

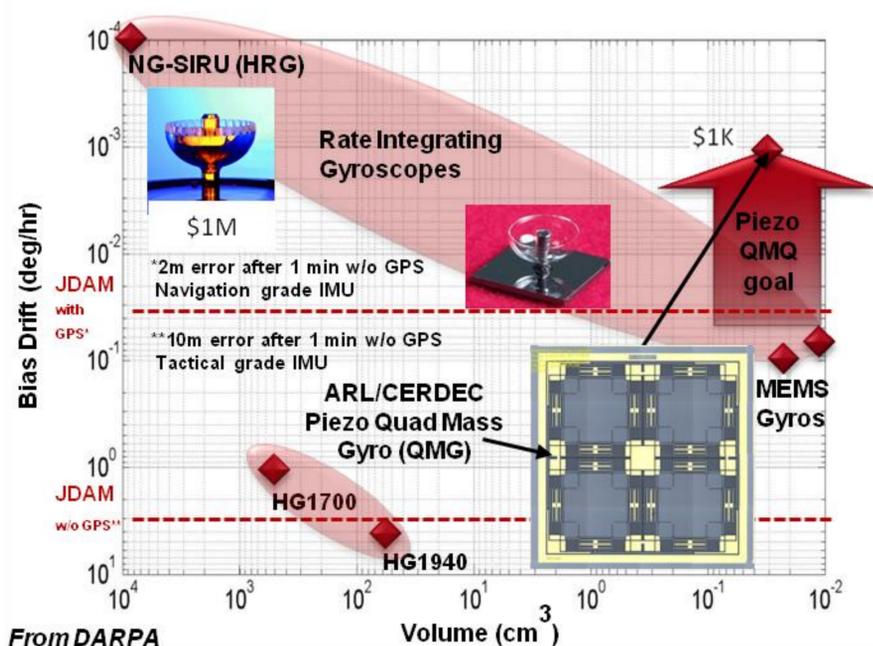
## S&T Campaign: Materials Research

Electronics  
MEMS

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## Research Objective

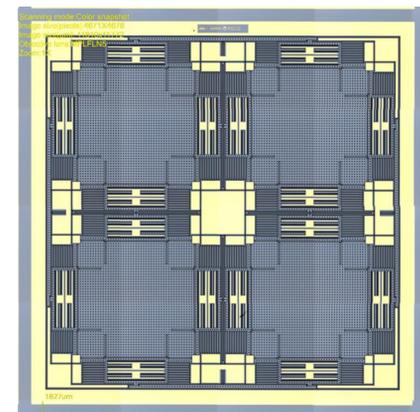
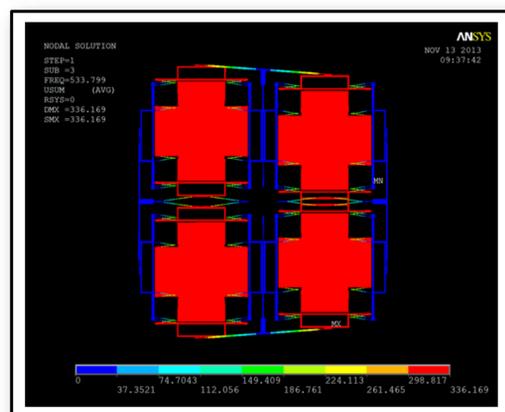
- Increase the accuracy and robustness of position, navigation, and timing (PNT) solutions for constrained applications such as dismounted soldier navigation, hand held laser designators, micro autonomous systems, smart munitions, and missile navigation.
- Provide uninterrupted PNT Solutions for soldiers and systems in GPS-denied and contested environments.



The ultimate goal is to improve the performance of MEMS angular rate gyros to navigation grade at a 3 order of magnitude cost reduction.

## Challenges

- Enable robust fusion of vision and heterogeneous sensor with IMU in SWaP-C constrained systems
- Explore fundamental performance limits of MEMS-based inertial sensors and reduce bias drift in MEMS gyroscope and aided IMUs to achieve navigation grade (<0.01 deg/hr) operation including Tuning and trimming
- Reduce turn-on drift to enable rapid north finding



Quad Mass Gyro with integrated Piezo drive and sense show promise for as a means to push the state-of-the-art performance in MEMS angular rate sensing (Collaboration with Army CERDEC CP&I)

## ARL Facilities and Capabilities Available to Support Collaborative Research

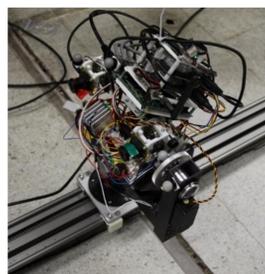
- Ultra-high vacuum MEMS packaging ( $\mu$ torr)
- Temperature Controlled Angular Rate Table
- Specialty Electronic Materials and Sensors Cleanroom (SEMASC) 15,000 ft<sup>2</sup> fabrication facility
- Plasma-Therm Versaline Deep Silicon Etch (DSE) with end-point detection for high aspect ratio silicon features
- MEMS actuator characterization laboratory (high speed video, laser doppler vibrometer, probe stations, etc)
- 3 Degree of Freedom (3-DOF) Motion Controlled Gantry with Motion Capture and multi-sensor, multi-computation node platform
- Robust, Ground-Truthed, Multi-Sensor datasets for Navigation and State Estimation
- 3-D Coded Apertures for Compressed Sensing Characterization Facility



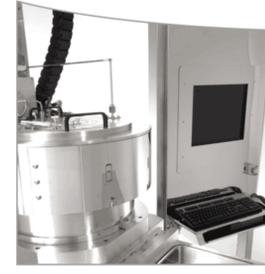
Ultra-High MEMS Vacuum Packaging ( $\mu$ T)



Acutronic AC-117 w/ temp chamber



3-DOF Controlled Motion Gantry with Motion Capture



Plasma-Therm Versaline DSE

## Complementary Expertise / Facilities / Capabilities Sought in Collaboration

- Advanced Micro Fabrication and Packaging
- System level integration
- Instrumented Outdoor Flight Facilities