
Specular Reflection

Update on Wireless Scoring System

MITEE Mouse 12

MINOS '10
Royal Holloway
David Otten



Taiwan International Contest

- MITEE Mouse 11 crashes into walls
- Diagnostics reveal that front/back sensors “see” walls differently when resting on front and back skid
- Walls are shiny but PSD system is not supposed to be affected by reflectivity of walls



Specular Reflection

- Mirror-like reflection of light
- All measurements courtesy of Harjit Singh



Reflectometer Measurements

- Mirror
 - » Specular: 98.8%
 - » Overall: 99%
- Japanese Wall
 - » Specular: 1%
 - » Overall: 89.7%
- Melamine wall
 - » Specular: 0.4%
 - » Overall: 85%



Reflectometer Measurements

- Korean wall:
 - » Specular: 3.3%
 - » Overall: 87.6%
- Taiwanese wall:
 - » Specular: 3.7%
 - » Overall: 88.2%



Japanese wall

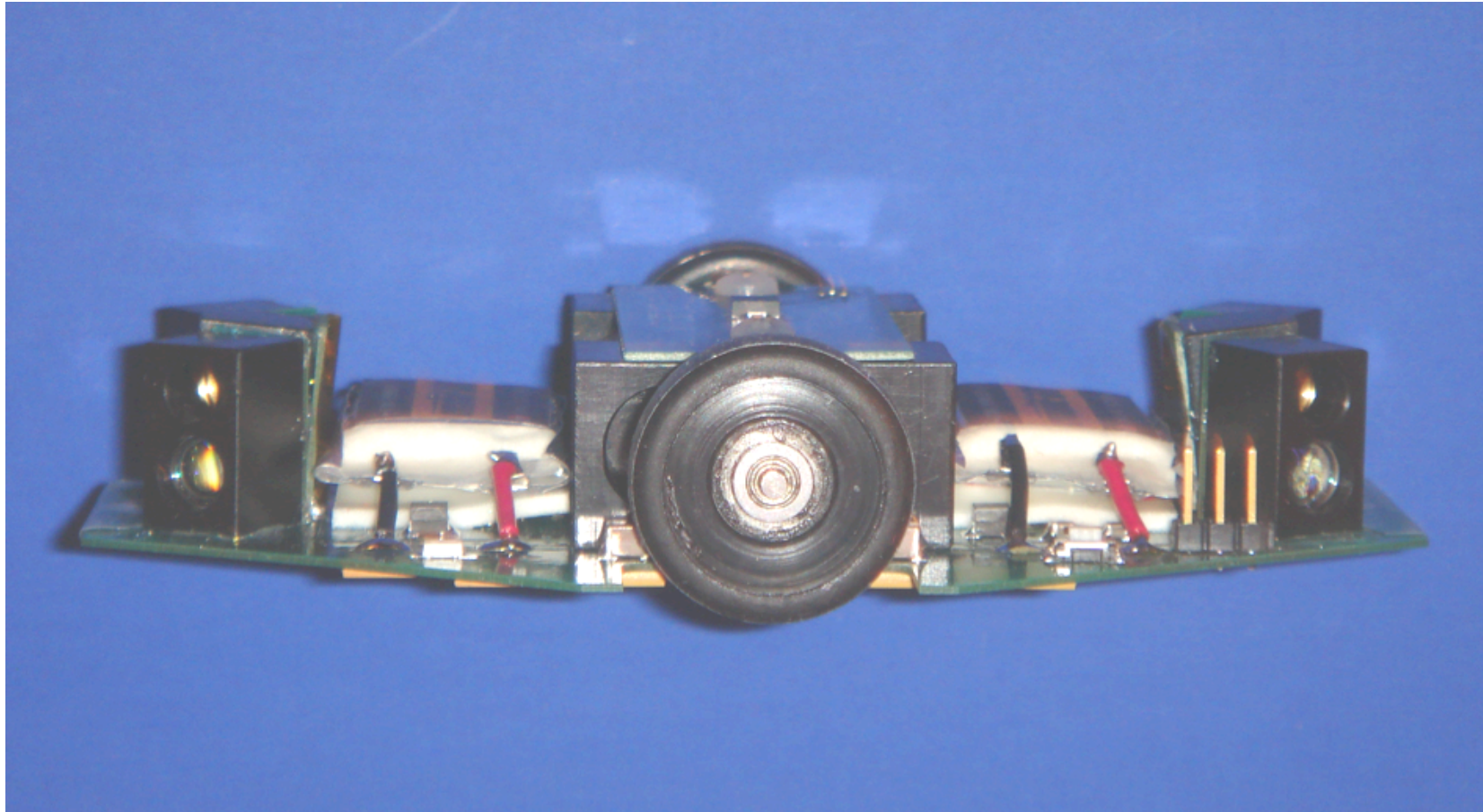


Taiwanese wall



M12 Side View

Front Sensors Tilted up

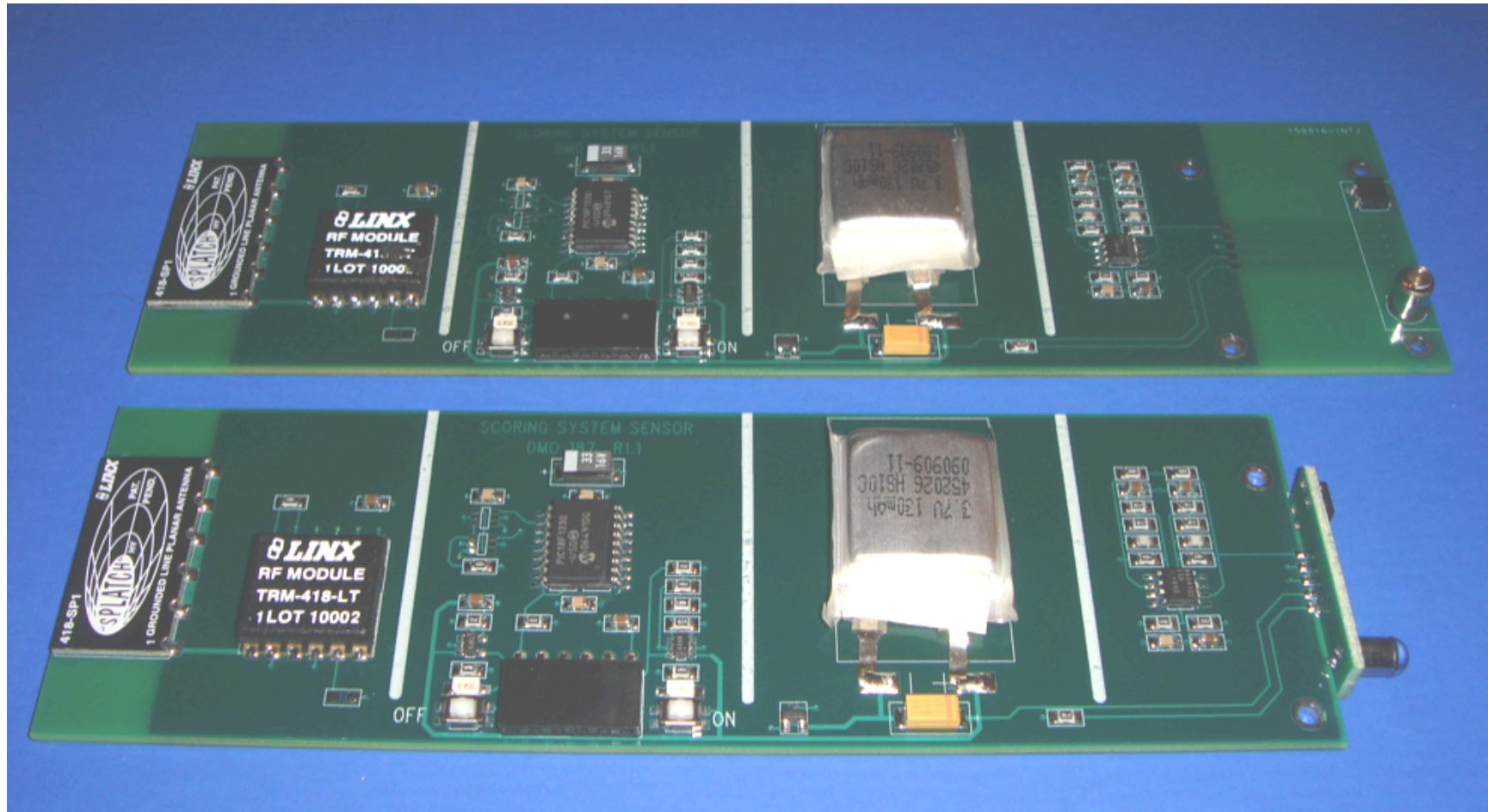


Wireless Scoring System Update

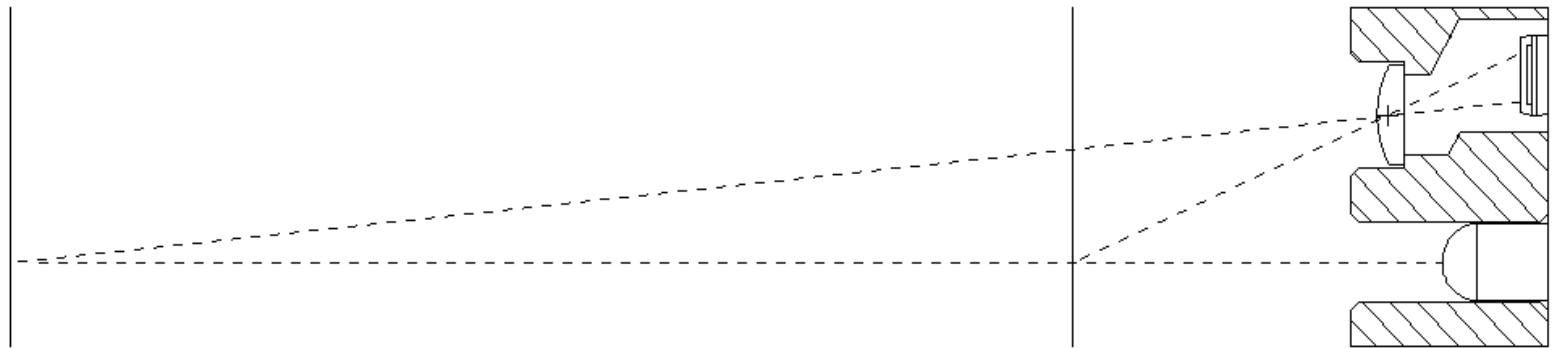
- System was used at APEC '10
- Sensors worked flawlessly
- Bug in score calculations created minor havoc
- Raw data storage allowed correct scores to be calculated after the fact
- New wall sensors have been designed and fabricated (not ready in time for APEC '10)



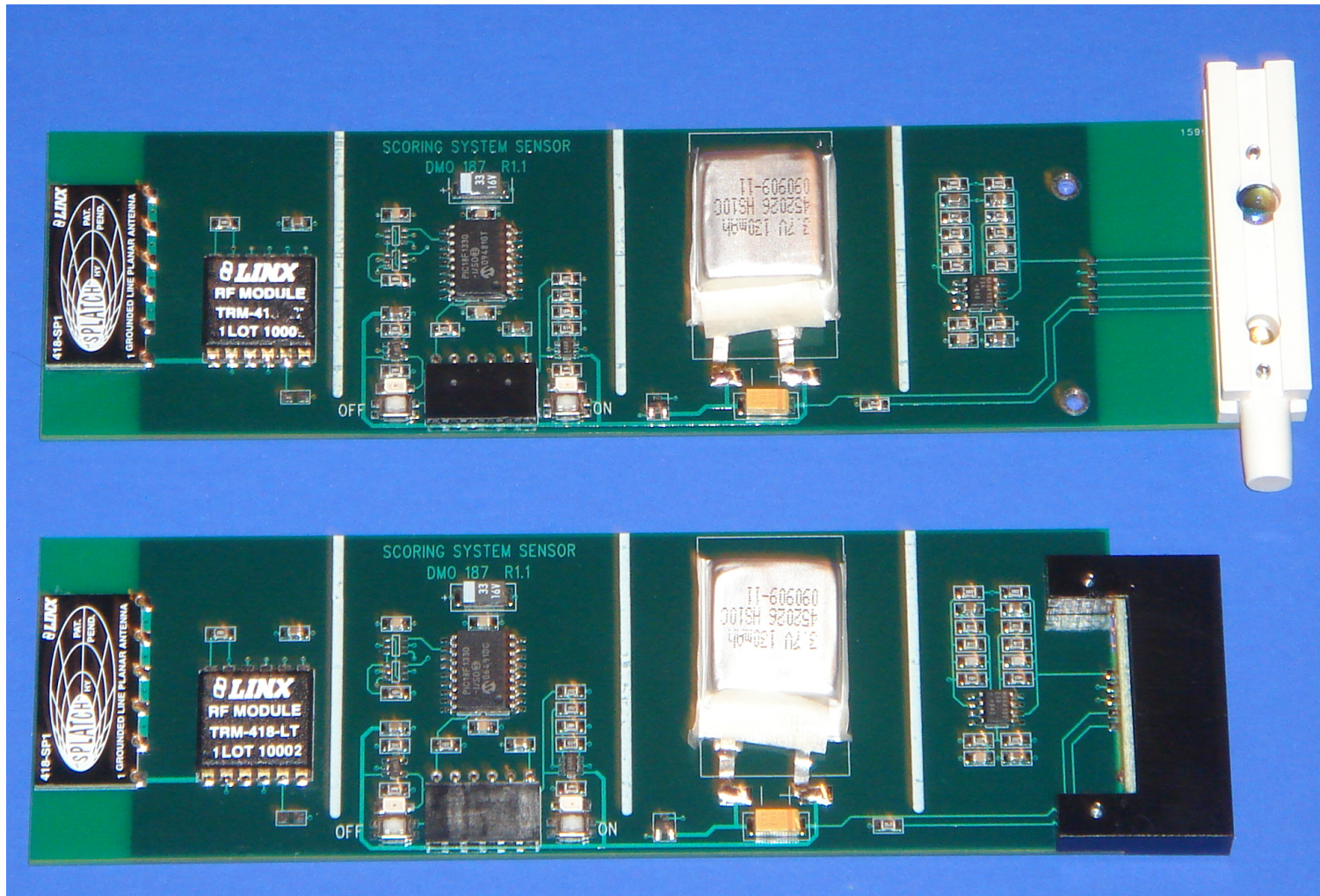
New Start and Finish Sensors



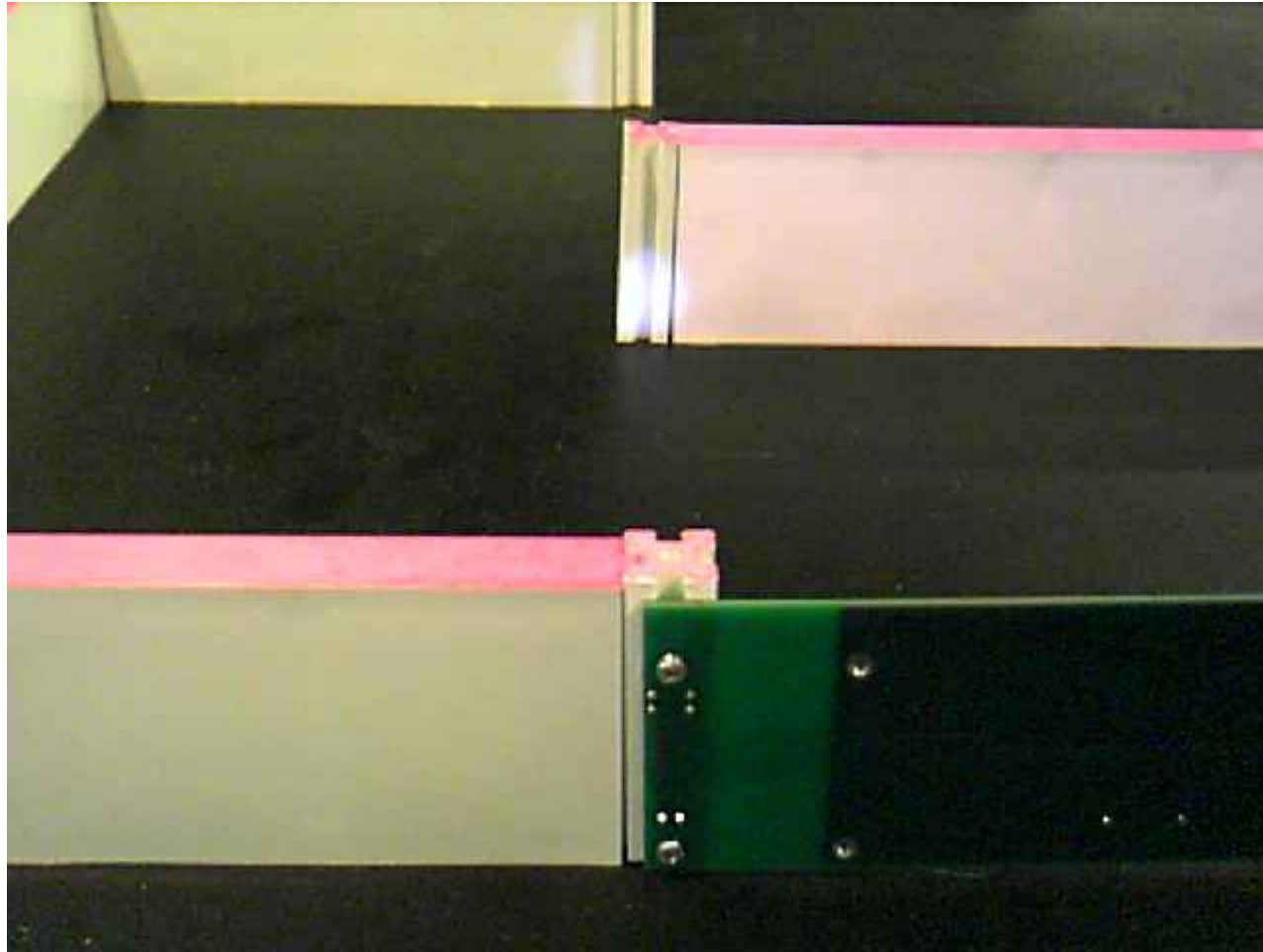
Mechanical Configuration



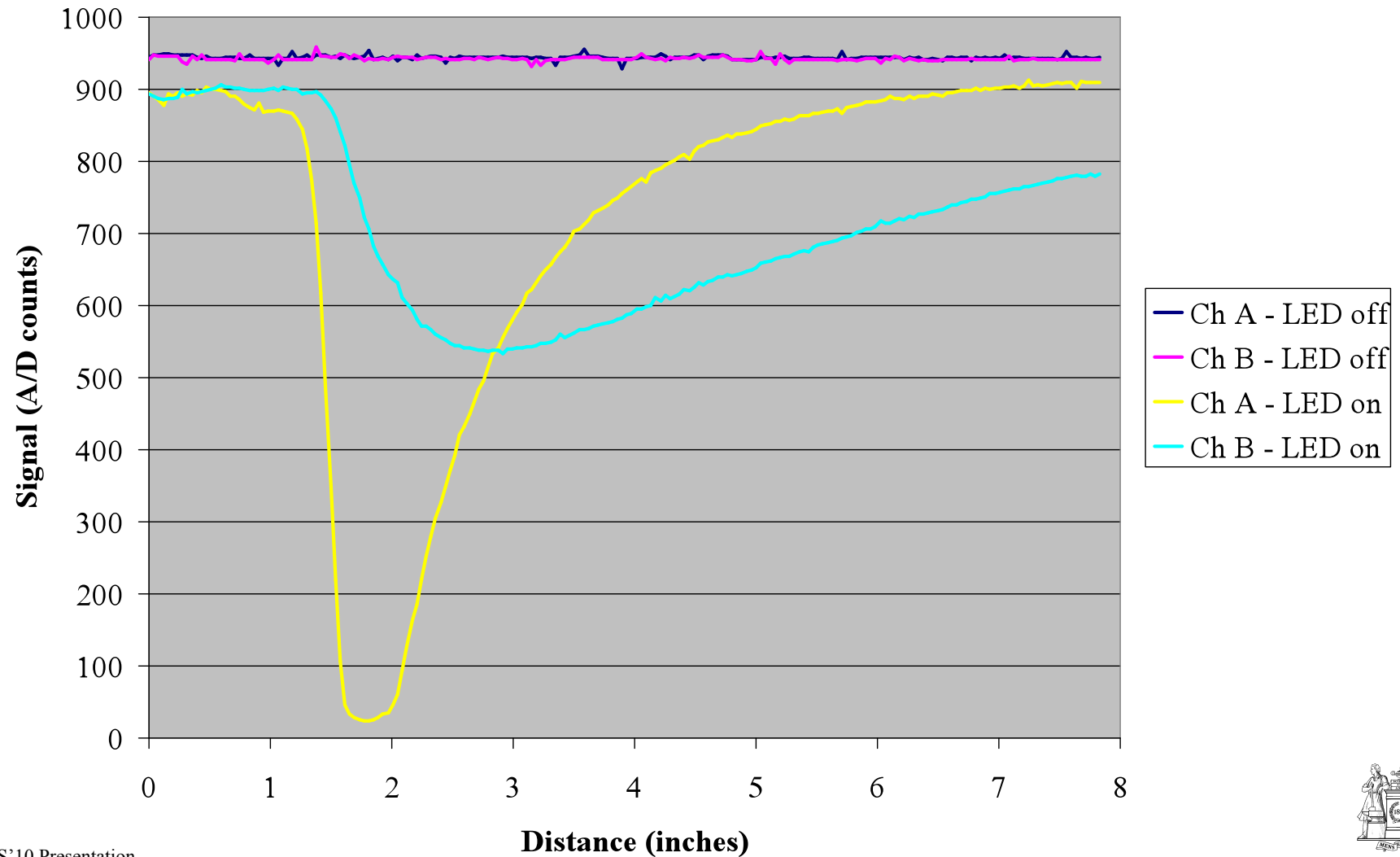
Sensor with Lenses



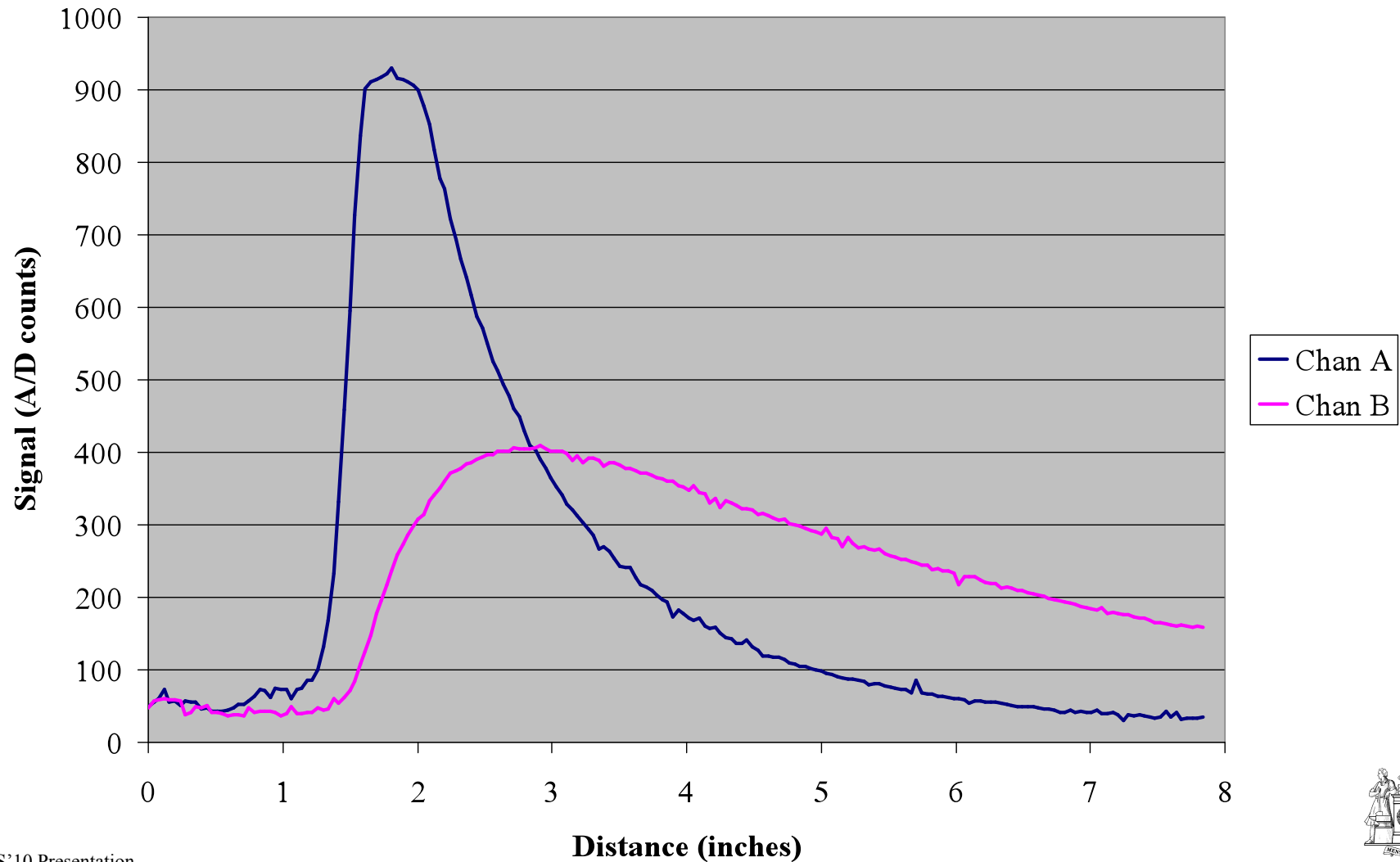
Start Sensor Spot Size



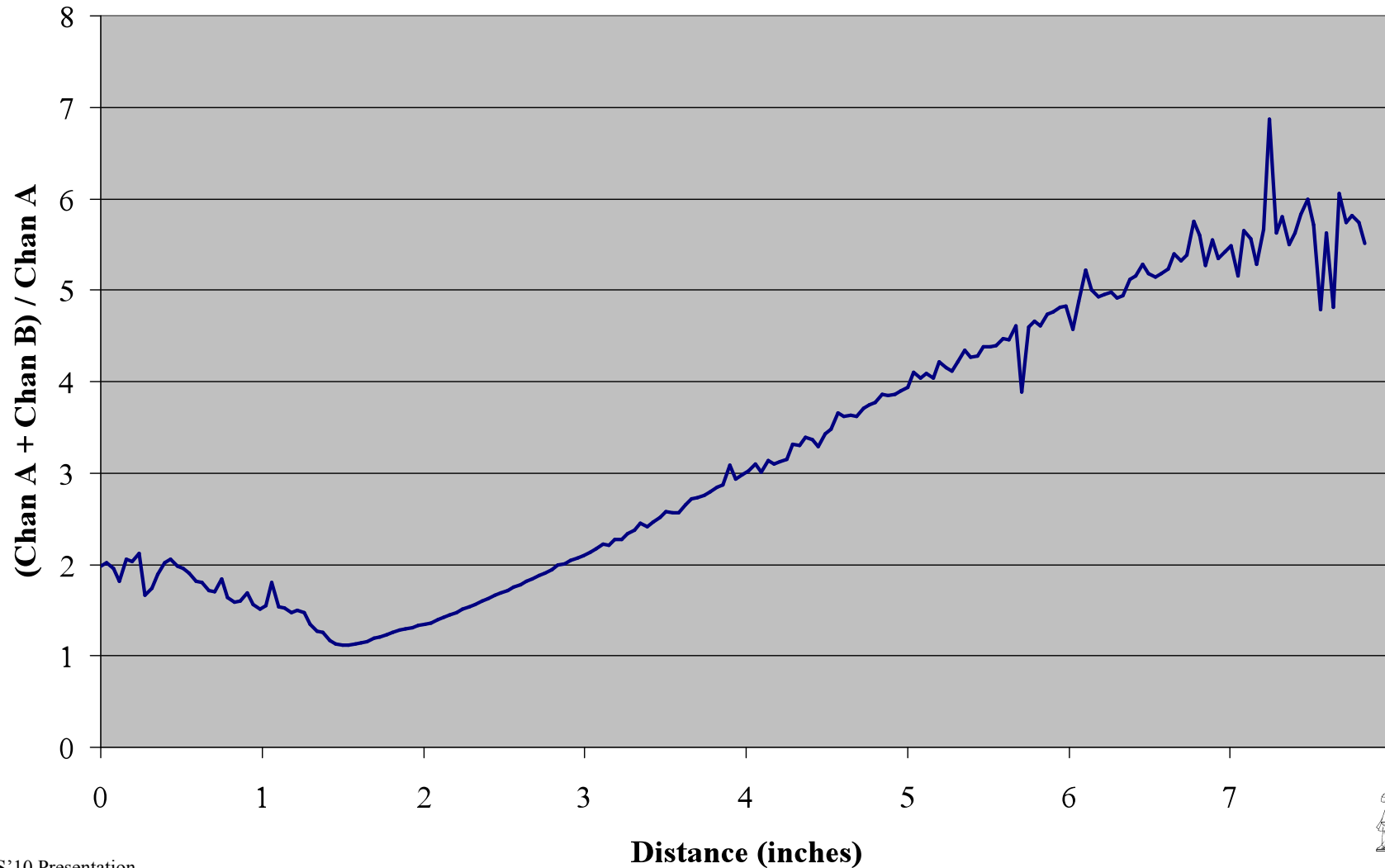
Channel A and B Signals



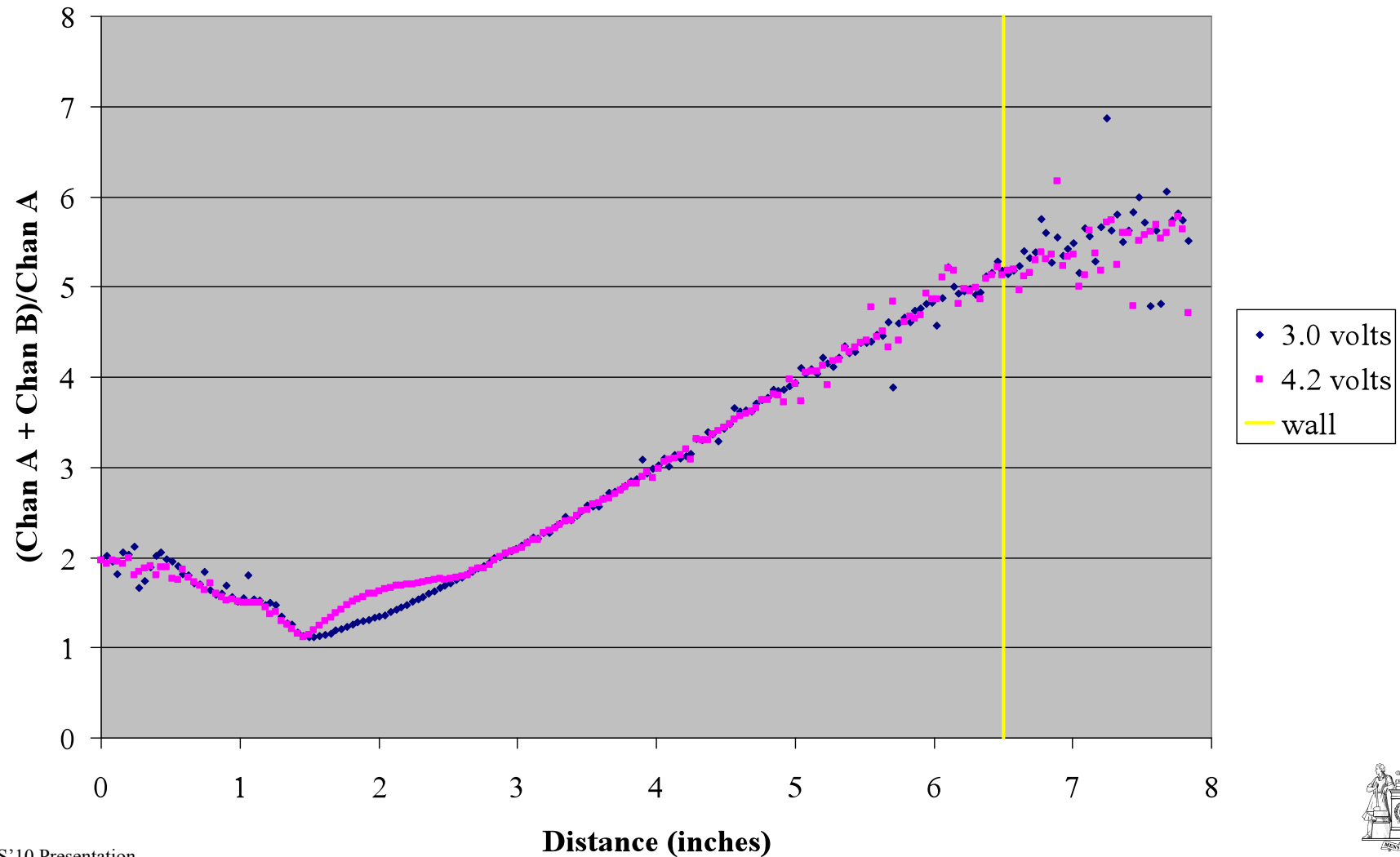
Signals with Zero Subtracted



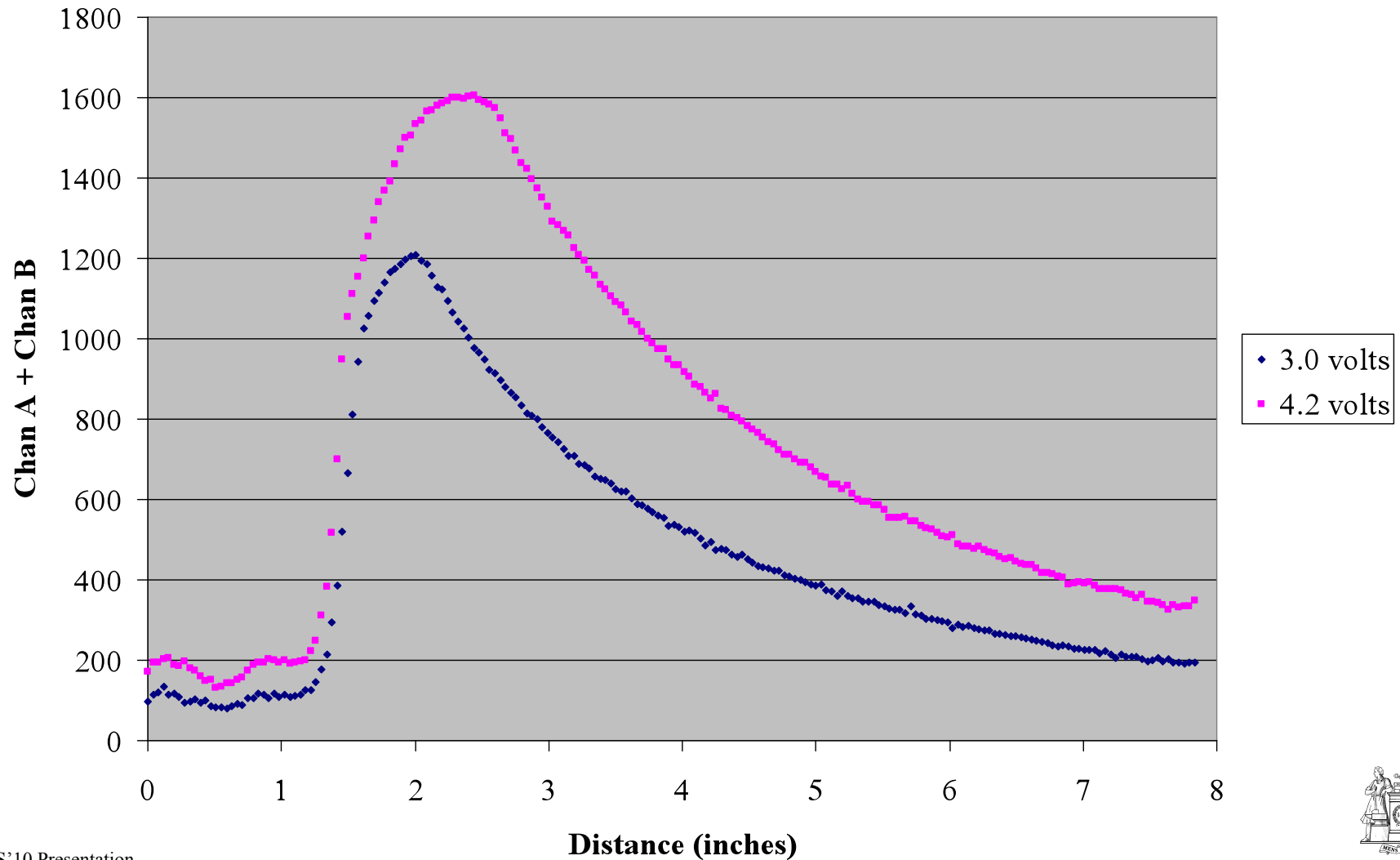
Ratio vs Distance



Ratio vs Distance and Voltage



Total Signal vs Distance



Benefits

- Combined use of distance and intensity measurements should allow detection of the front of the mouse even if it:
 - » Absorbs all light
 - » Reflects all light
 - » Has high specular reflection
 - » Has low specular reflection



MITEE Mouse 12

- Experimental vehicle for investigations in inertial navigation
 - » 3-axis accelerometer mounted in center of mouse below axle
 - » 3-axis accelerometer mounted in center of mouse above axle
 - » Gyroscope to measure yaw

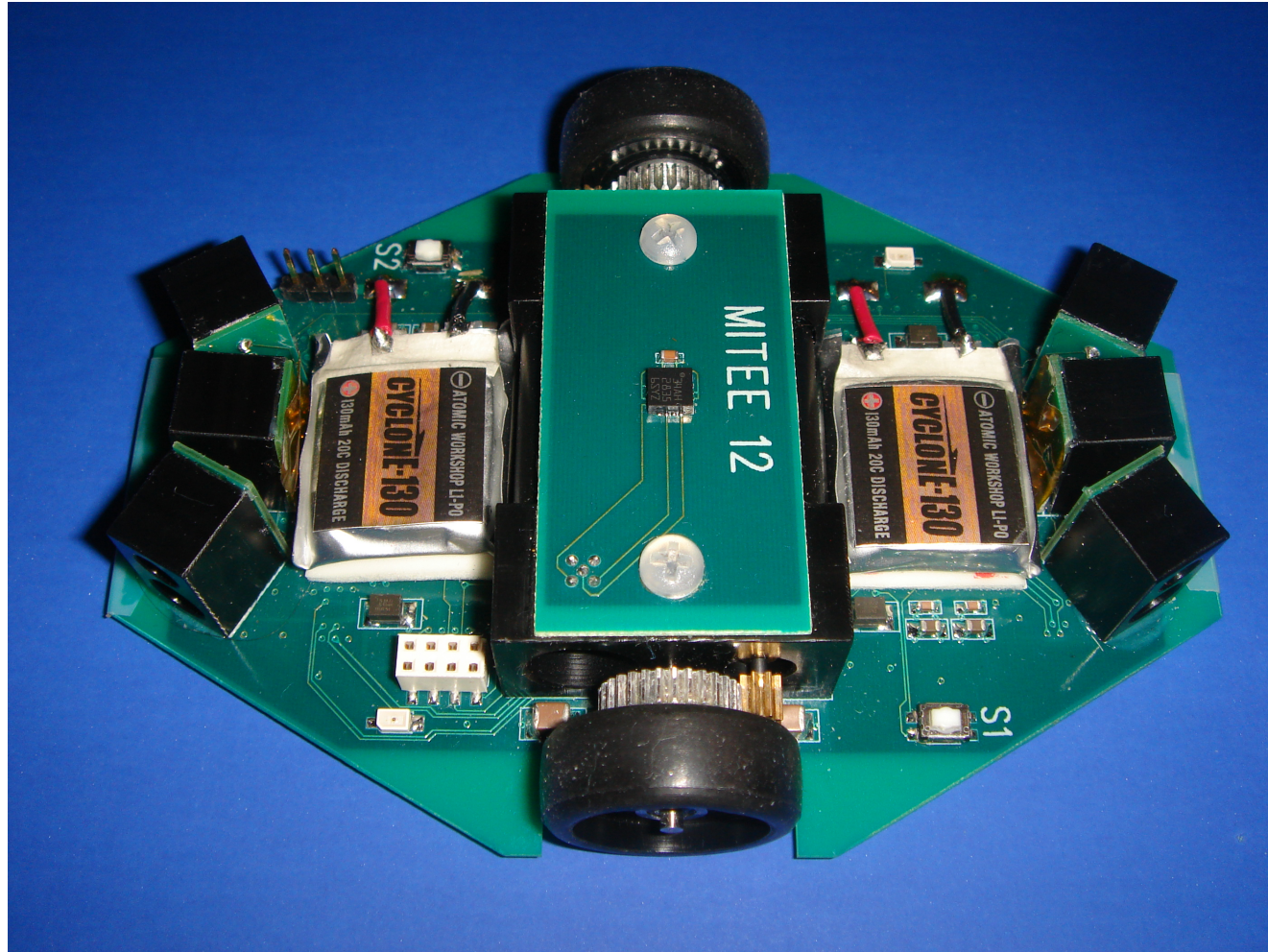


Additional M12 Features

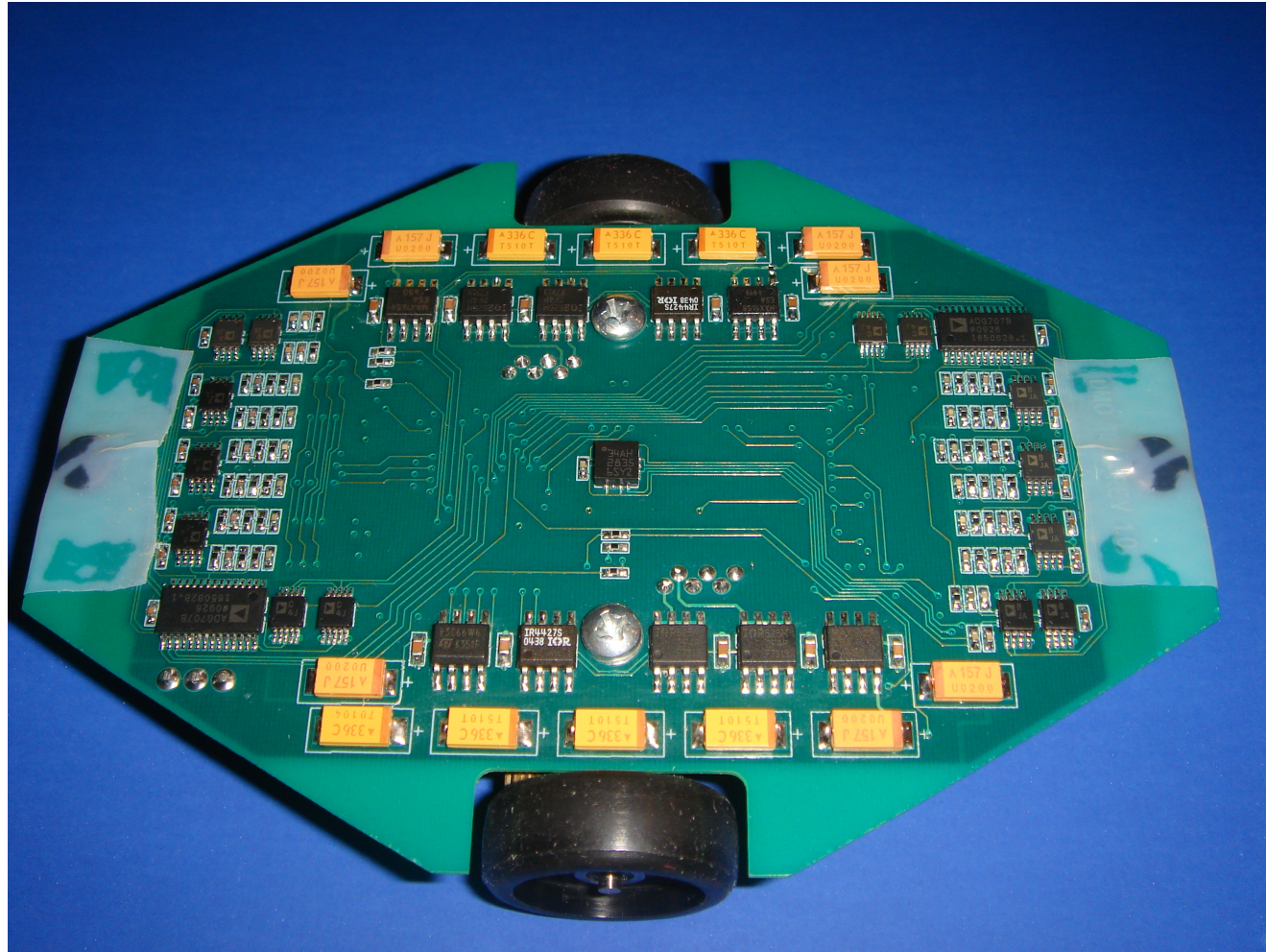
- 6 mm focal length optics instead of 9 mm to reduce size and weight of sensors
- Narrower tires
- Smaller batteries – 130 mAh @ 7.4 v
- Lighter – 100.2 g



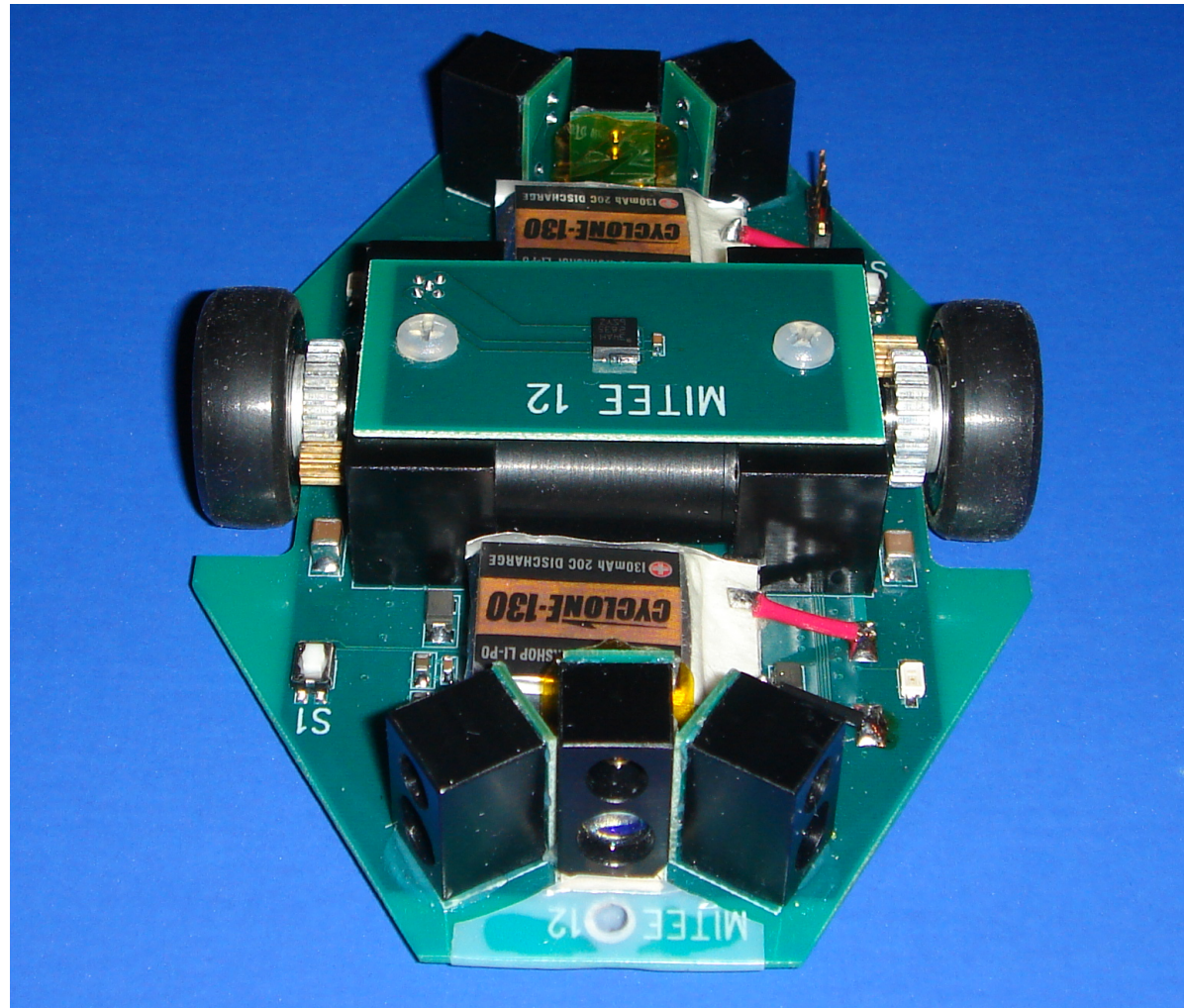
M12 Top View



M12 Bottom View

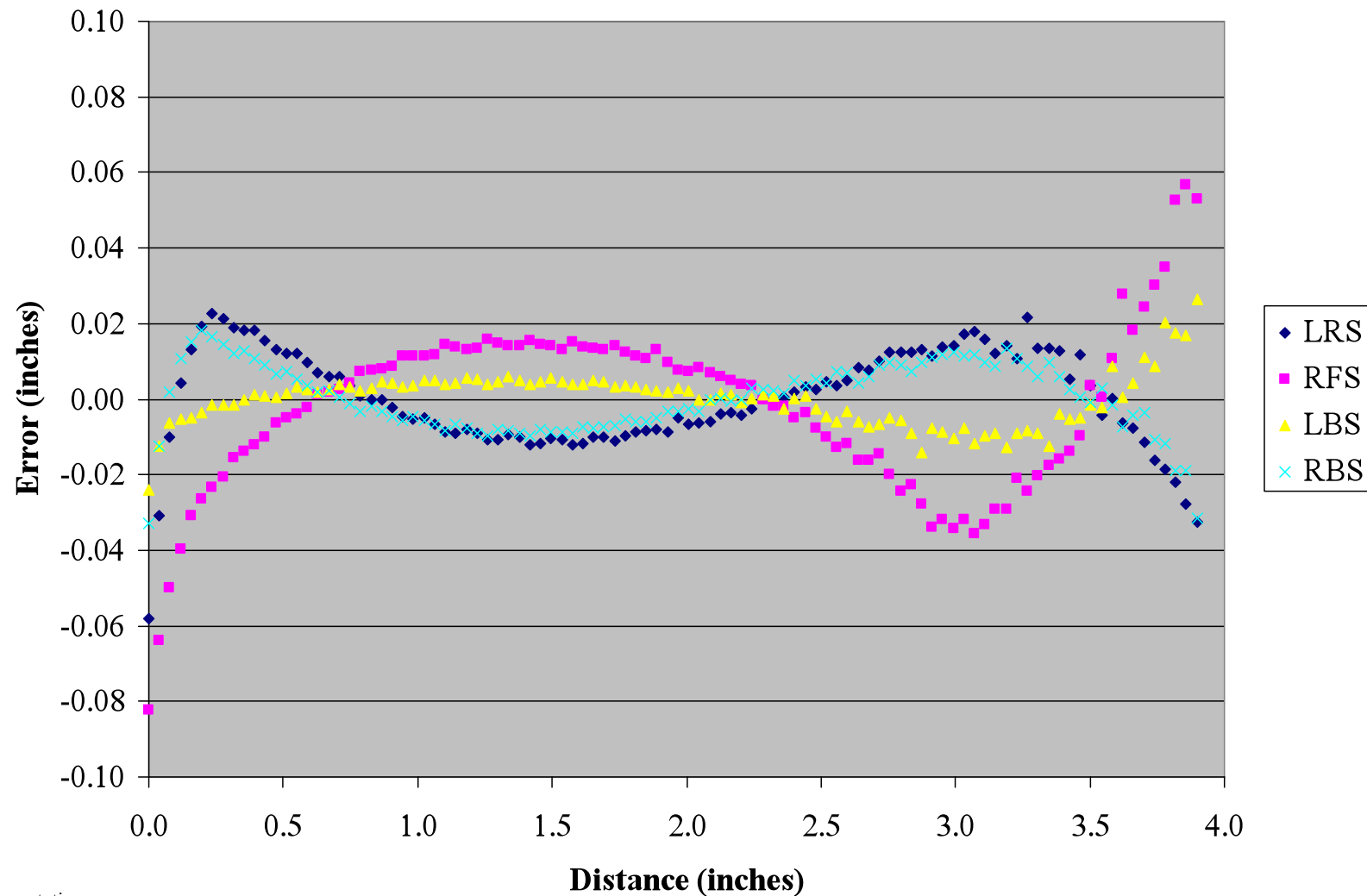


M12 Front View



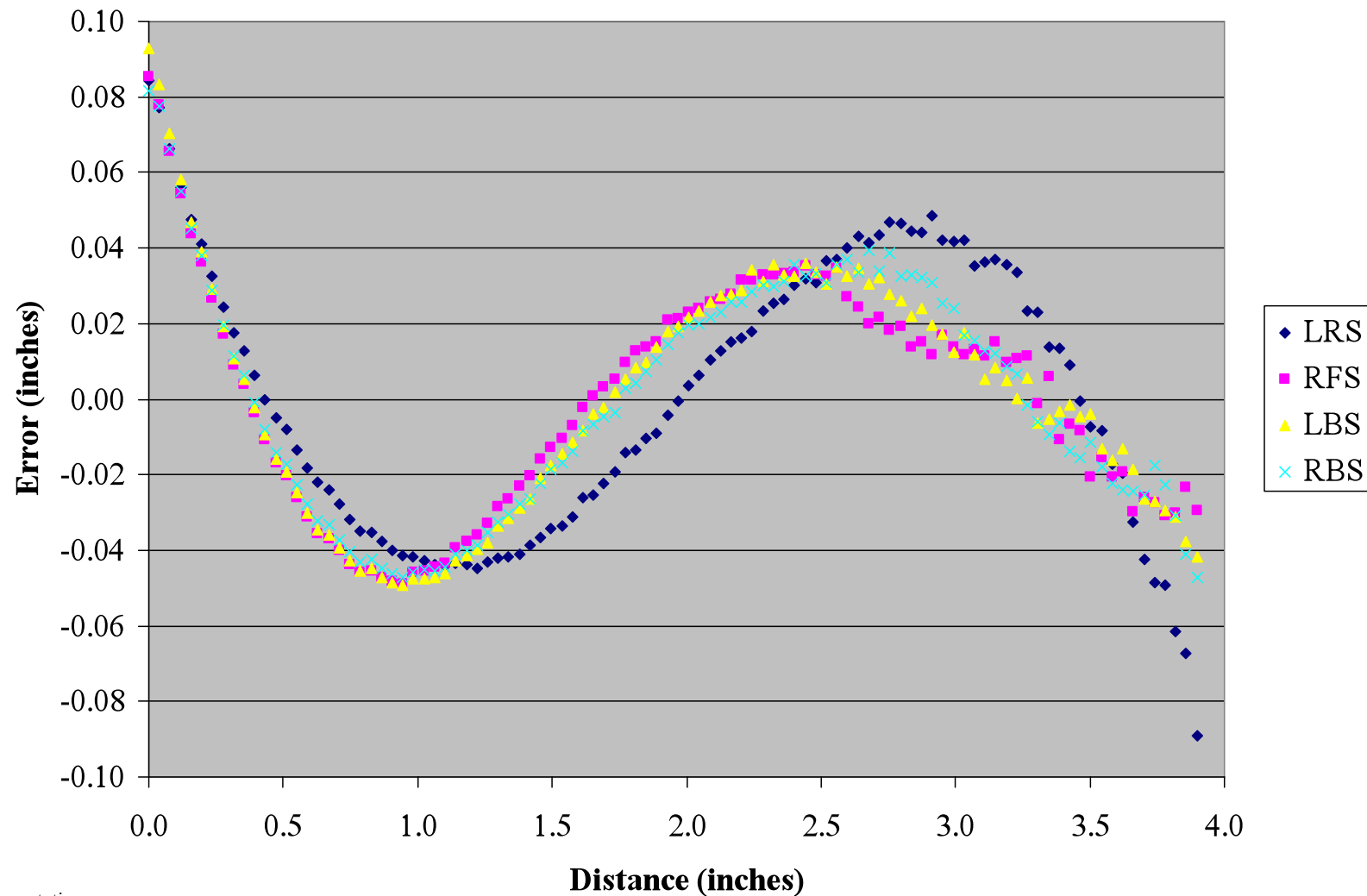
M11 Sensor Linearization Error

Optics Focal Length = 9 mm

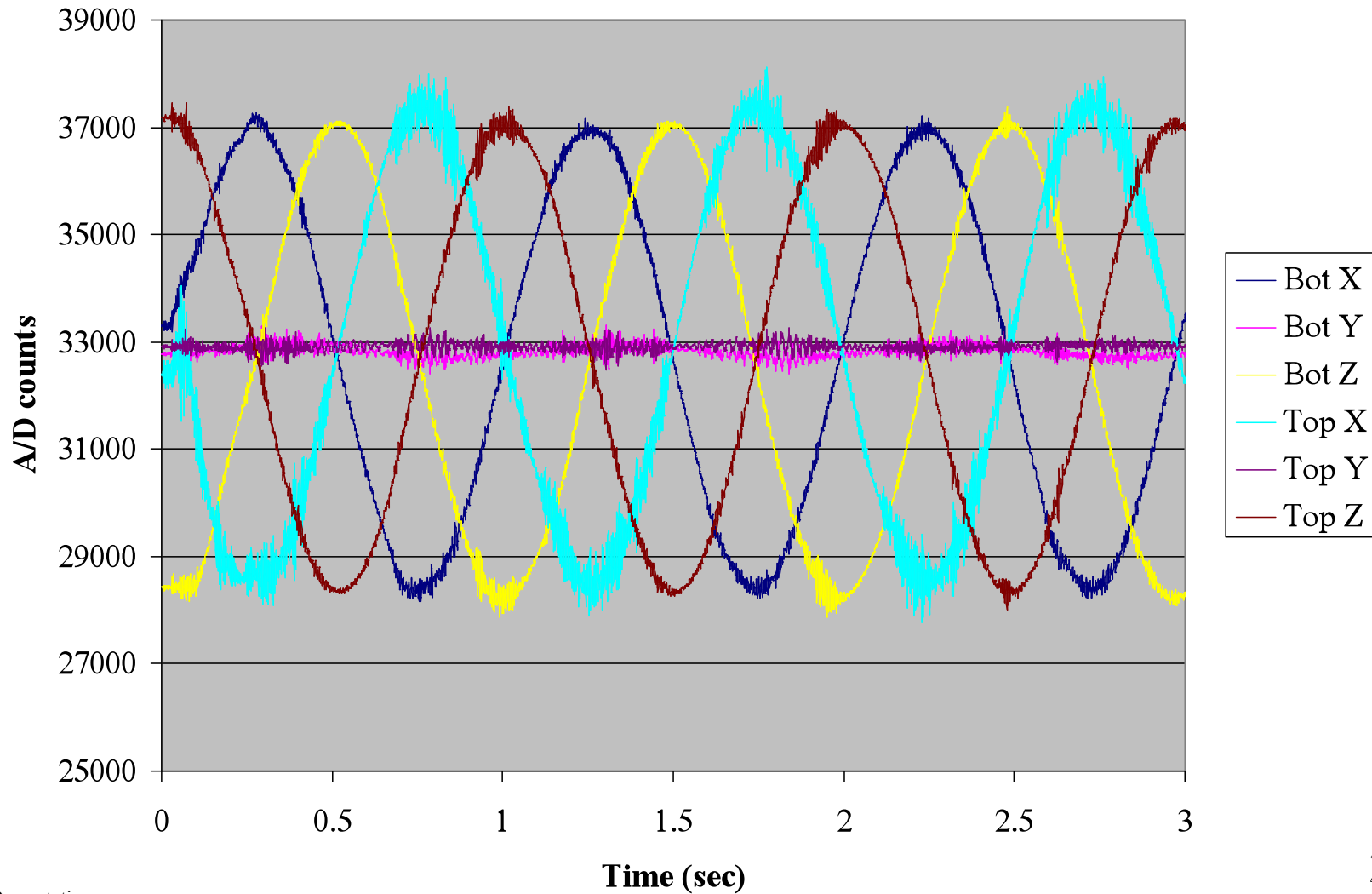


M12 Sensor Linearization Error

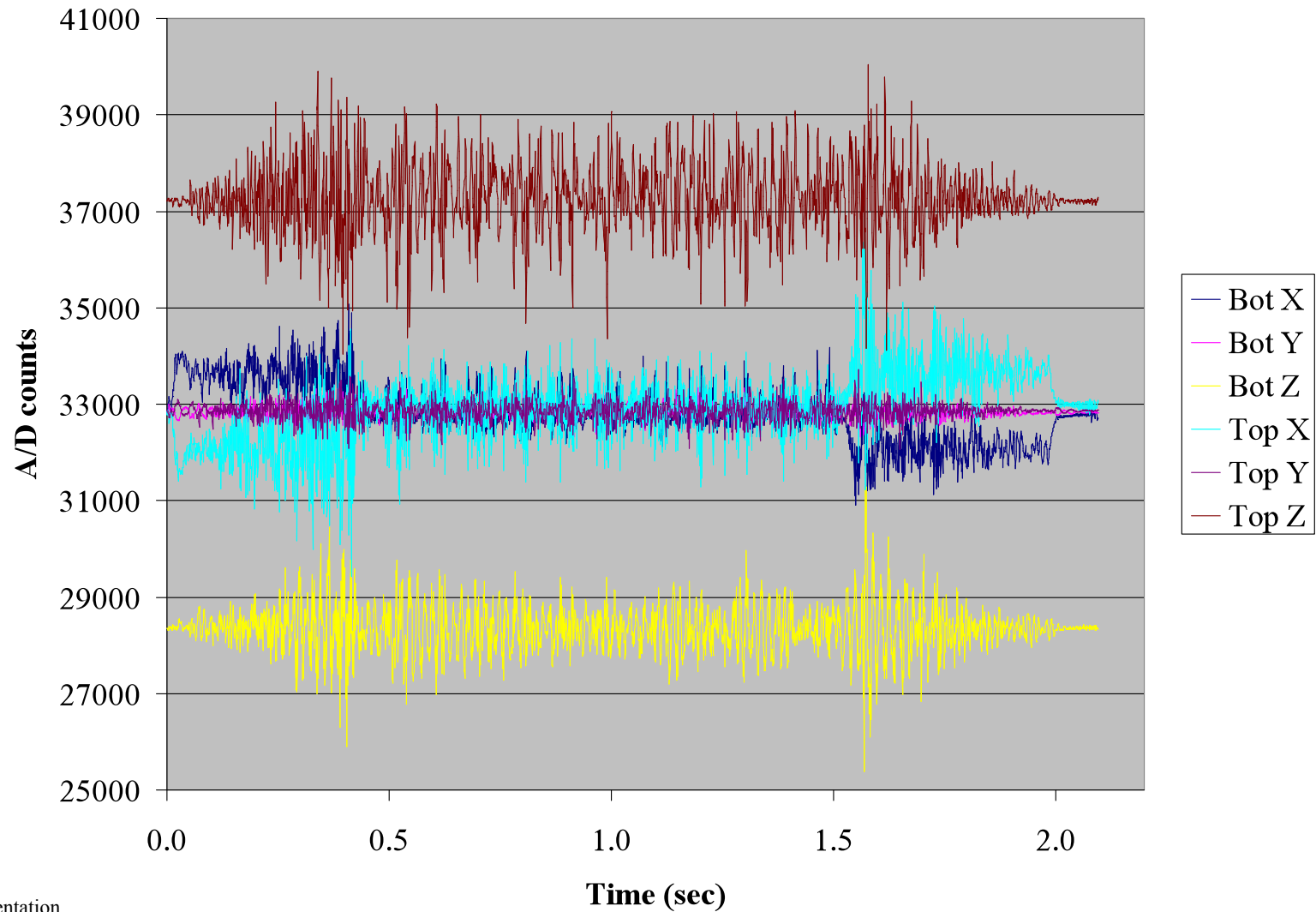
Optics Focal Length = 6 mm



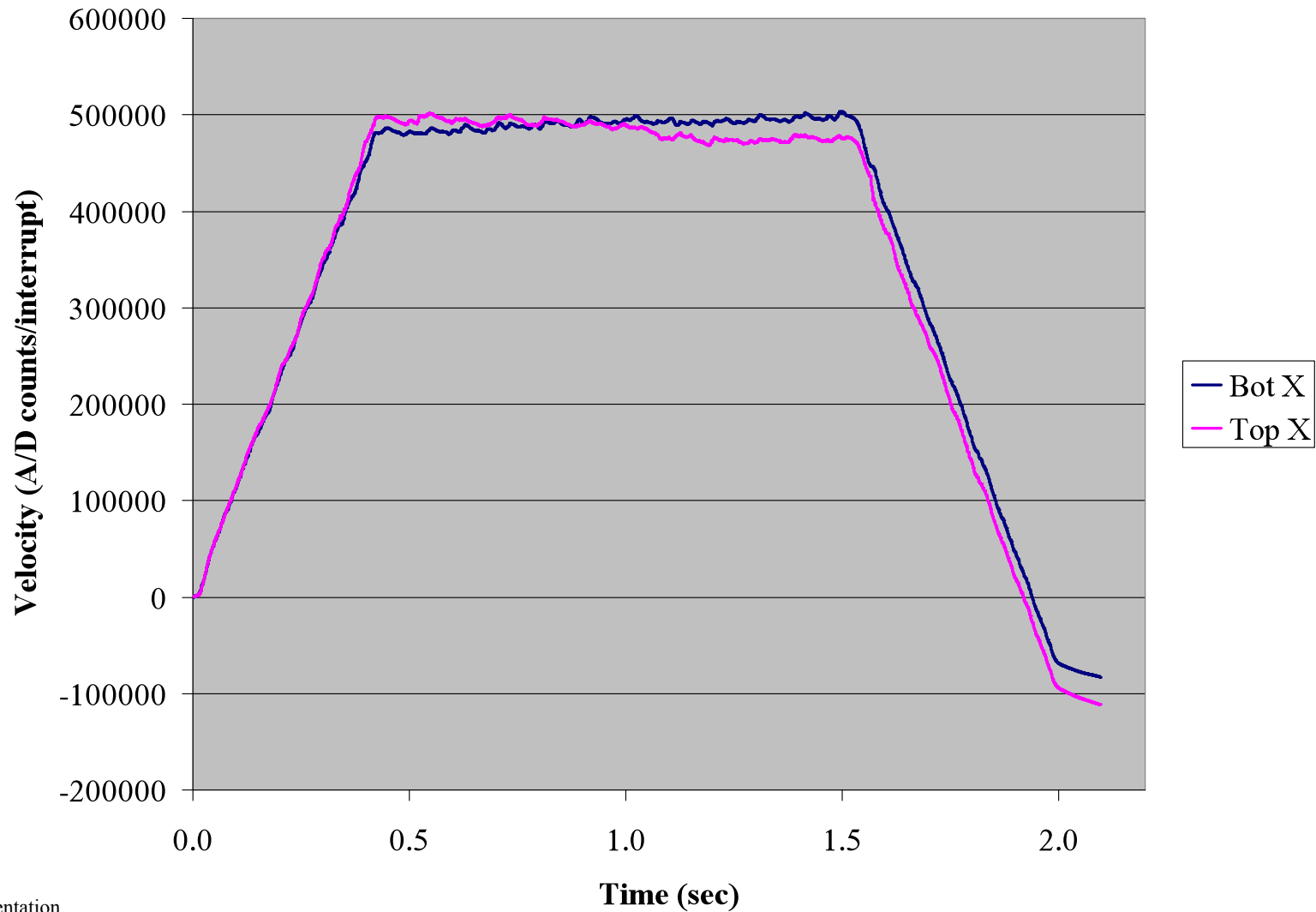
Response to Rotation about Axle



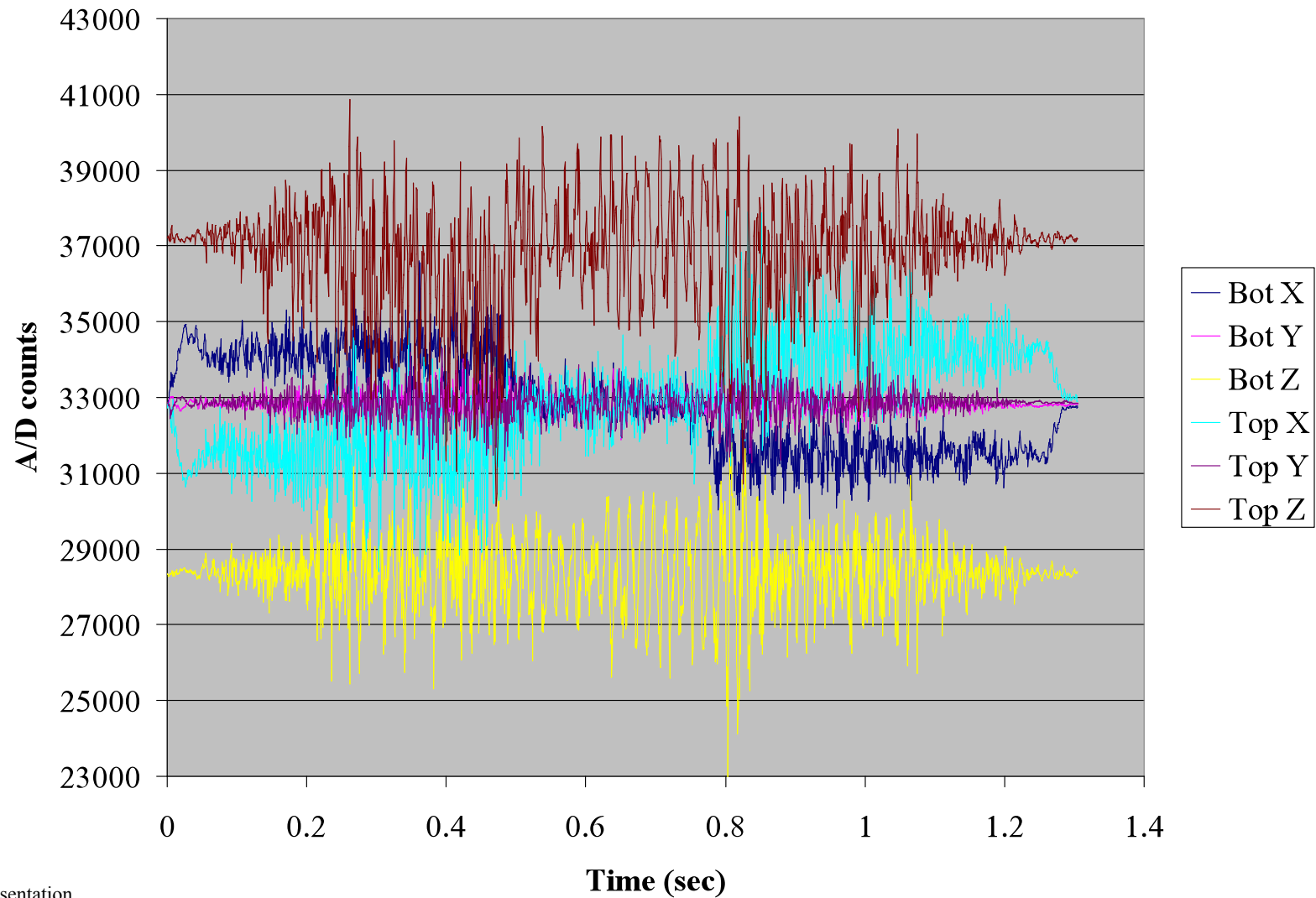
Accel - Constant Velocity - Decel



Integrated Accelerometer Signals



Higher Acceleration and Velocity



Integrated Accelerometer Signals

