# Inertial Measurement Unit (IMU)

## Precision Sensing, Measurement and Controls

## Applications

ATA has designed and built custom Inertial Measurement Units (IMUs) for applications including navigation and Line-of-Sight stabilization for systems such as satellites and tactical airborne platforms.

Many systems require precise knowledge of location and orientation, and many have missions that require tracking objects at great distances. Two or more systems pointing at the same distant object can cooperatively triangulate the location of the object only if each possesses very precise knowledge of its own position and attitude.

## What is an Inertial Measurement Unit (IMU)?

- An IMU uses accelerometers and gyroscopes to measure and report a platform's position, velocity, and orientation
- Many systems employ IMUs for navigation and attitude control
- Many systems require precise Line-of-Sight (LOS) stabilization (*e.g.*, telescope, laser communication)
- ATA's IMU includes "jitter sensors" to support LOS stabilization



**Inertial Measurement Unit**
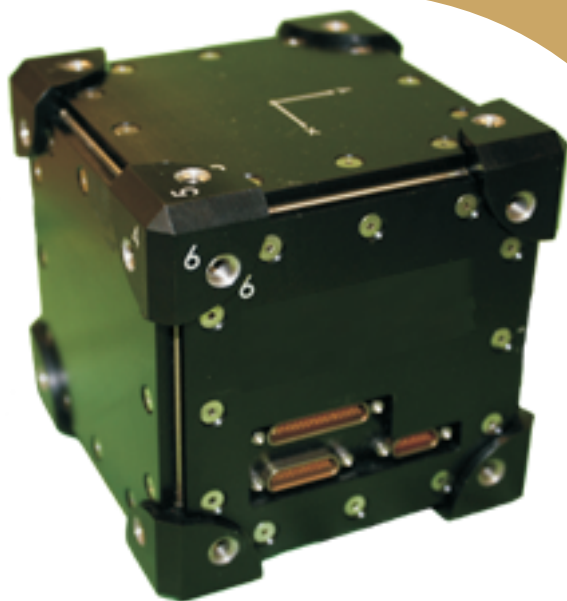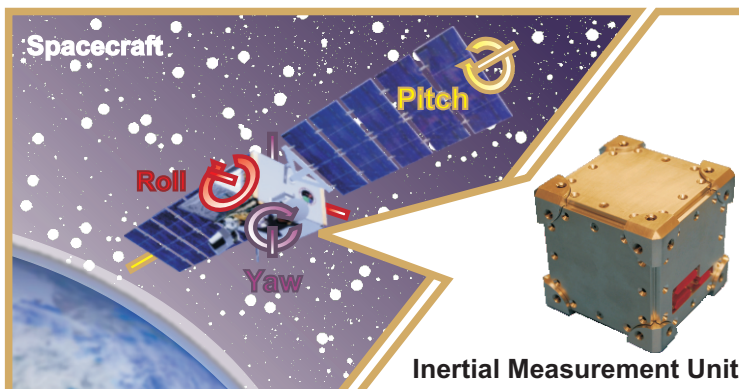


**Rad-Hard IMU**

## Next-Generation Inertial Measurement Unit (IMU)

Current IMU solutions are somewhat ad-hoc and mission-specific based on performance requirements and limitations of sensors due to size, weight, and power. IMU performance and size are diametrically opposed, i.e., small IMUs have lower-performance and higher-performance IMUs are large.

ATA has designed custom IMU solutions including radiation hardening by design, high-frequency angular rate sensors, a flexible communications interface and computational architecture, and higher-performance in a small package. ATA's IMU solutions comply with new standardized IMU communication interfaces, including MDA-STD-005.

14M0893

# ATA
*Applied Technology Associates*

# ATA's Innovative Fusion

To achieve higher-performance in a smaller package, ATA's custom IMU solutions innovatively fuse an ATA developed magneto-hydrodynamic (MHD) angular rate sensor (ARS) with a high fidelity Micro Electro-Mechanical Systems (MEMS) gyro. These two gyros are "fused" via proprietary ATA algorithms in the field programmable gate array (FPGA) fabric. The combination of compact quartz accelerometers with the gyros forms the IMU hybrid triad. Packaging this hybrid triad and FPGA-based fabric processors produces a compact and flexible computational architecture, which affords the flexibility of software and the reliability of hardware.
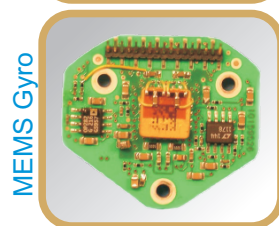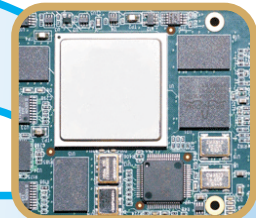
Inertial Sensor Triad
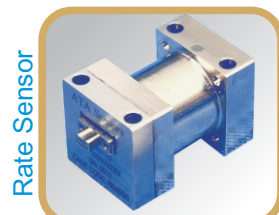
Qualification Testing

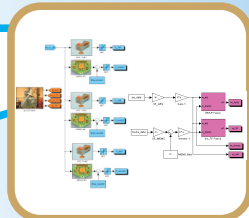Rate Sensor

FPGA Electronics

Accelerometer

FUSION

MEMS Gyro

Algorithms
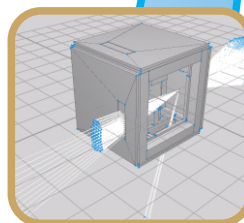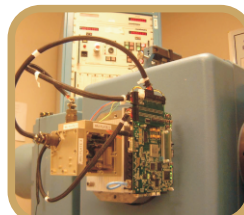
Radiation Analysis
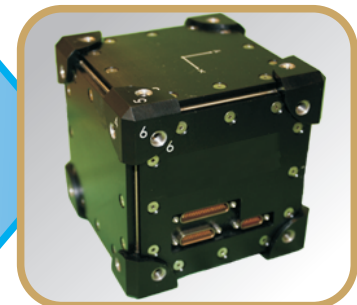
Rad-Hard IMU

## ATA IMU Parameter Scale

| Parameter | Scale | Units |
|---|---|---|
| 1. Size | < 55 | in³ |
| 2. Mass | < 1.5 | kg |
| 3. Power | < 15 | Watts |
| 4. Angle Random Walk | < 0.01 | º/√hr |
| 5. Accelerometer Dynamic Range | ± 70 | g |
| 6. Angular Acceleration Capability | > 0.5 | rad/s² |
| 7. Output Data Range | > 100 | Hz |
| 8. Operating Temperature Range | -54 to +32 | °C |
| 9. Radiation Hardness (TID) | 100* | krad |

*Based on analysis

# Cutting Edge Technology in Sensing and Controls