MAGNETIC BEARINGS FOR SPACE FLIGHT DEVELOPMENT

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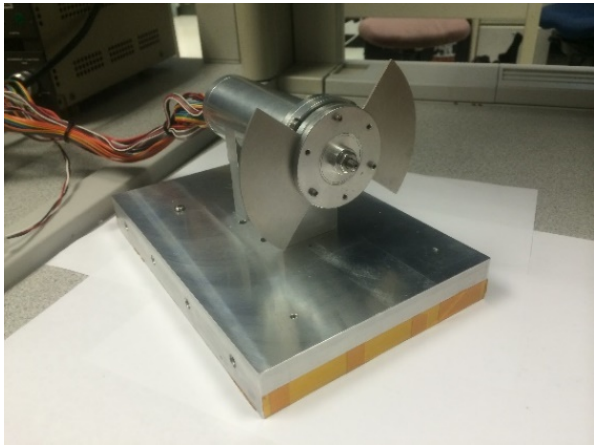
WHAT IS A MAGNETIC BEARING?

Device to support a load using magnetic levitation

Used for mechanisms that need

- high-speed operation
- precision



ADVANTAGES OF MAGNETIC BEARINGS

Reduce vibrations

Allow for higher precision

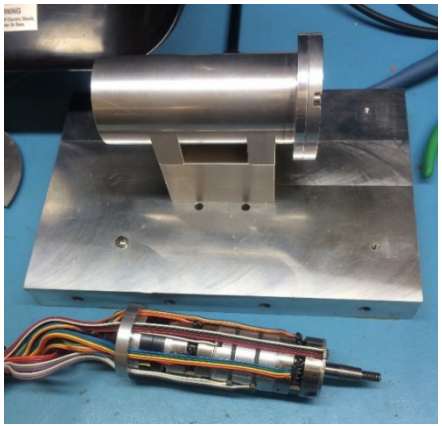
Eliminate friction and lubrication issues

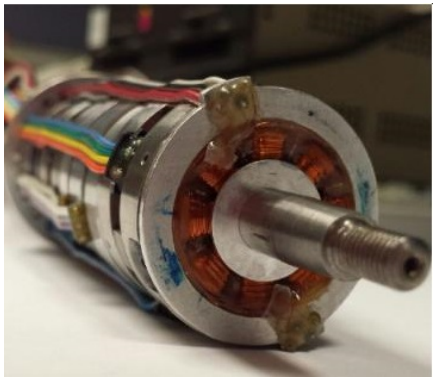
Works very well in vacuum

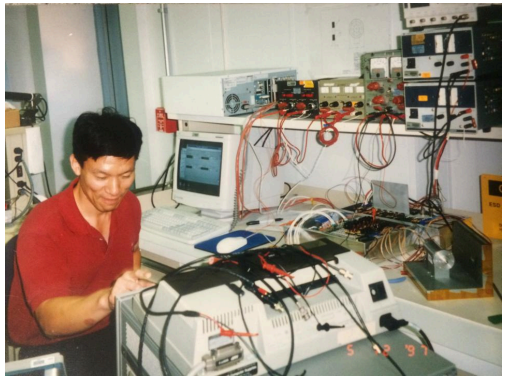
Longer life than their mechanical bearing counterpart

GOAL

To set-up and operate the existing magnetic bearing system that was developed at the Electromechanical Systems Branch





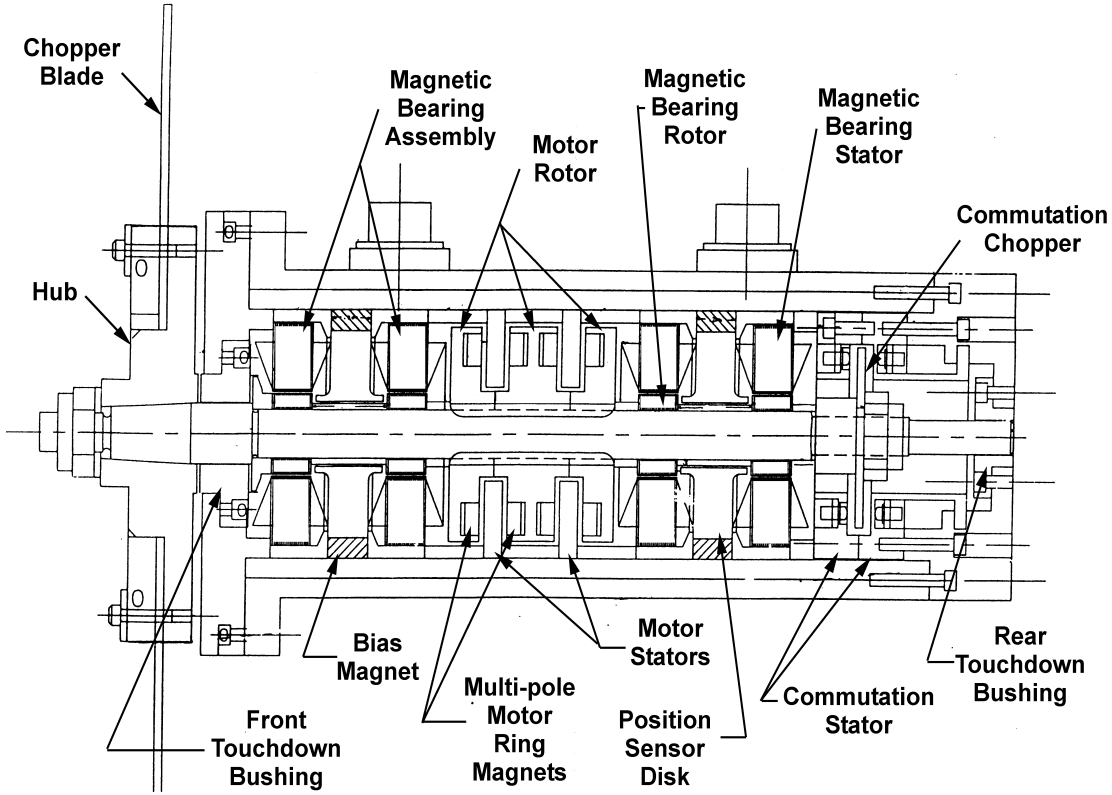


OVERVIEW

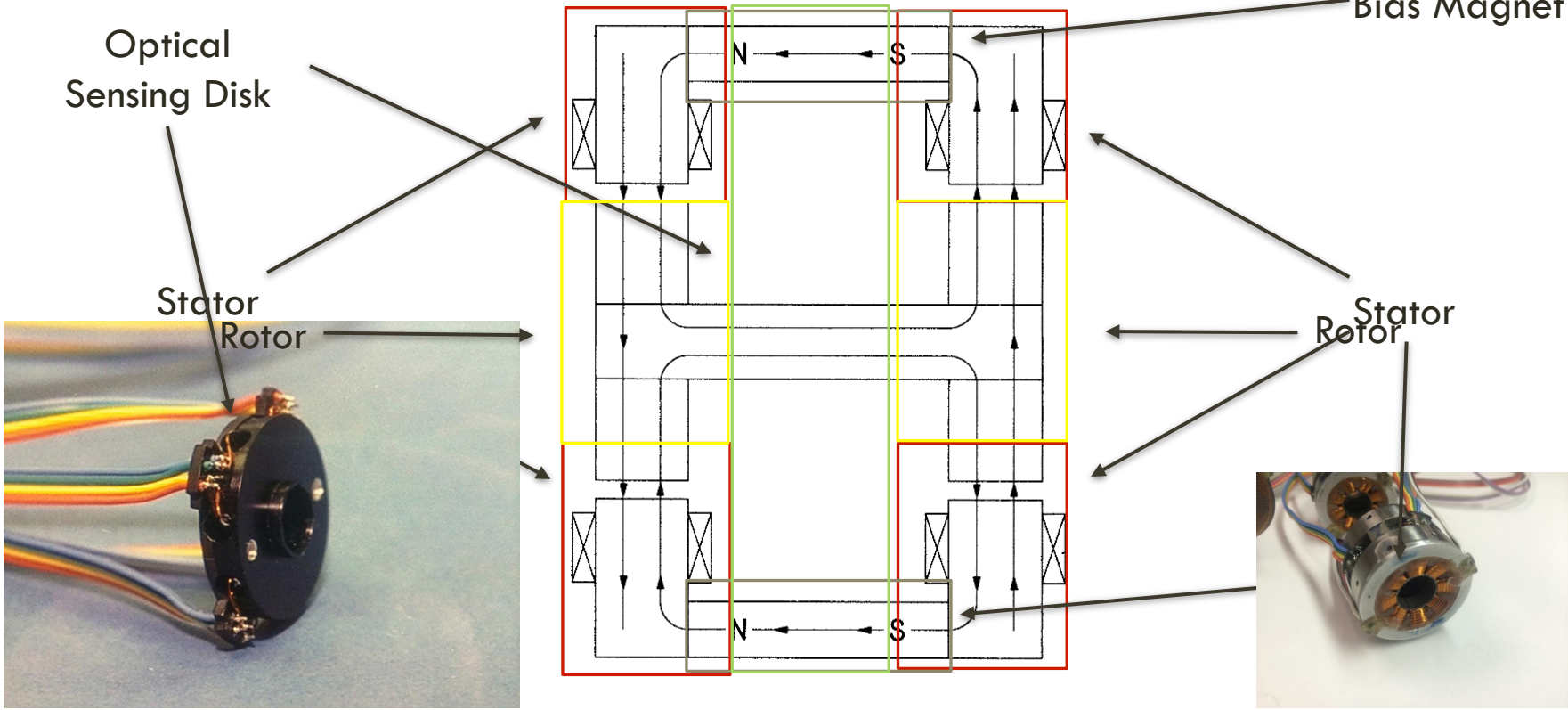
I will go over:

1. Theory of how it works
2. Electronics
3. Matlab/dSPACE
4. Testing the Sensors
5. Operating the Proportional Integral Derivative (PID)
6. Future work

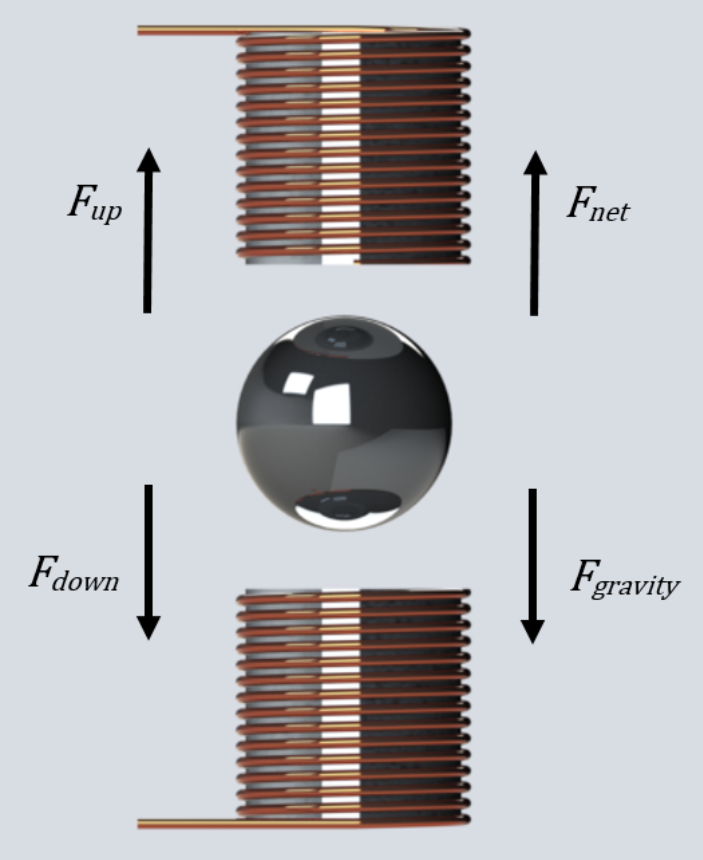
OPTICAL CHOPPER COMPONENTS



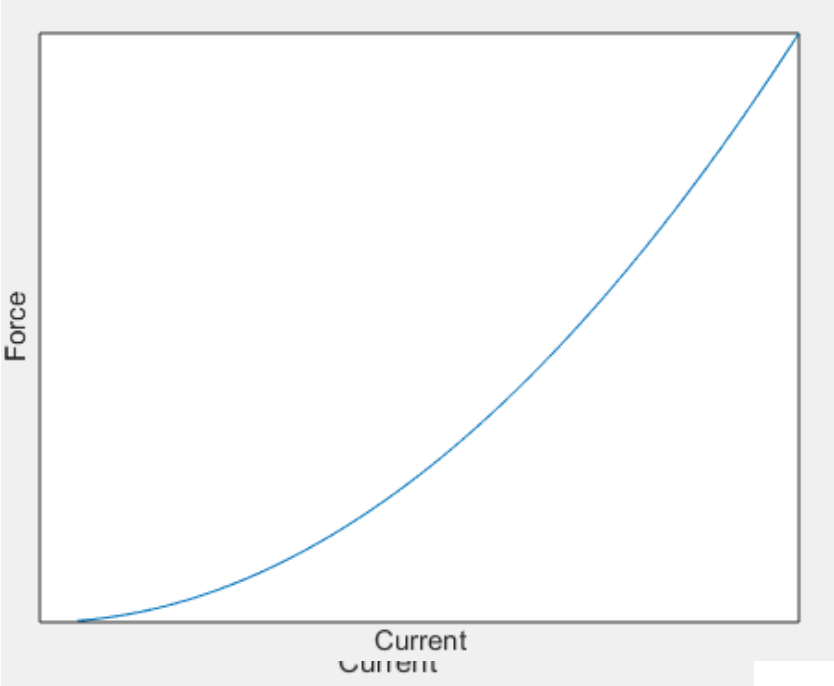
MAGNETIC BEARING ASSEMBLY



1. THEORY



THEORY: LINEARIZATION



(1)

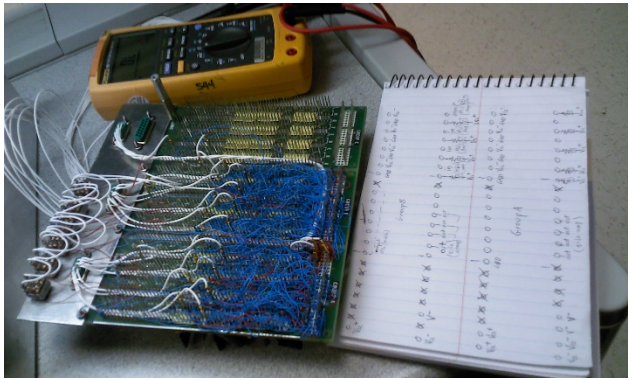
$$F_{up} \propto (B_0 + B_c)^2 \quad (2)$$

$$F_{down} \propto (B_0 - B_c)^2 \quad (3)$$

$$F_{em} = F_{up} - F_{down} \quad (4)$$

$$F_{em} \propto 4 B_0 B_c = 4 B_0 I_c \quad (5)$$

2. CIRCUITS



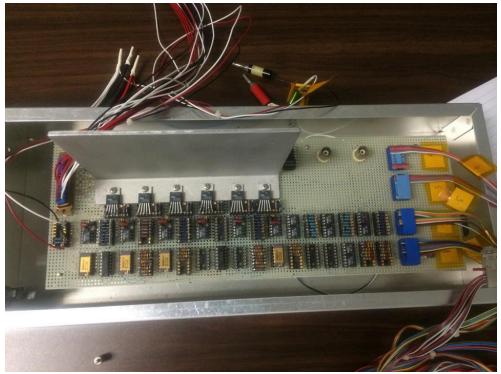
Continuity tests

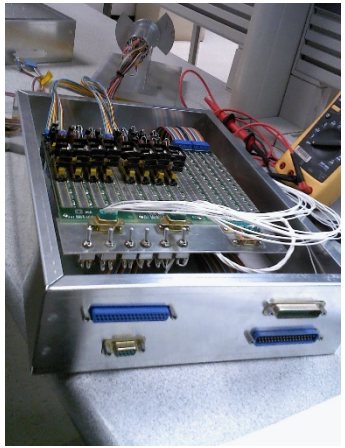
Schematics of motor and bearing circuit

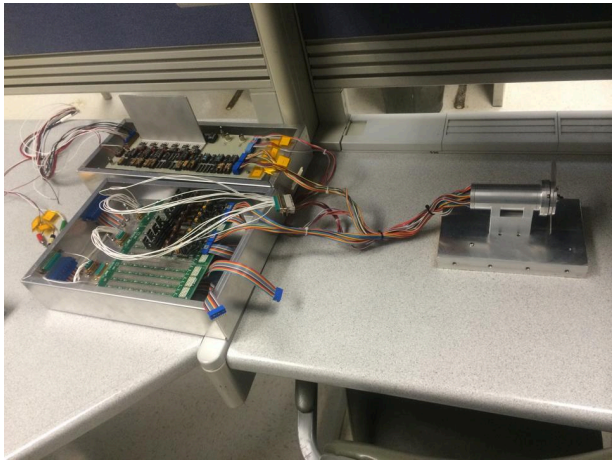
Simulated schematics on Multisim and LT spice

Mapped Pin in/out (on circuit boards and dSPACE)

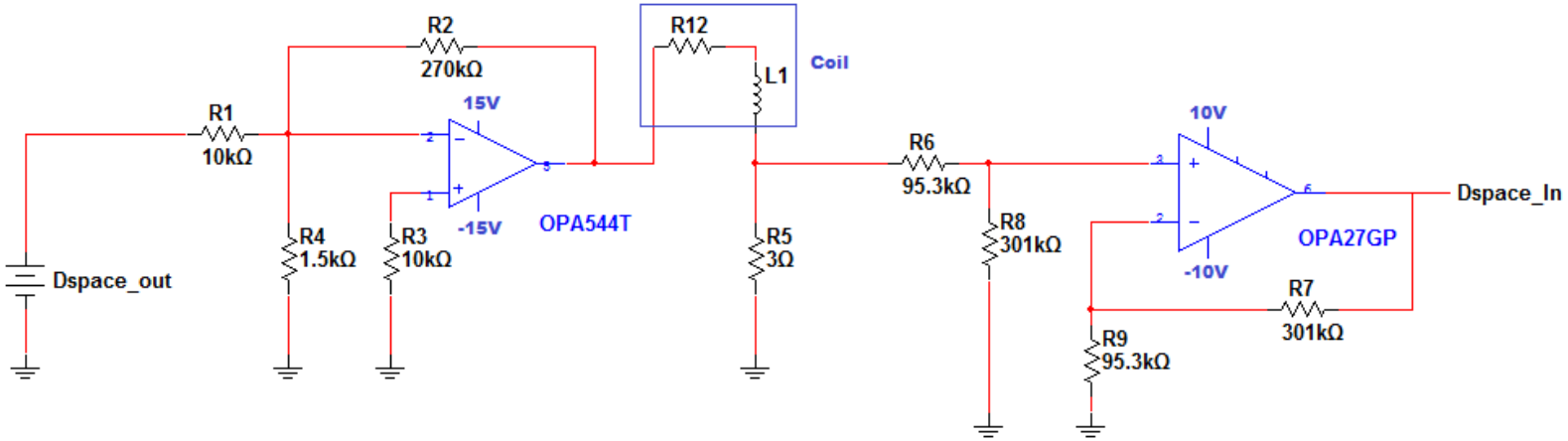
Created Harness

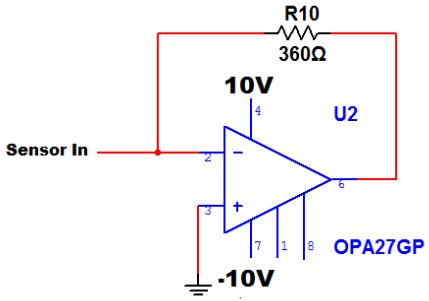






MAGNETIC BEARING DRIVER CIRCUIT



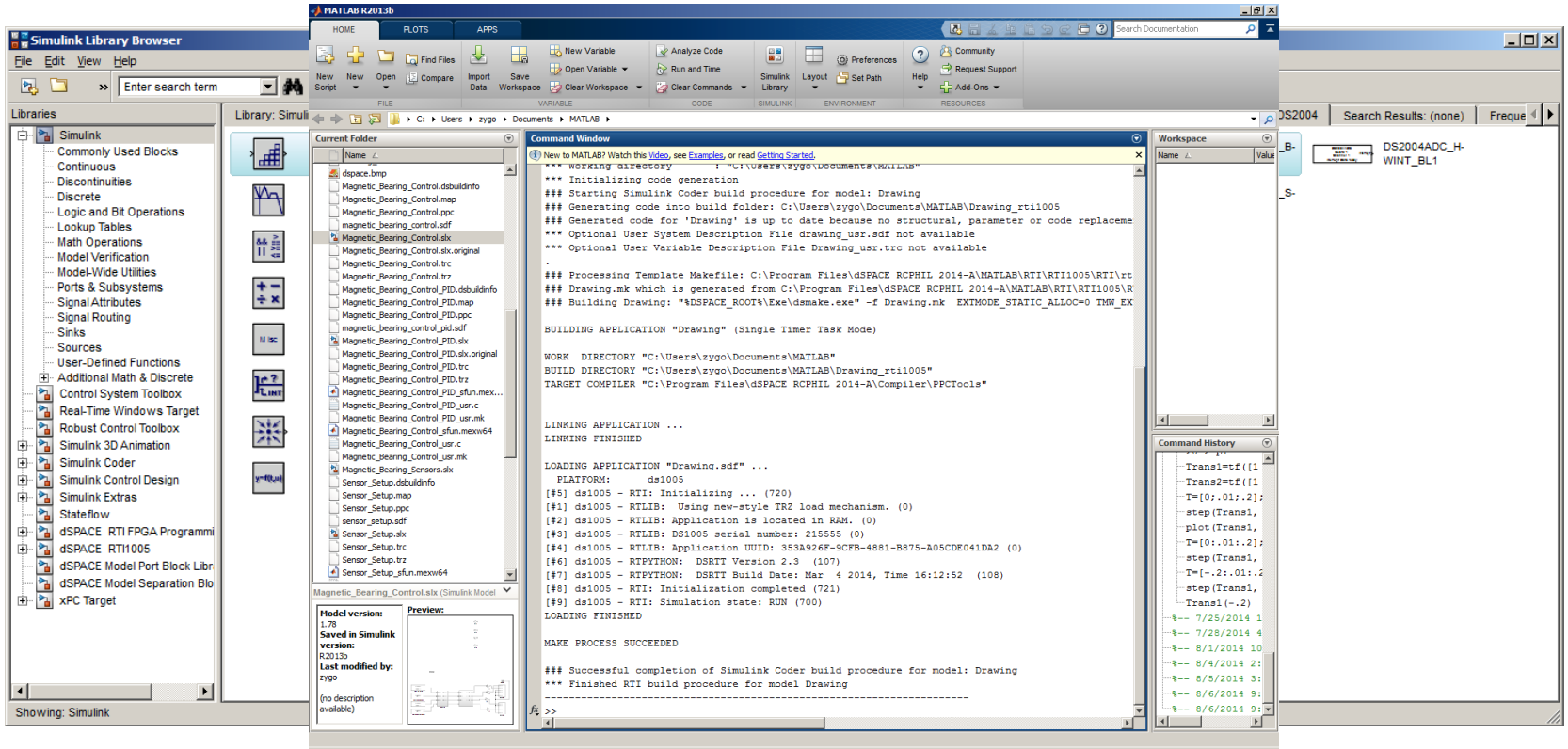


3. MATLAB SIMULINK

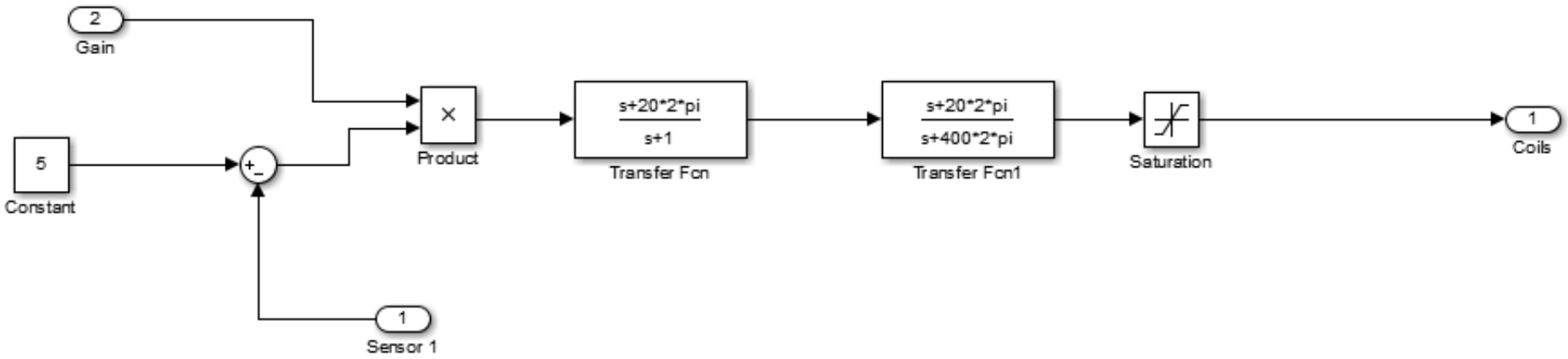
Built in Block Library

Build Simulink file in Matlab

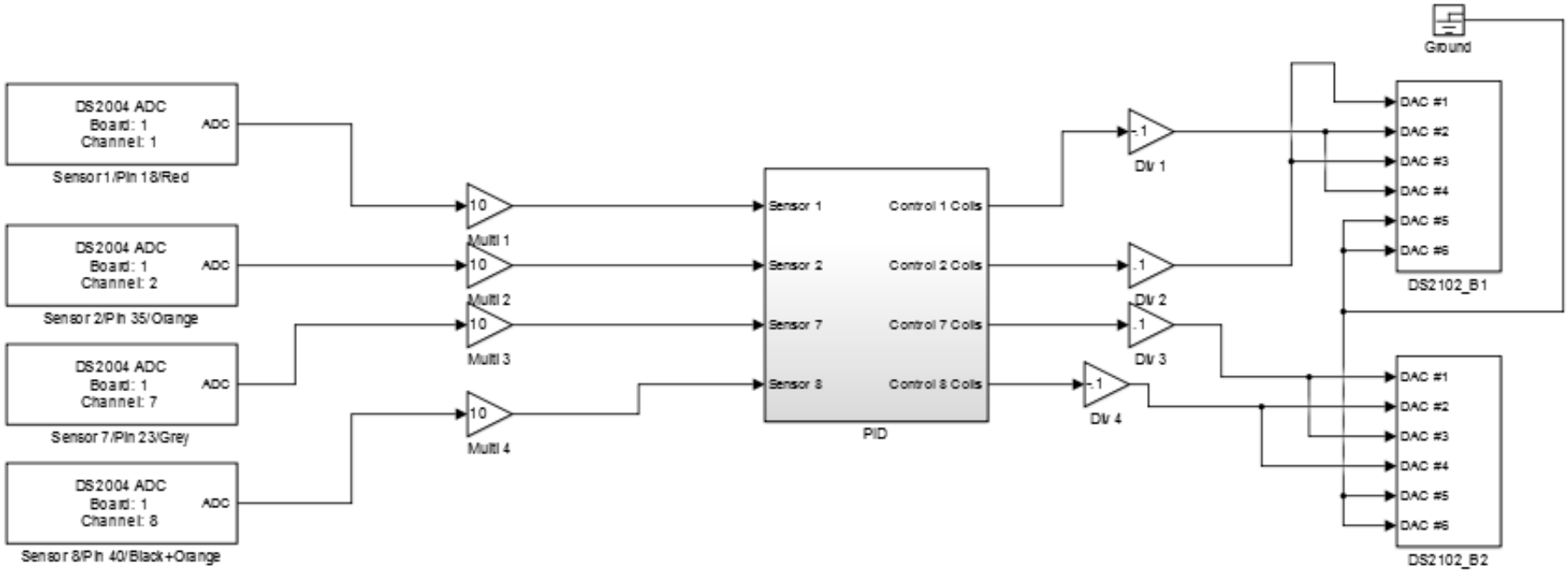
dSPACE Block Library



4.PID CONTROL

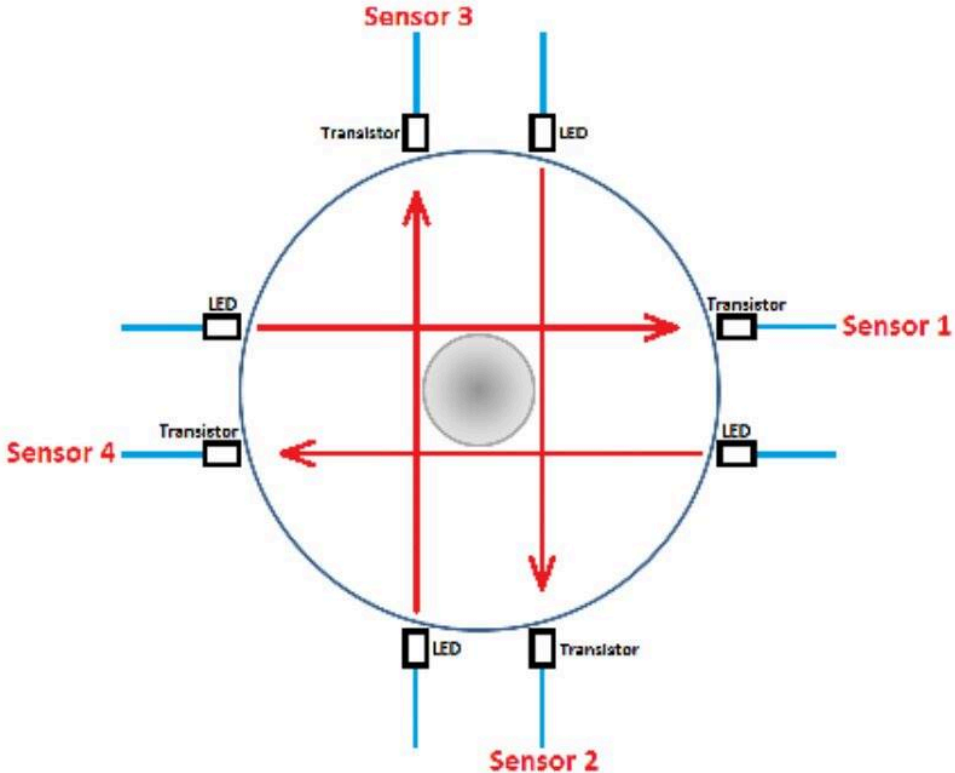


PATH OF SIGNAL

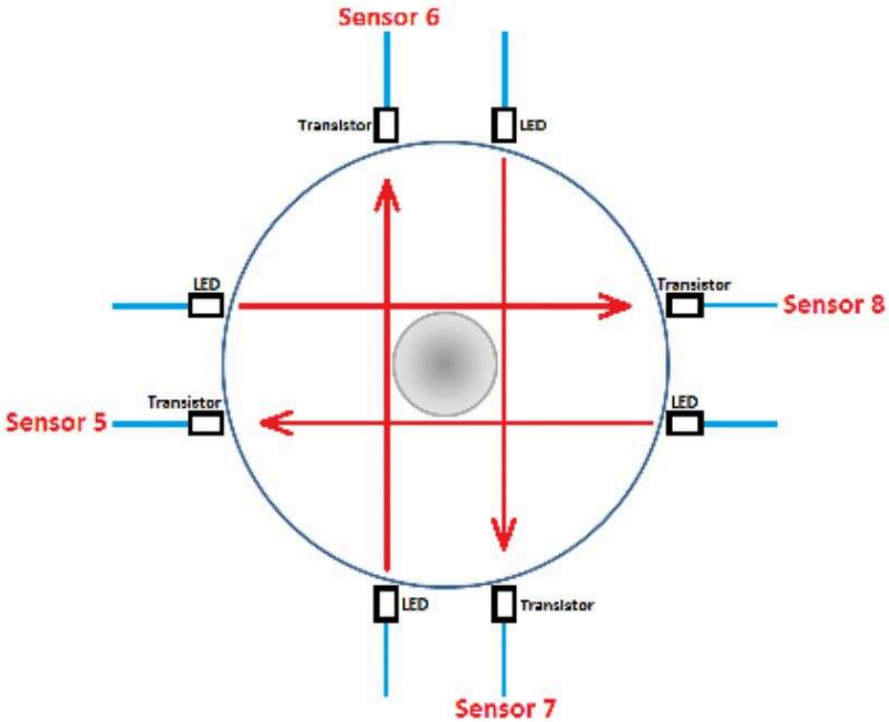


4. TESTING THE SENSORS

Front Sensors

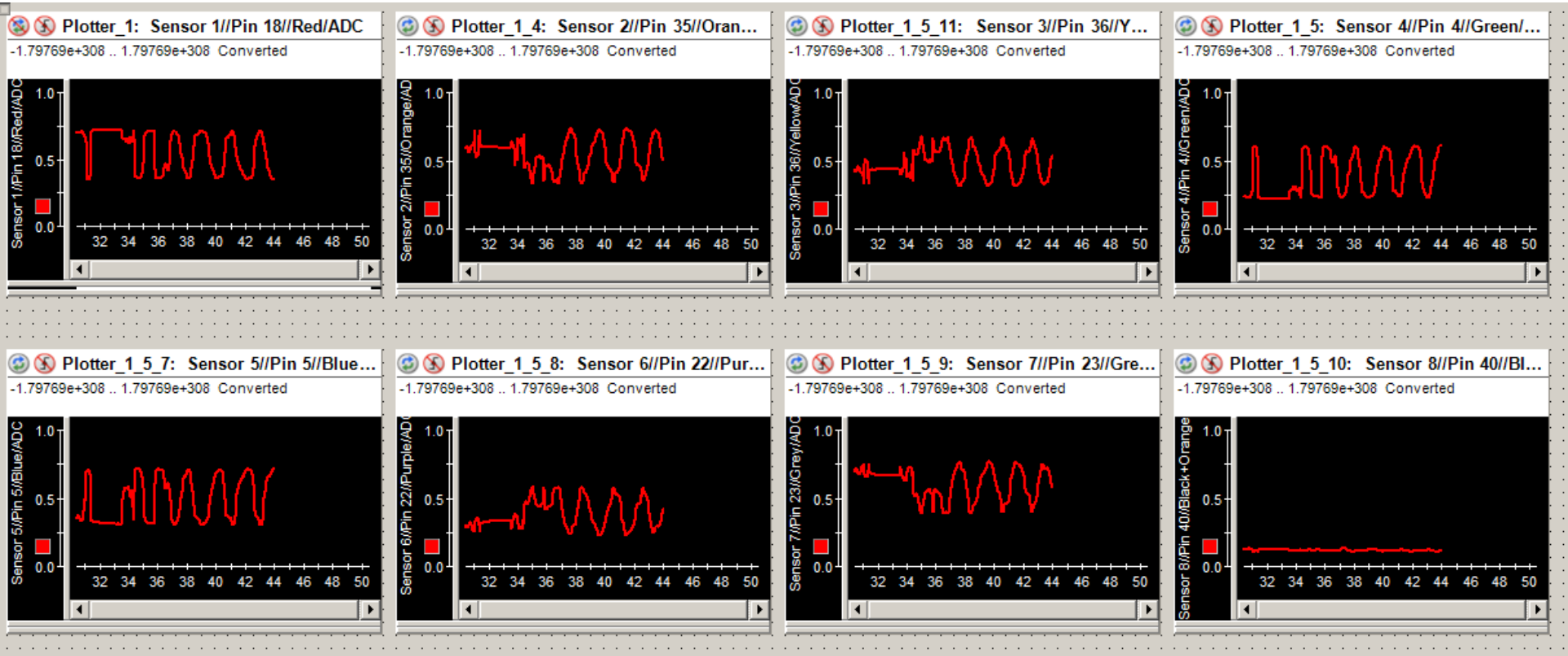


Back Sensors

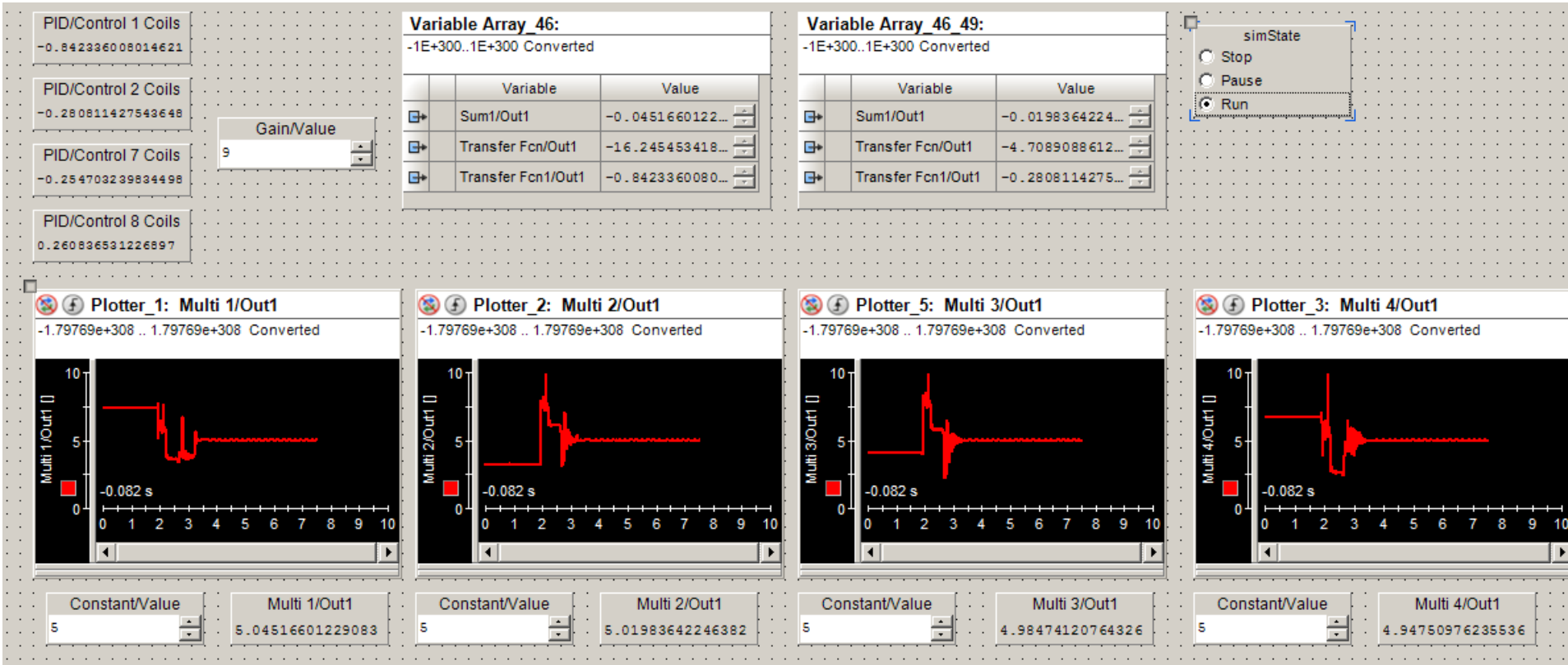


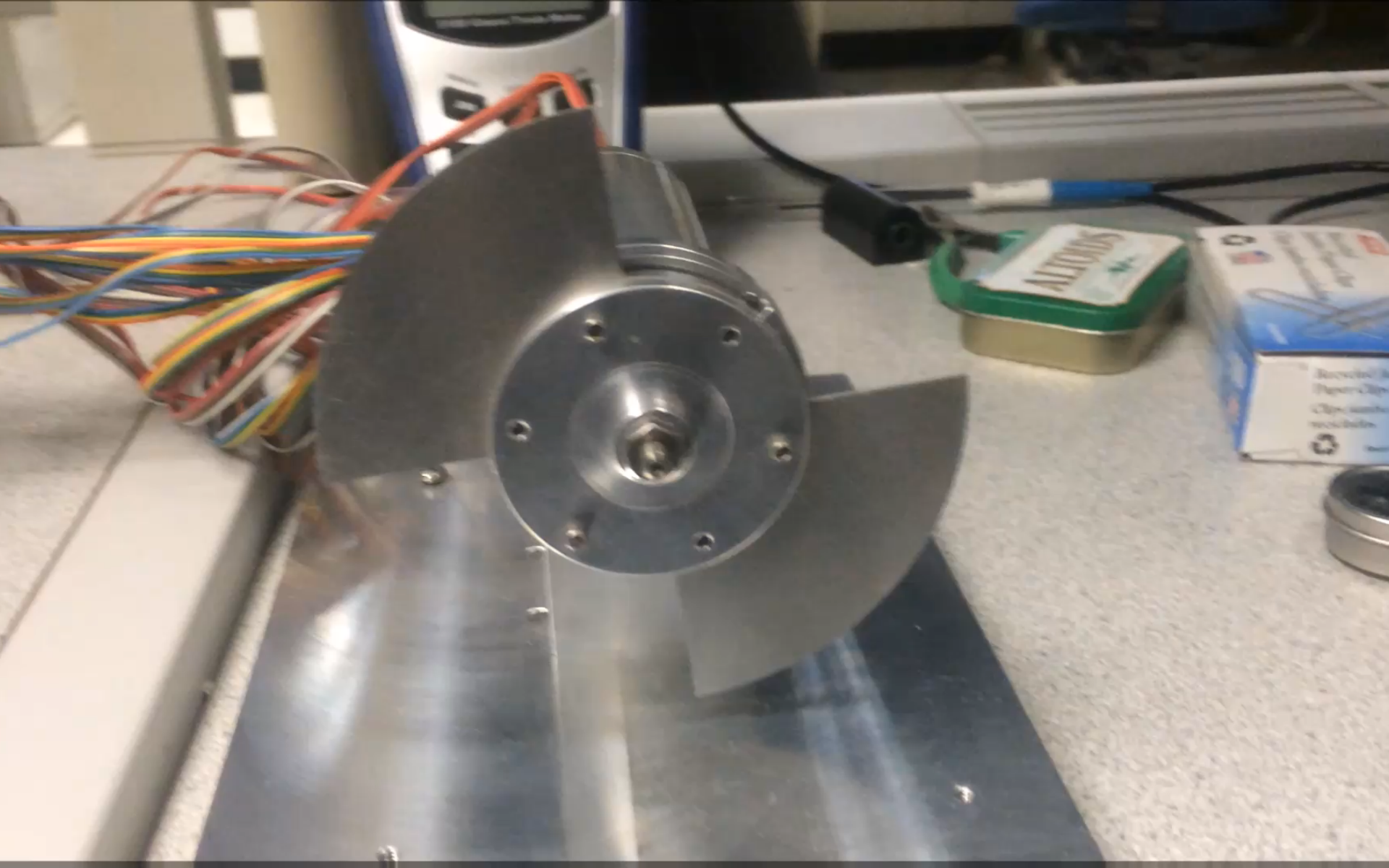
TESTING THE SENSORS

Horizontal | Vertical | Vertical | Horizontal



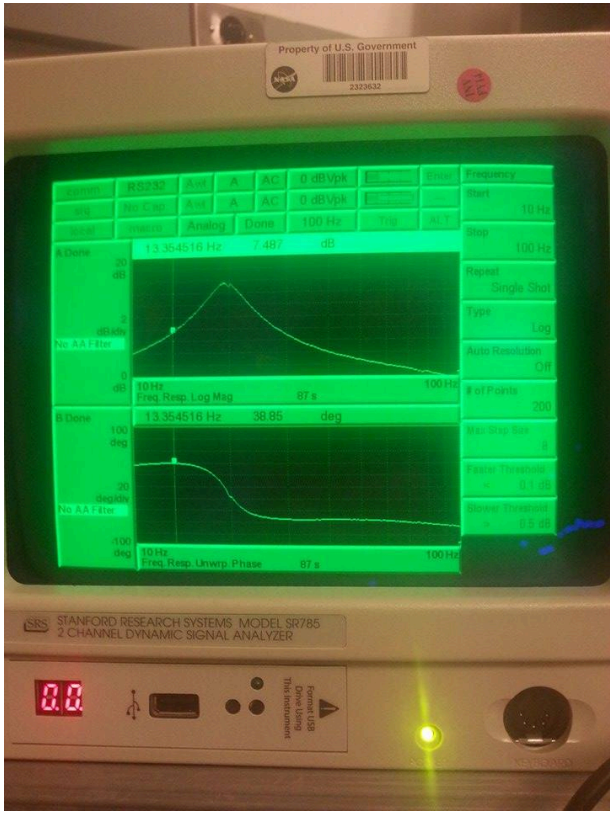
5.OPERATING THE PID





6. NEXT STEPS: DYNAMIC SYSTEM ANALYZER (DSA)

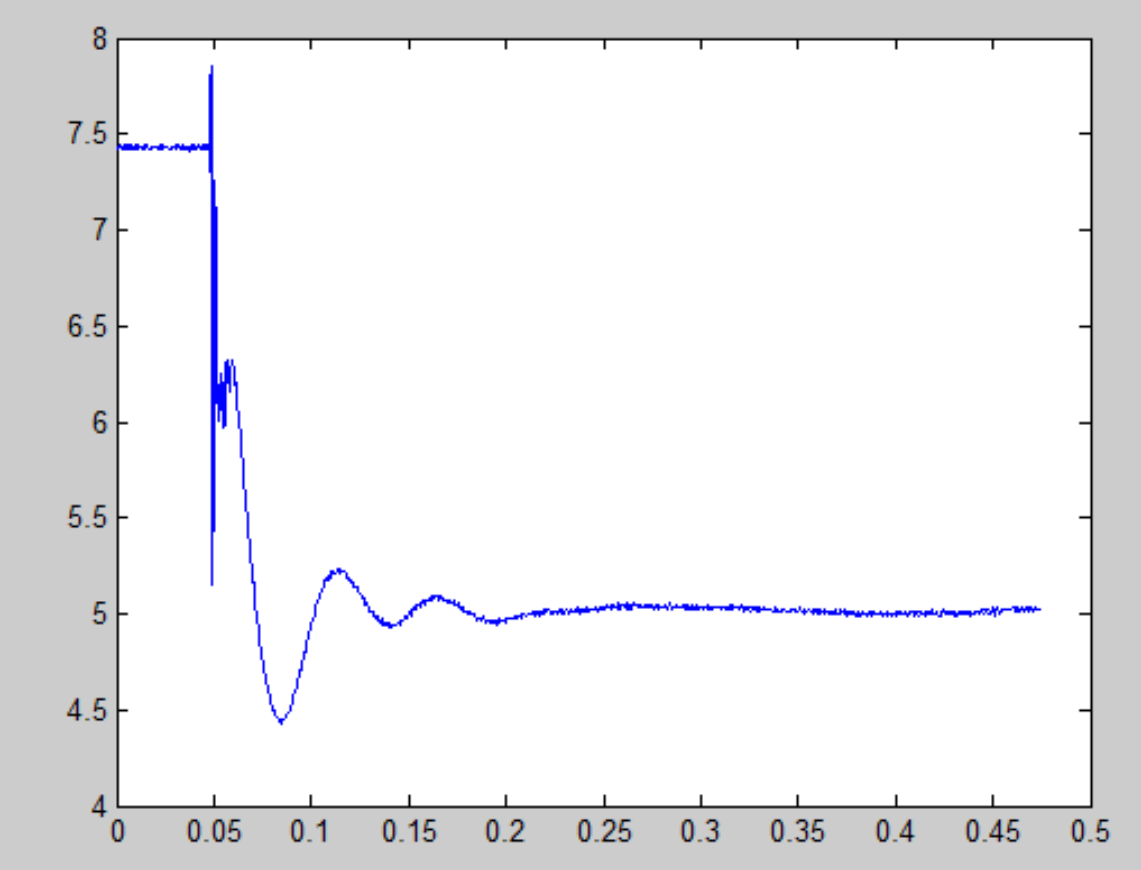
- DSA for optimizing the transfer functions
- Breaking box method for each function



NEXT STEPS

Optimize closed loop control

Repair motor circuit



THANK YOU!

QUESTIONS?