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**Auburn University** 

## Issues with MEMS Sensors in High-G Environments

- Acceleration induced bias offset (MEMS gyros)
- Increased noise floor (MEMS gyros)
  - High G accelerations at high frequency
  - Mechanical shock loading
- Permanent bias point change (various sensors)
- Damage/failure (various sensors)

#### Effects of High Power, High Frequency Acoustic Noise on MEMS Gyroscopes





ADI ADXRS300 gyro exposed to 95dB sound level at 15KHz. 20X increase in noise floor.

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### Related Evaluation Facilities at Auburn University



- Large and small shakers
  - Large shaker has a thermal/humidity chamber
- Acoustic test facility
- Drop towers
- Programmable rate table



- Thermal cycling, shock and storage chambers
- Humidity chambers
- Characterization and failure analysis equipment





### MEMS Design and Fabrication Capabilities at Auburn University



- FEA multi-physics simulation
- Photolithography mask set layout
- ASIC design
- Microfabrication
- Packaging
- Support electronics
- System Integration
- Environmental characterization



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**Related Efforts at Auburn University** 



- Evaluation of MEMS gyros
  - High frequency vibration
  - High frequency acoustic excitation
  - Impact loading
- Development of mitigation technologies
  - Packaging
  - System isolation
- Development of better MEMS gyros

#### Passive Micromachined Vibration Isolator for Attached Vibration Sensitive MEMS Devices





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# Related Publications (Available Upon Request)



- S.J. Kim, R. Dean, G. Flowers and C. Chen, "Active vibration control and isolation for micromachined devices," ASME J. of Mechanical Design, Vol. 131, Sept. 2009, pp. 091002-1 – 091002-6.
- R.N. Dean and A. Luque, "Applications of microelectromechanical systems in industrial processes and services," IEEE Trans. on Industrial Electronics, Vol. 56, No. 4, April 2009, pp. 913-925.
- R. Dean, G. Flowers, N. Sanders, R. Horvath, M. Kranz and M. Whitley, "Micromachined vibration isolation filters to enhance packaging for mechanically harsh environments," J. Microelectronics and Electronic Packaging, Vol. 2, No. 4, 2005, pp. 223-231.
- R.N. Dean, S. Castro, G.T. Flowers, G. Roth, A. Ahmed, A.S. Hodel, B.E. Grantham, D. Bittle and J. Brunsch, "A characterization of the performance of MEMS gyroscopes in acoustically harsh environments," IEEE Trans. on Industrial Electronics, manuscript submitted 2/26/10.
- R. Dean, A. Anderson, S.J. Reeves, G. Flowers and A.S. Hodel, "Electrical noise in MEMS capacitive elements resulting from environmental mechanical vibrations in harsh environments," IEEE Trans. on Industrial Electronics, manuscript submitted 10/31/09.