
    - Serial Communication
      - Basic understanding
      - What are the parameters we have to set?
        - Baud rate = speed
        - Stop bit = are we finished?
        - Parity = rarely used, don't worry about it
        - Number of data bits = actual data, 7 or 8 bits typical
- Arduino Programming
  - Data types
    - Names
    - Range of possible values
  - How is a variable declared?
  - What is the basic setup of an Arduino program?
    - What does setup() do?
    - How about loop()?
  - Know variable scope within a sketch (Arduino program)
  - How are functions defined?
  - Basics of control structures
    - What are the comparison operators?
    - If... else
    - Switch... case
    - For loops
    - While loops
    - Do-while loops
  - Serial Comm. with Serial Monitor

- Why is it useful?
  - How to set up?
- Basic Arduino functions
  - pinMode
  - analogRead
  - analogWrite (actually PWM)
  - digitalRead
  - digitalWrite
- Design
  - House of Quality
  - Specification Sheet
  - Function Tree
  - Morphological Chart
  - Evaluation Matrices (1st, 2nd, and 3rd level)
- Controls Overview
  - What's the basic purpose of each block in a generic block diagram?
  - P, PD, and PID control
    - What's the basic setup?
    - What is the function of each of the gains? (the table we talked through in class)
    - How can we choose/tune the gains? (Ziegler-Nichols is one way)
- Command Generation
  - What is a bang-bang input?
  - What is a bang-coast-bang input?
  - When should I use either?
  - What's the relationship between bang-bang and bang-coast-bang force commands and resulting velocity and position?
  - What are the problems when these commands are issued to flexible systems?
- Command Generation for Flexible Systems
  - How can we reduce vibration?
    - Move slow
    - Intelligently design commands
  - Input Shaping
    - Impulse response explanation
    - How do you convolve a series of impulses with a command?
    - How is input shaping implemented?
    - What is the tradeoff between shaper duration and robustness to changes in frequency?