



# Utilizing Low Cost Sensors on Mortar Platforms for Fire Control Applications

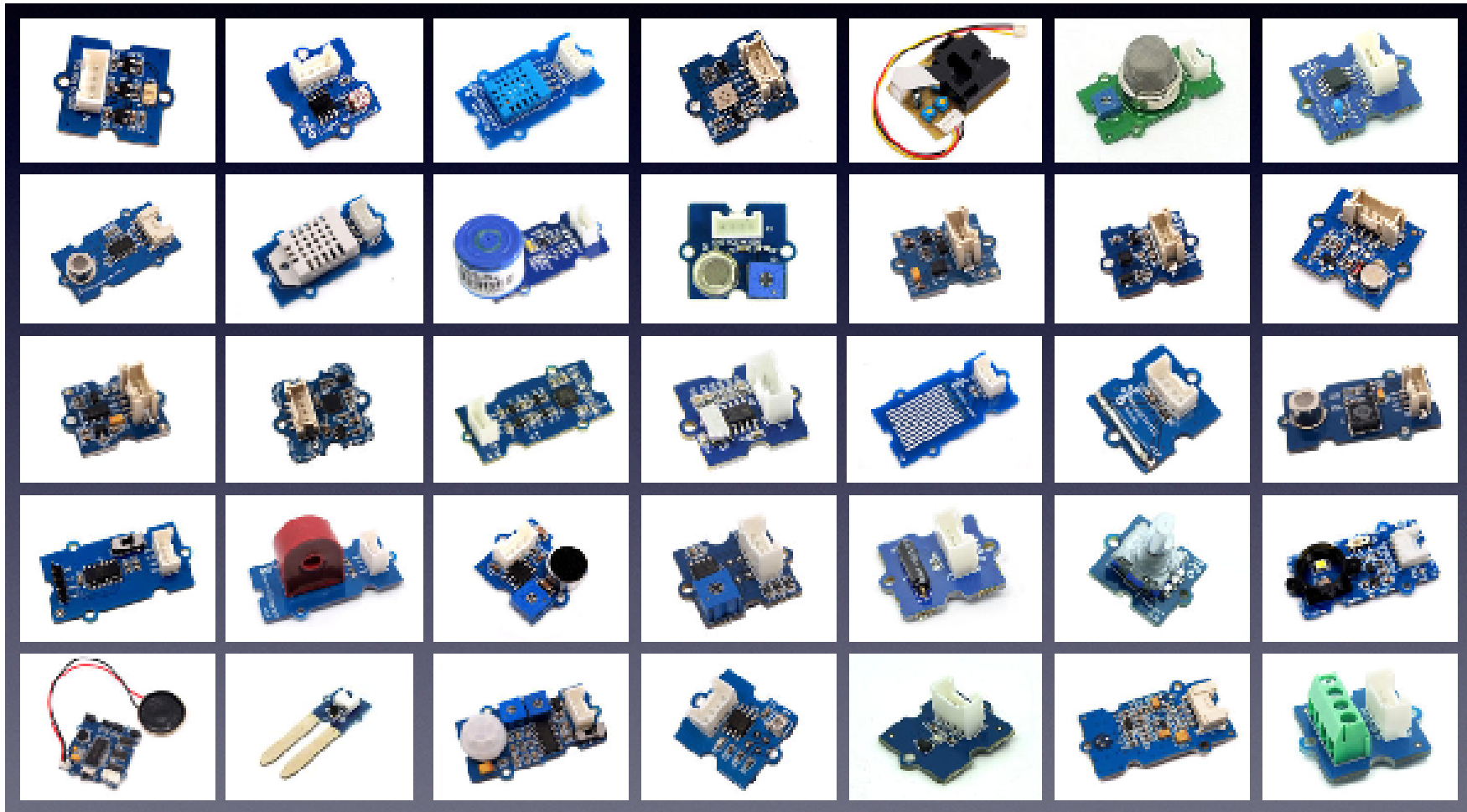
Presented by  
Mr. Greg Byrne

Mr. Greg Byrne, Mr. Steve Sadowski, Mr. Ralph Tillinghast, Mr. Michael Wright & Andrew Yu  
Fire Control Systems & Technology Directorate  
US Army ARDEC, RDAR-WSF-M

PAO Log # TBD



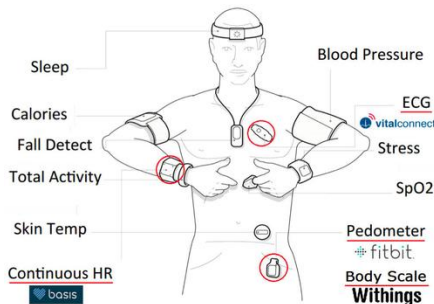
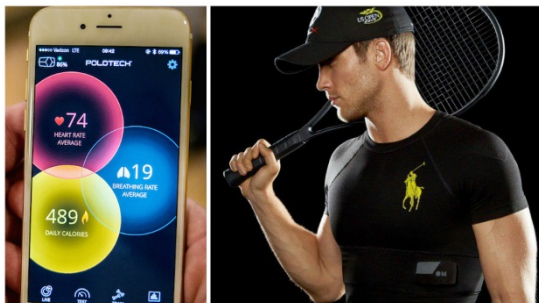
**TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.**



# Internet of Things (IoT)

## Internet-connected machines and sensors

- Cheaper Sensors
- Mass Data to Big Data
- AI & Robot Diversity



**TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.**



# Players

## Platforms & Enablement (Horizontal)

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## Applications (Vertical)

<b>Quantified Self</b> 

<b>Internet</b> 

## Building Blocks

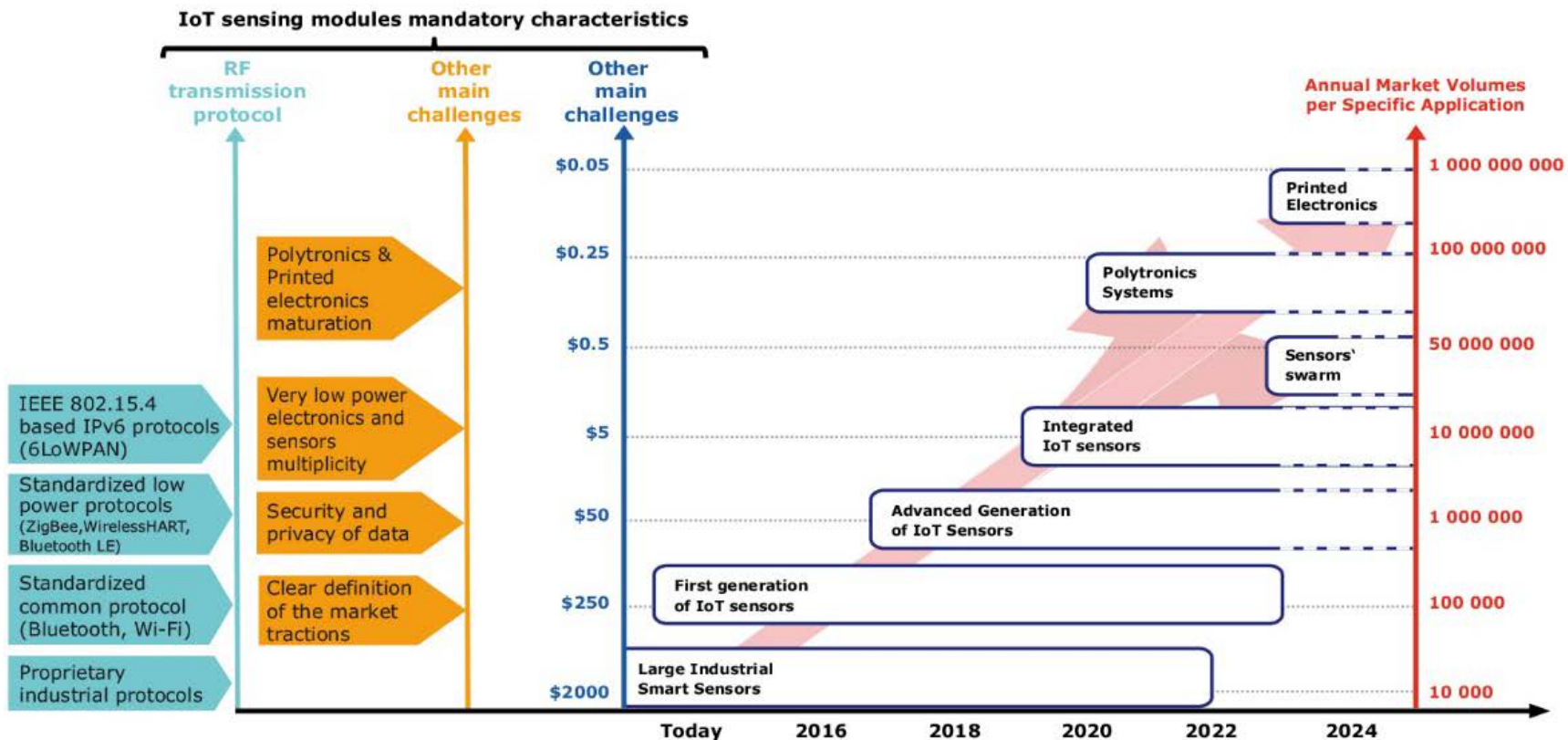
<b>Connection Protocols</b> 							
<b>Software</b> 	<b>Mobile</b> 	<b>Hardware</b> 	<b>Parts / Kits</b> 	<b>Services</b> 	<b>Incubators</b> 	<b>Funding</b> 	<b>Distribution</b> 



**TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.**

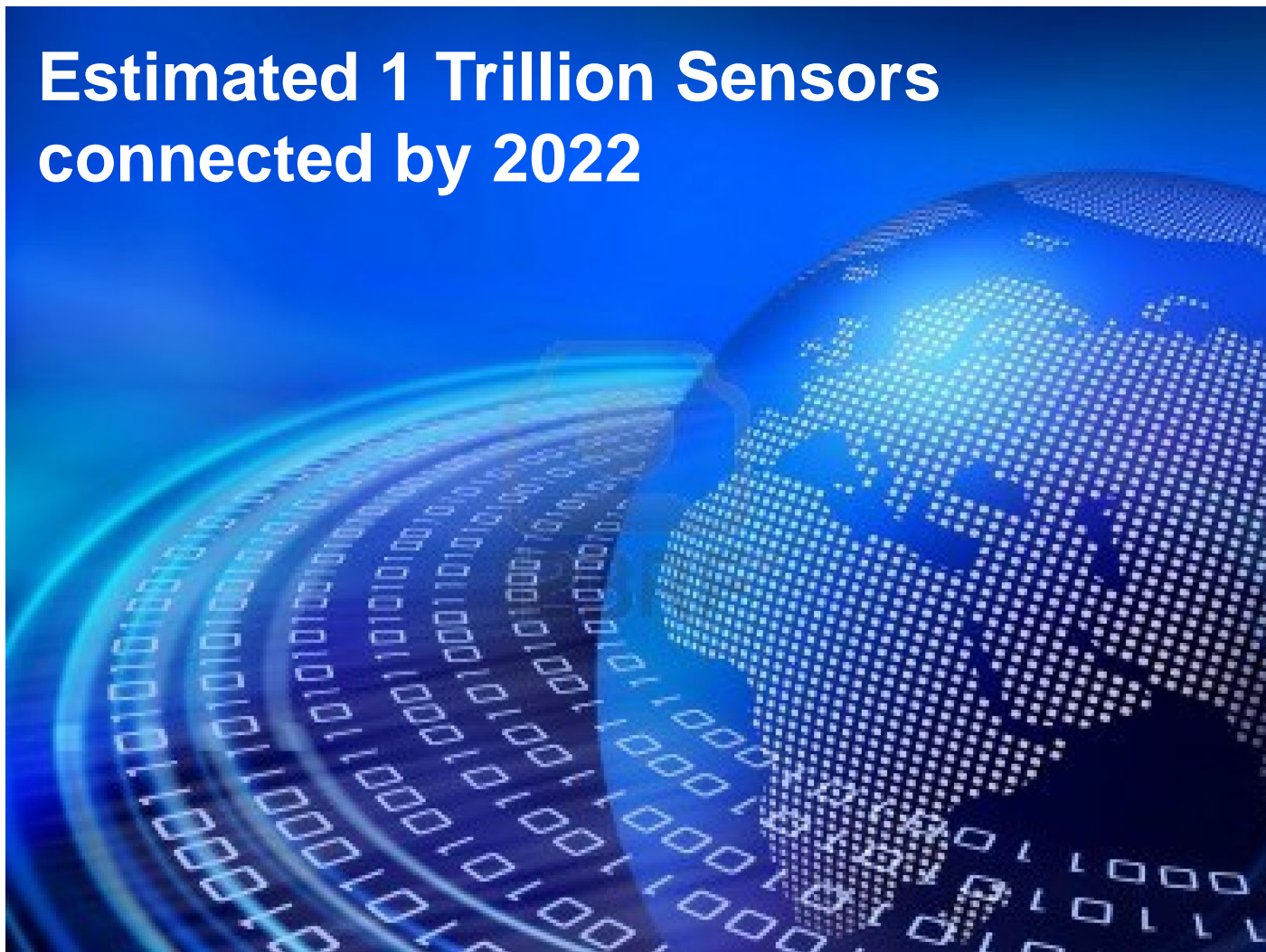
## The Internet of Things roadmap

(Source : Technologies & Sensors for the Internet of Things, Yole Développement, June 2014)





# Estimated 1 Trillion Sensors connected by 2022



REF: BI Report, 2015, 21 Technology Tipping Points



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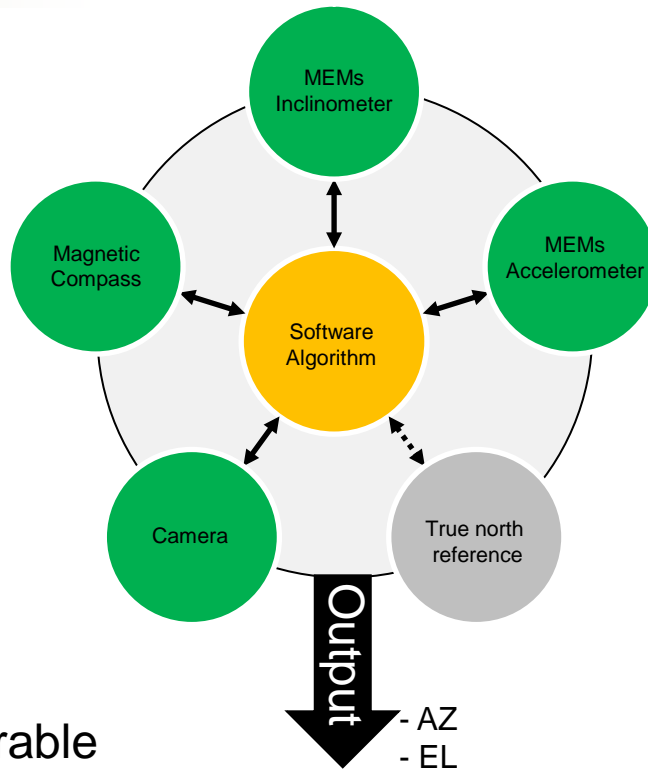
# Weaponized Universal Lightweight Fire-Control (WULF)



**TALIN**

**WULF**

- ▶▶ 5 lbs
- ▶▶ 3mil Accuracy
- ▶▶ 3.5 Watts (peak)
- ▶▶ GPS Denied Capable
- ▶▶ No Isolation Required
- ▶▶ 60, 81 & 120mm Interoperable
- ▶▶ Overcomes Magnetic Interference



*81mm Mortar Testing*



*60mm Mortar Testing*

## Mission Process Flow



Mission Received

Calculate Ballistics and Aim Point (LHMBC)

Acquire Gun AZ & EL (WULF Sensor)

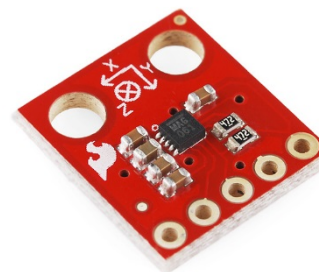
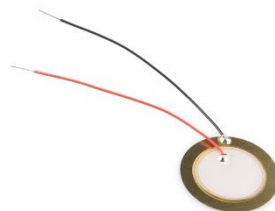
Display Aim Point (WULF Disp)

Gunner Adjust Orientation to Aim Point

# Low Cost Sensors



- Inductive coils (single and multi)
- Acoustic Microphone
- Inertial
- Accelerometer
- Magnetometer

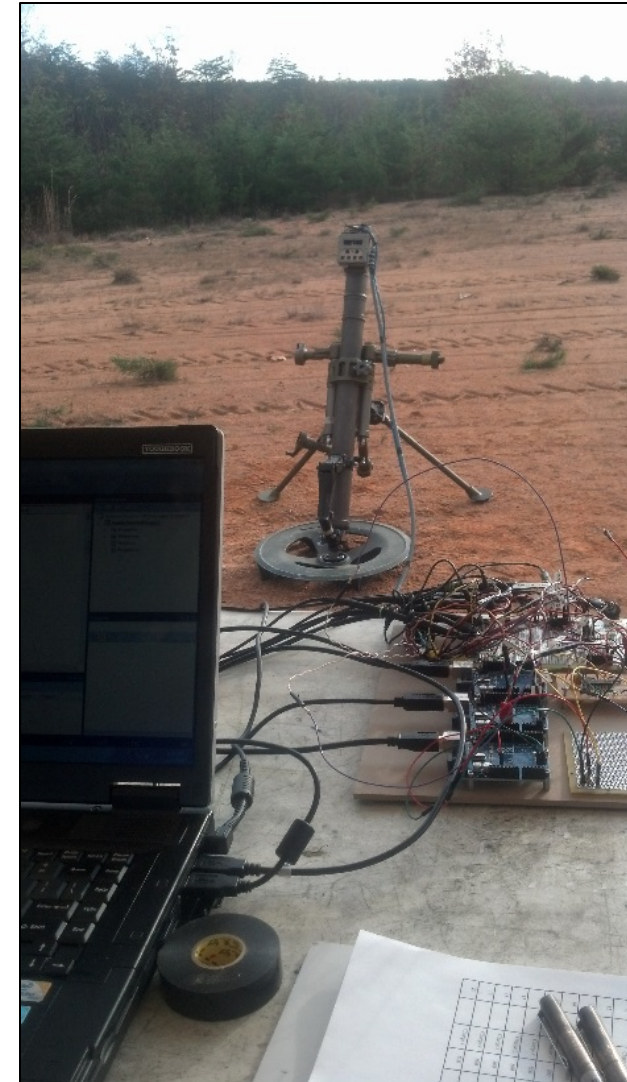
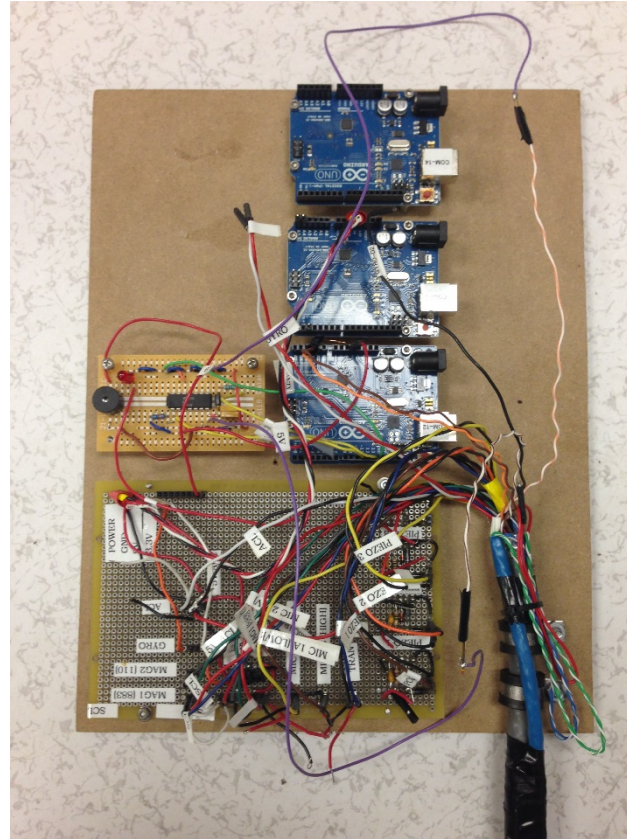
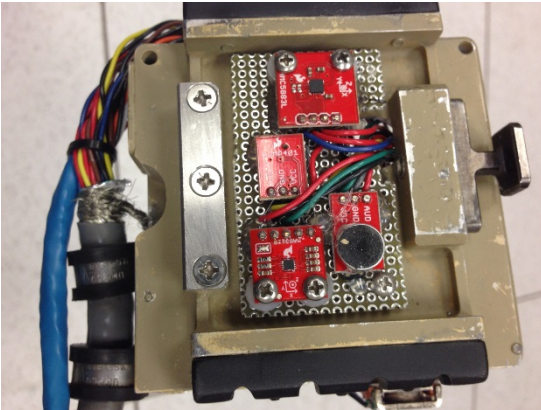
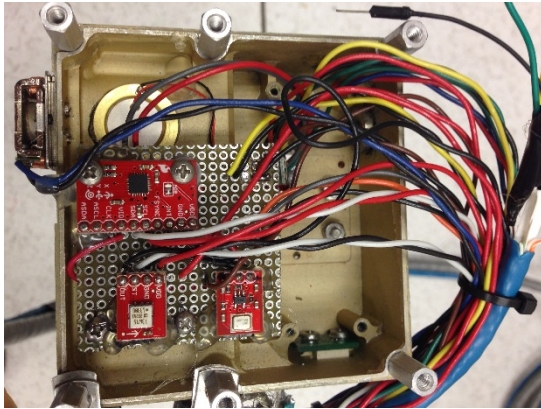




# Test Platform



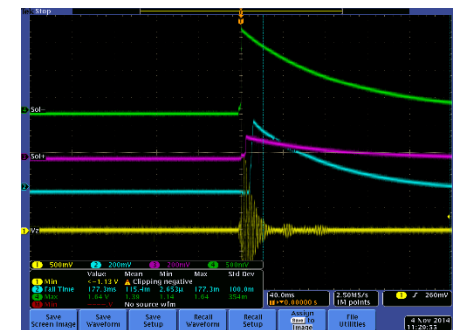
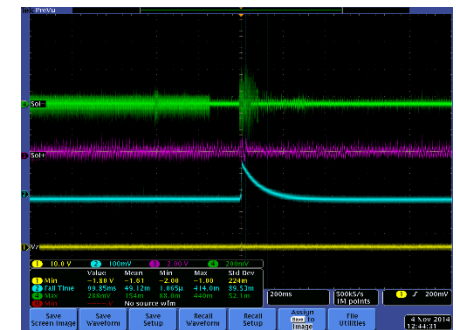
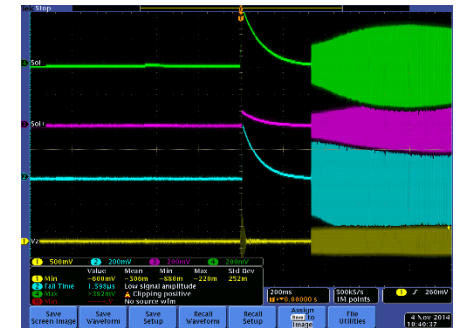
- 60mm Mortar (Charges 0-4)
- 11 different Sensors



# Findings



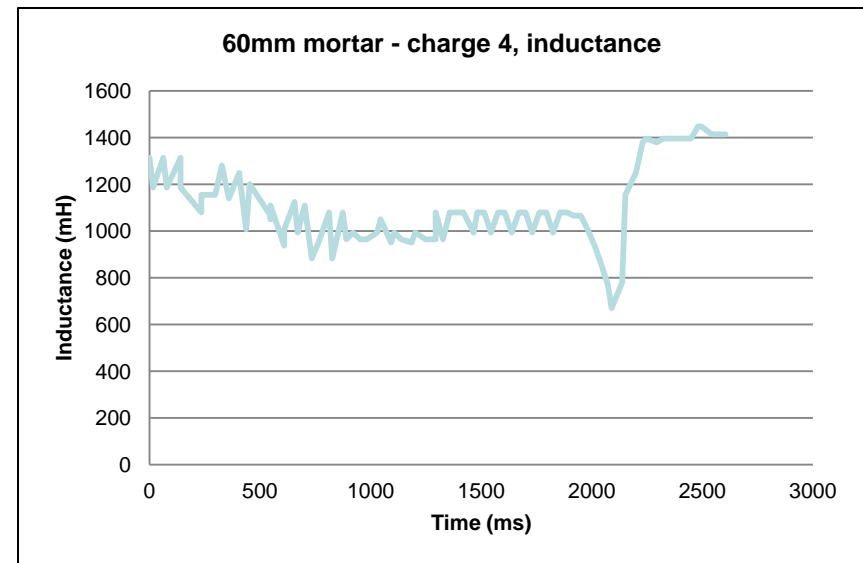
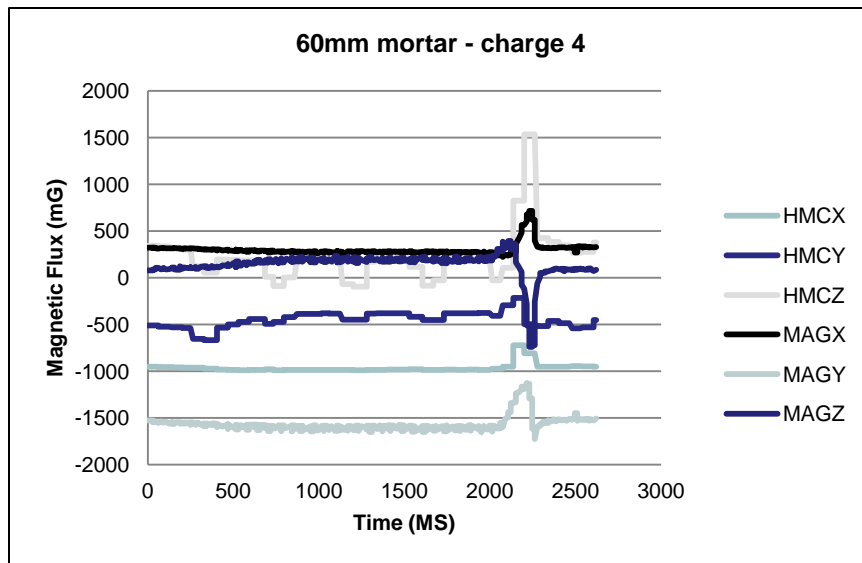
- All survived shock
- Inductive coil (single and multi)
  - To slow for exit
- Acoustic Microphone
  - Saturated & over sensitive
- Inertial & Accelerometer
  - Successful capture
  - Further work needed to filter
- Magnetometer
  - Successful in detecting EMP



# EMI Blast Over Pressure



- Will Mortar Blast Over Pressure Damage sensors?
  - Electro Magnetic Pulses were found
  - Levels are not enough to cause damage



# Conclusions



- Sensors can survive
- Rugidization may be required
- Sensor Selection critical
- Filter strategy required
- Ideal for prototyping and proof of concepts

# Thoughts...



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**Title:** Utilizing Low Cost Sensors on Mortar Platforms for Fire Control Applications

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**Abstract:**

Low cost sensors are becoming increasingly available on the open market. As these sensors have become widely adopted their reliability and accuracy has increased. This availability prompted the question if these sensors are robust enough to be utilized on weapon systems for fire control applications. This paper looks at the findings of low cost sensor testing conducted on 60mm mortar systems. This included testing of MEMs accelerometer, magnetometers, piezos and other sensor types. The paper will describe the testing conducted and results for each sensor type. Overall attendees should gain an understanding of the technology readiness of low cost sensors in Fire Control applications.

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