Defeating Magnetic Interference on the Battlefield

How multiple sensory inputs are enabling lightweight robust weapon pointing for mortar fire control systems

Presented by

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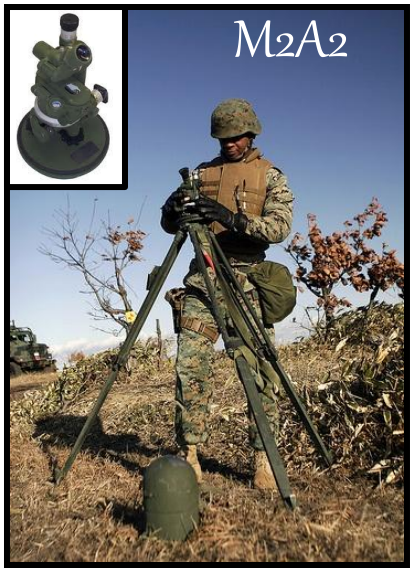
Current Mortar Fire Control

Digital Fire Control (Non-Magnetic)

- M150/M151 120mm Mortar Fire Control
  - Ring Laser Gyro Based system (+/- 1 mil)
  - ~200 lb Fire Control System

Legacy Fire Control (Magnetic)

- M2 Compass
  - Accuracy, +/- 10 mils
  - Handheld, Magnetic
- M2A2 Aiming Circle
  - Accuracy, +/- 2 mil
  - Large, Magnetic, Labor intensive



Current Technology for True North Reference

Commercially available Gyro's:

- Ring Laser Gyro (RLG)
  - Accurate, Expensive, Power Hungry, Heavy
- Dynamically Tuned Gyro (DTG)
  - Accurate, Slow
- Fiber Optic Gyro (FOG)
  - Less Accurate, Expensive, Slow
- Hemispherical Resonator Gyro (HRG)
  - Inaccurate, Slow

New Technologies:

- GPS Interferometer
  - Accurate, Slow, Requires GPS signal
- Fluid Gyro
  - Inaccurate, Slow
- Portable Celestial System
  - Accurate, Fast, Degraded at Dusk/Dawn and with Clouds/Fog

Man Portable Fire Control Technology Hurdles

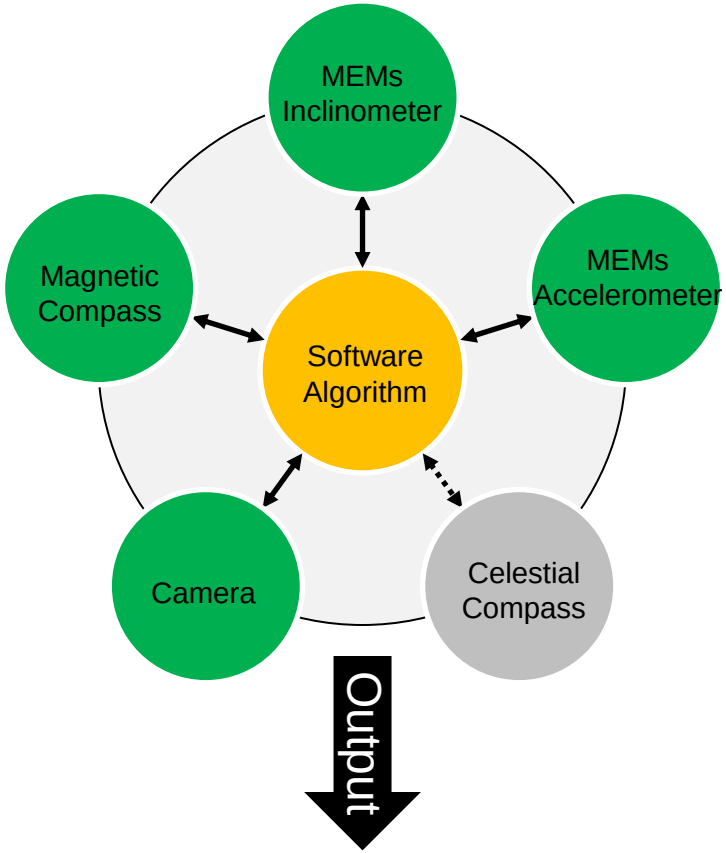
- ***Magnetic Sensors:*** North finding easily affected by interference, incorrect declination, and magnetic terrain variations
  - Error is not always evident
  - Reported azimuth value unstable due to floating variations in local magnetic field
- ***MEMs Inertial Sensors:*** North finding not accurate, stable, or fast enough for Digital Fire Control
- ***Optical Systems:*** Cannot handle large or rapid shifts in azimuth and elevation
- ***Portable Celestial System:*** Accurate, Fast, Degraded at Dusk/Dawn and with Clouds/Fog

Combination of Technologies

- Combination of technologies required to accurately detect and hold north reference through magnetic interference and firing events
  - Magnetic north reference used to establish direction
  - Accelerometers and gyros used to detect motion to determine if change in magnetic reference is due to motion
  - Optical tracking used to compensate for “noise” in both the magnetic and inertial tracking as well establish known markers for referencing the system back to a known location
  - Celestial System (when available) used for onsite on weapon magnetic declination
  - Software Algorithms used to filter the data

Multiple Sensor Based Solution

5 Integrated Technologies



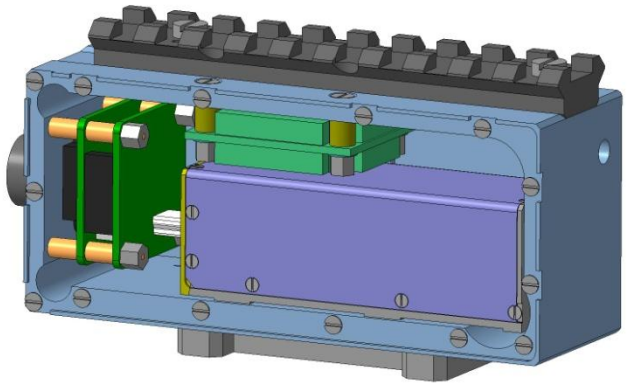
- AZ
- EL
- Roll

How it works:

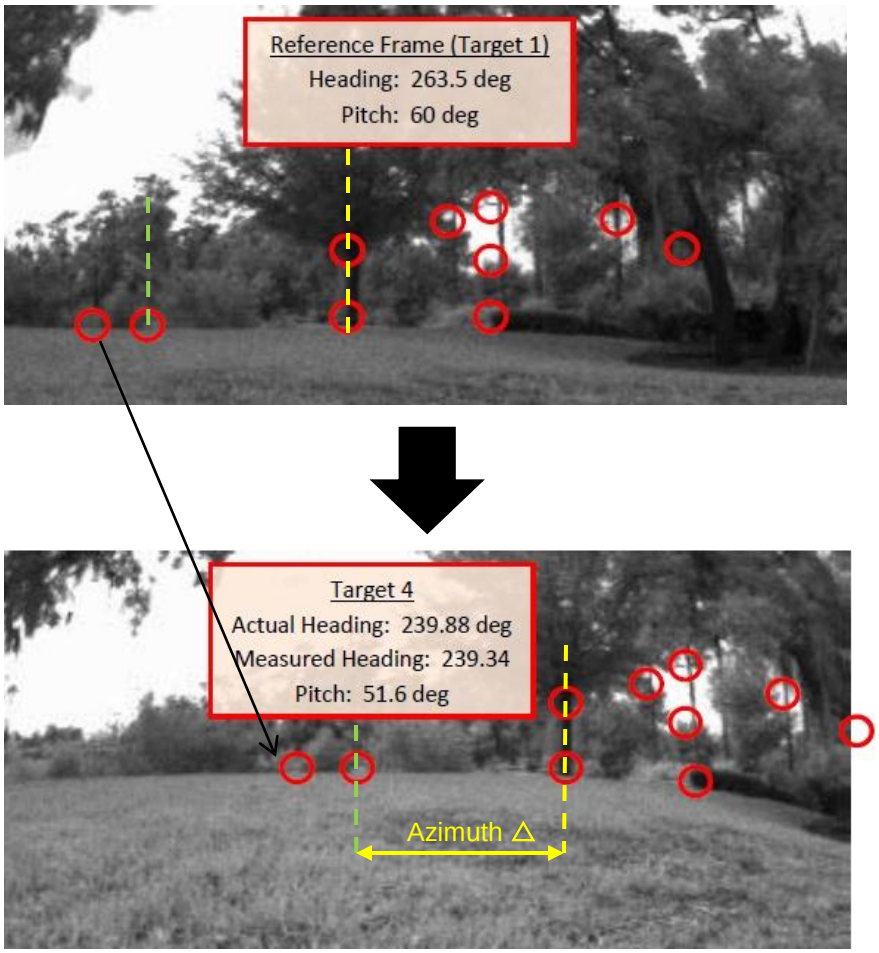
Each of the technologies compensate for each other's deficiencies and errors. Acts as a self checking and calibrating system.

Example:

If a magnetic change is sensed but the camera and accelerometers see no change, then magnetic change is ignored.



Optical Tracking



Optical Algorithm

- Software tags geographical points
- Software tracks geographical location change relative to calibrated Azimuth

Detailed Process:

- Reference image collected at start up
- Points in the reference are identified like a constellation
- The change in the location of the constellation points is used to determine azimuth change
- Camera distortions are handled by factory calibration
- Linear movements are handled by system algorithms

Current Development Status

Weaponized Universal Lightweight Fire-Control (WULF)

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

WULF North Finder

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

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

WULF Firing

Questions

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