Weekly reports are to be emailed to atbecker@uh.edu by 5:00pm on Tuesdays. The purpose of a weekly report is to: (1) give you text and images for your papers, thesis, and dissertation, (2) document progress, (3) identify if you are stuck or need resources.

Weekly report

1. **My *Goals* from last week**
   - **Deliverable 1:** Begin creating a Simulink model of the control system. Two equations are used (x-axis and y-axis). I did this in order to be able to use a direct measurement (position) as a feedback state. I would like to use FULL state feedback and determine the velocity feedback state by computing the velocity from previous position change information. I could also use an estimator for that state variable. I will also compare to MPC and PID. - **Model Complete, Controller Testing In Progress**
   - **Deliverable 3:** Test interface with current control loop and Simulink. Verify Simulink can send valid current commands to control loop. - **In Progress**
2. **My *Accomplishments* this week**
   a. Project 1: Magnetic Coil Control for Mico robots
      - **Deliverable 1:** Refine Simulink model of the control system. See Equation (1) and (2) for the state-space equations for the ball bearing. Two equations are used (x-axis and y-axis). I did this in order to be able to use a direct measurement (position) as a feedback state. Equation (3) is the magnetic field gradient used to compute the forced induced on the sphere.
      - Figure 1 shows the current Simulink model. Figure 2 shows the path taken by the test object (small magnetic sphere weighing 1 gram in water).
      - **Deliverable 3:** Test interface with current control loop and Simulink. Verify Simulink can send valid current commands to control loop. (In Progress).

$$\begin{bmatrix}\dot{x}\\ \dot{v}_x\end{bmatrix}=\begin{bmatrix}0 & 1\\ 0 & \frac{(-6\pi\mu r v_x)}{m_s}\end{bmatrix}\begin{bmatrix}x\\ v_x\end{bmatrix}+\begin{bmatrix}0\\ \frac{(F_{mx}-u_k F_N)}{m_s}\end{bmatrix}u(t)$$

Equation (1)

$$\begin{bmatrix}\dot{y}\\ \dot{v}_y\end{bmatrix}=\begin{bmatrix}0 & 1\\ 0 & \frac{(-6\pi\mu r v_y)}{m_s}\end{bmatrix}\begin{bmatrix}y\\ v_y\end{bmatrix}+\begin{bmatrix}0\\ \frac{(F_{mx}-u_k F_N)}{m_s}\end{bmatrix}u(t)$$

Equation (2)

$$\nabla\dot{B}(x,y)=\frac{dB}{dx}\frac{dB}{dy}$$

$$\frac{dB}{dx}=\frac{((u_o N I R^2)(-3x))}{(R^2+x^2)^{2.5}}$$

Equation (3)
Note: Similar solution for y-plane

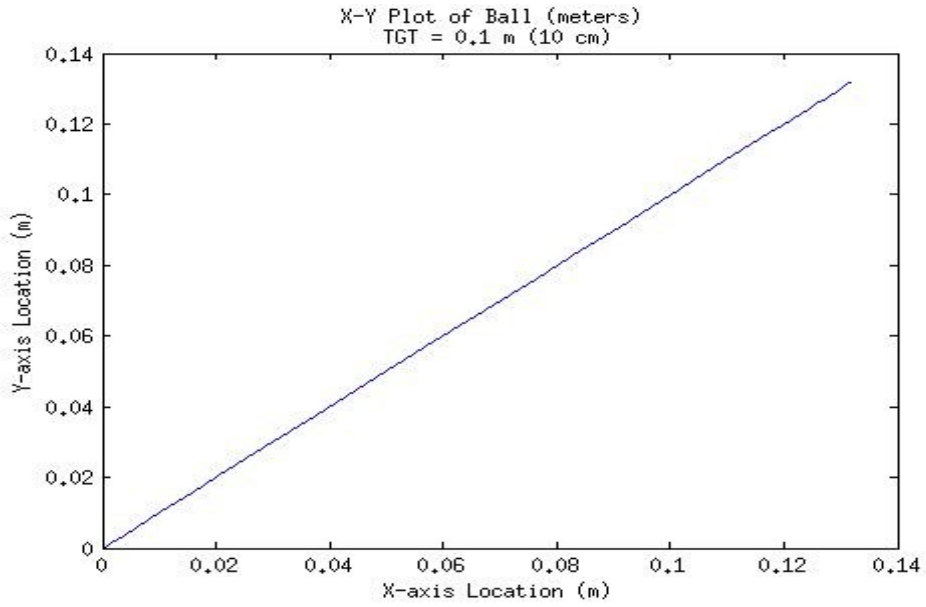

Figure 2 – XY Plot of ball. TGT (x,y) = (0.1,0.1)

3. **My *Goals* for next week**
   - Objective 1. Build a coil with the electrical and physically properties required for a working coil control system.
   - Objective 2:Start construction on a frame to hold the six coils and operating area for micro-robots.
   - Objective 3: Continue system modeling and building in Simulink of the control loop. Compare MPC, PID, and FULL state feedback to determine which control methods performs the best.
   - Objective 4: Continue to improve model for non-linear and real-world aspects of system.
   - Objective 5: Improve Tracking of sphere in model to desired location (x,y).
     a. Meeting with Dr. Becker on Friday 19 JUN15 at 1300. Request confirmation via Google Calendar. Review proposed state-space equations for object and Simulink modeling.
4. **What I need Dr. Becker to do:**
   a. Continue to provide daily oversight of Ademir in coil and frame construction.
   b. Discuss during next meeting additional model constraints and controls.

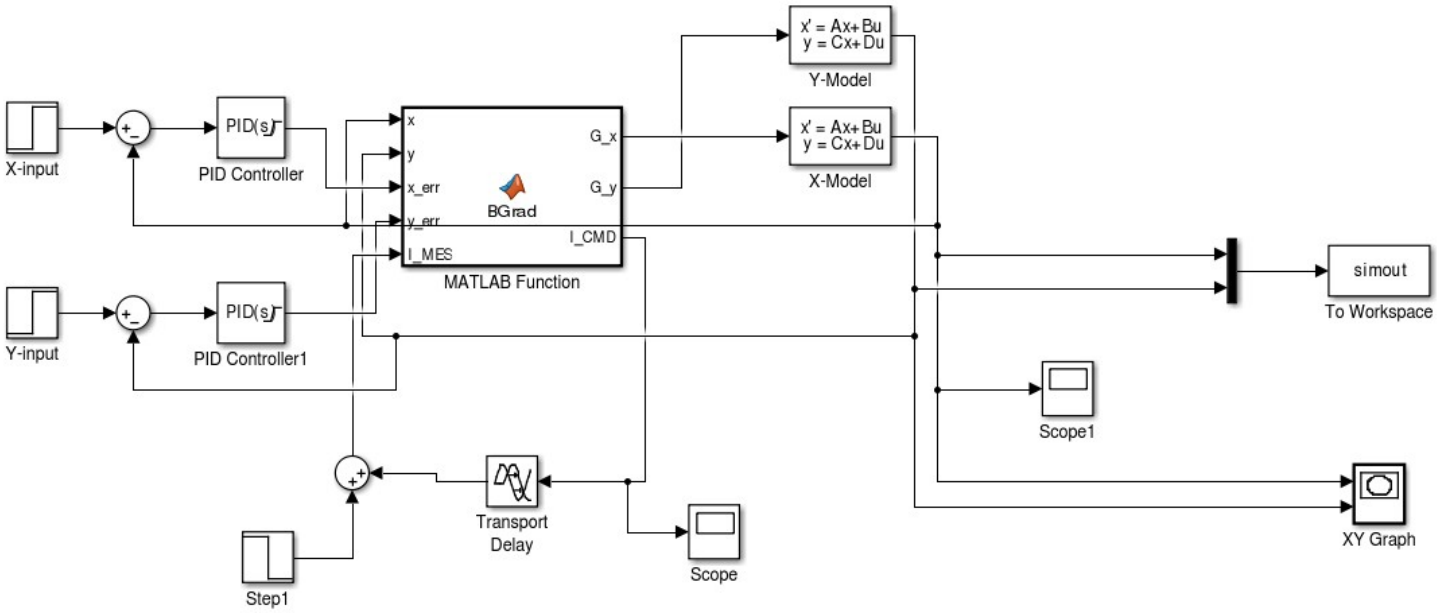
x' = Ax+Bu
y = Cx+Du
Y-Model
x' = Ax+Bu
y = Cx+Du
X-Model
X-input
PID(s)
PID Controller
x
y
x_err
y_err
I_MES
G_x
G_y
I_CMD
BGrad
MATLAB Function
Y-input
PID(s)
PID Controller1
simout
To Workspace
Scope1
Transport
Delay
Scope
XY Graph
Step1

Figure 1