



Bilkent University

Dept. of Electrical and Electronics Engineering

National Nanotechnology Research Center of Turkey (UNAM)

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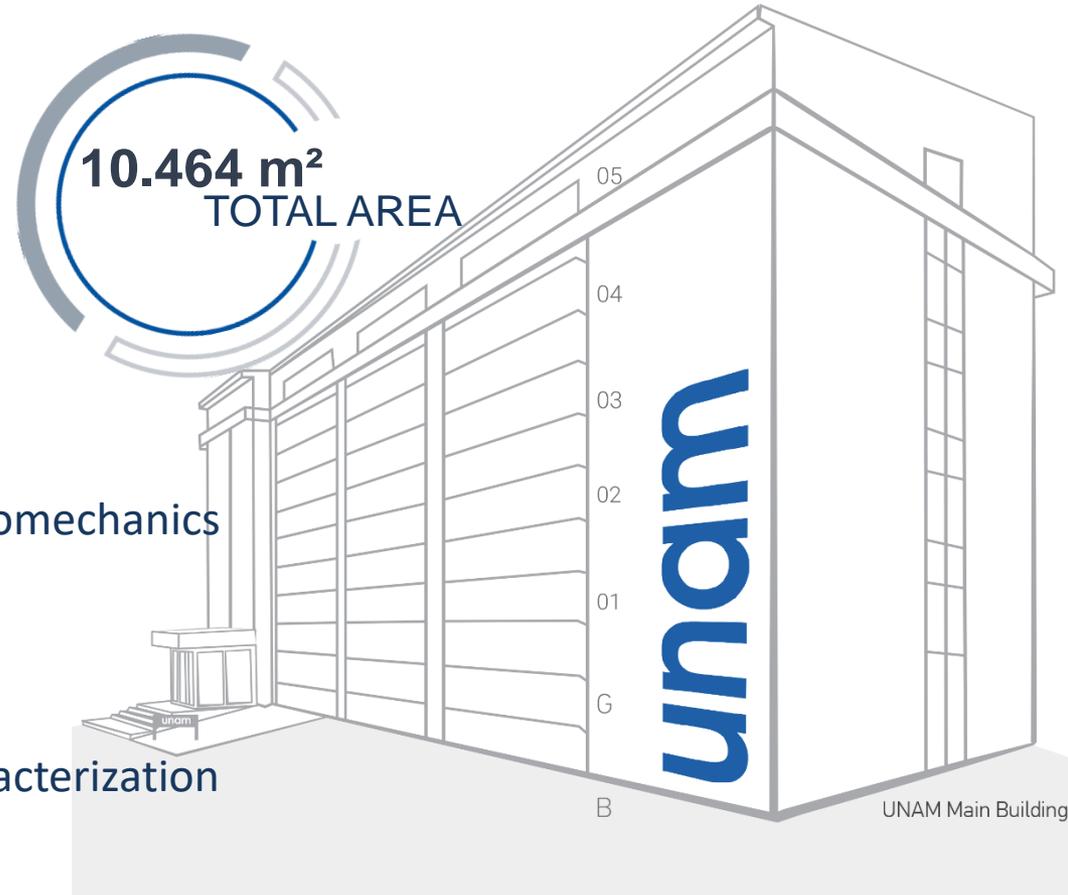


Research Areas

- Biomedical
- Computer Networks
- Electromagnetics
- **Electronics**
- Nanotechnology
- Optics and Photonics
- Robotics
- Signal Processing
- Systems and Control
- Telecommunications

- in Ankara, capital city
- first private unv. in Turkey
- 27 full time faculty members
- 9 IEEE fellows, 3 retired

- The National Nanotechnology Research Center of Turkey (UNAM)
- Multidisciplinary Institute



- 5 Life Sciences
- 4 Nanochemistry
- 3 Nanomaterials, Nanodevices
- 2 Nanophotonics, Nanoelectronics, Nanomechanics
- 1 Laser and Spectroscopy
- G Cleanroom (526m²)
- B Nanoimaging, Nanofabrication & Characterization

UNAM by numbers



**OVER 400
INSTRUMENTS**



248 R&D PROJECTS



**421 RESEARCHERS
AND STAFF**



**OVER 1,500 USERS from
107 UNIVERSITIES,
97 COMPANIES**



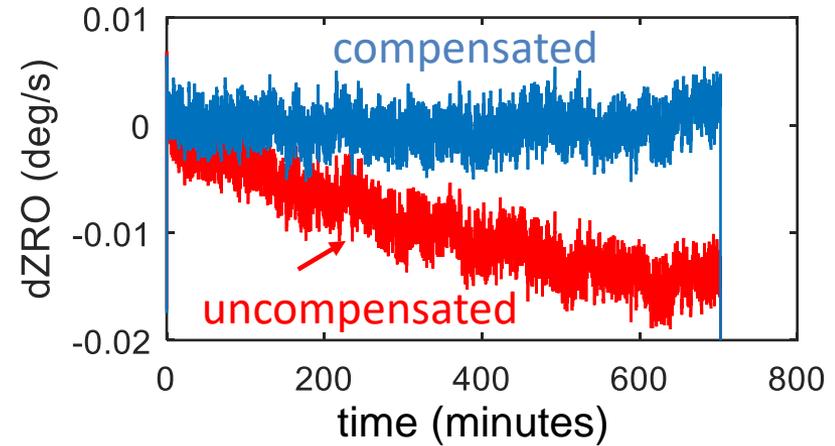
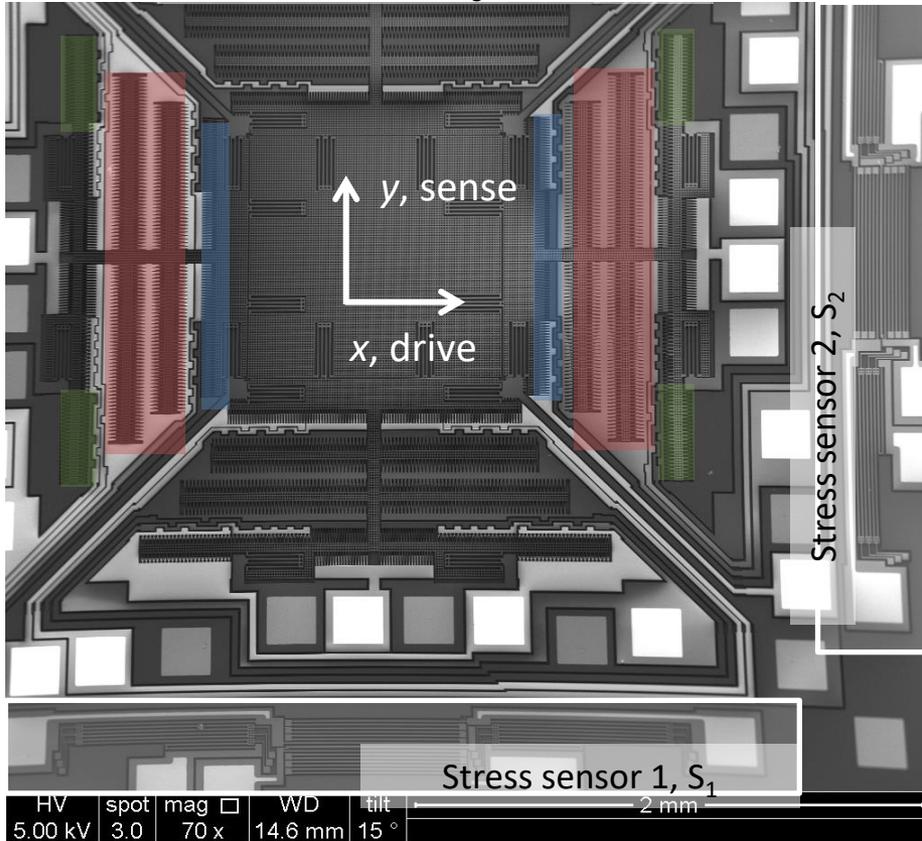
**500 THESES
COMPLETED
at UNAM**



- 7 ERC programs awarded
 - 3 completed
 - Ongoing 3 projects
 - 1 recently started

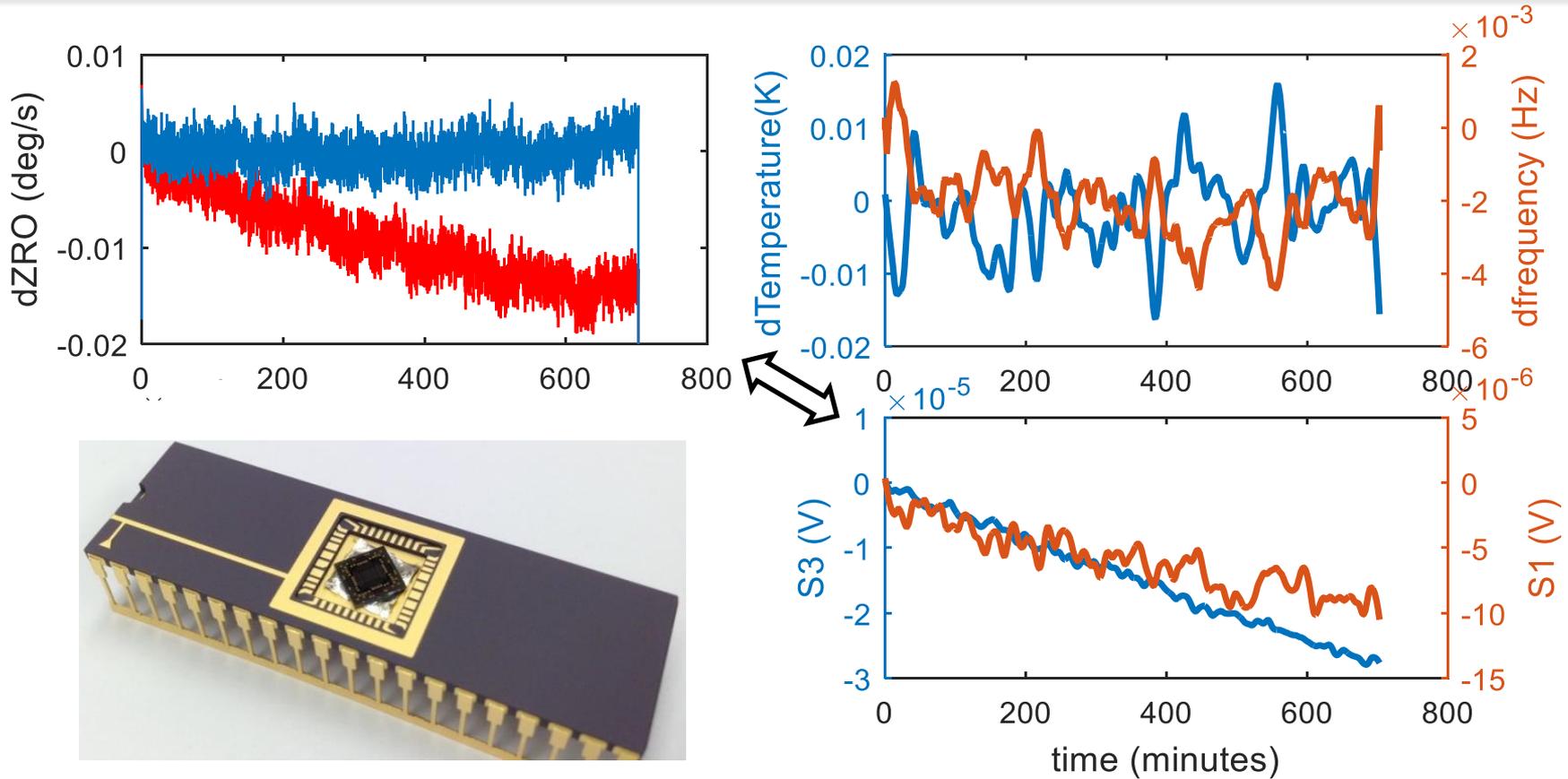
Info about myself

Stress sensor 3, S_3 , not shown



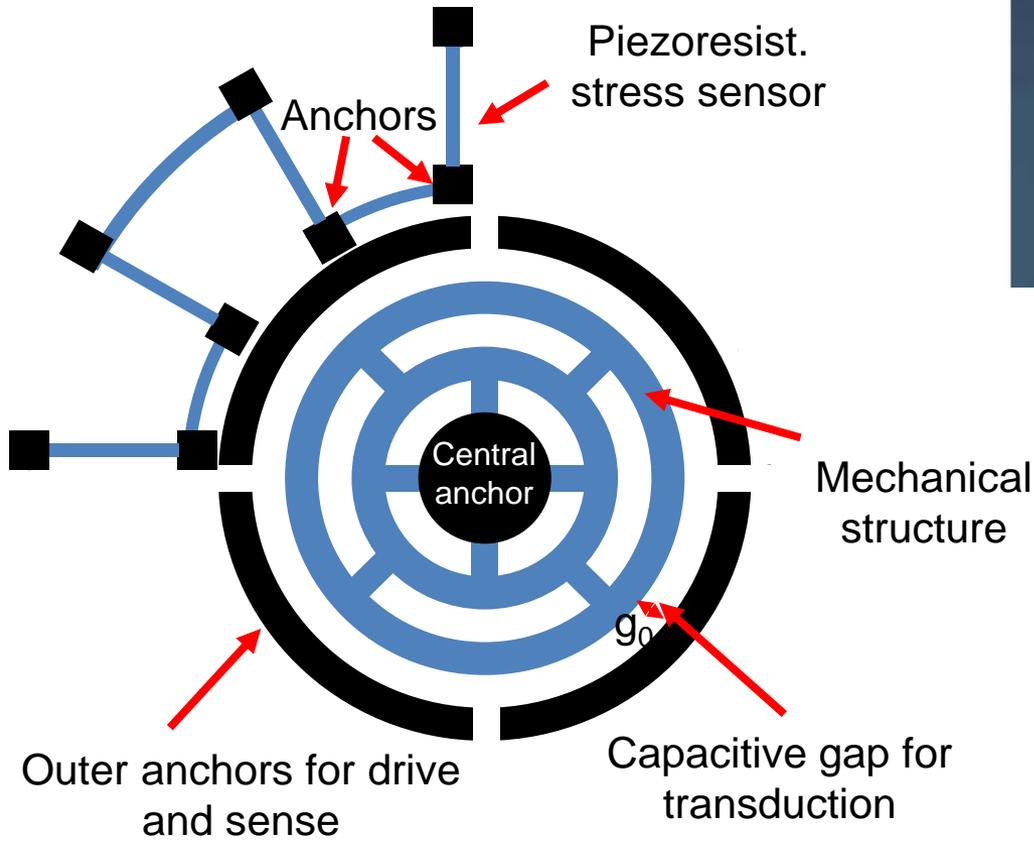
- MEMS guy, suppressing sensor drift
- PhD, Carnegie Mellon Univ., ECE Dept., 2016
- MEMS design eng., Analog Devices, Autonomous Transport. and Safety, 2016-2019
- August 2019-current, Assistant Prof. Bilkent Electrical and Electronics Eng., and UNAM

More on stress compensation

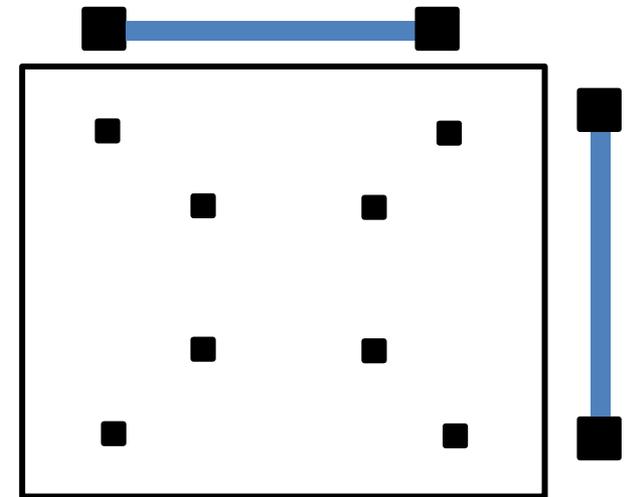


- Stress and offset have strong correlation!

Current Research: MEMS gyro

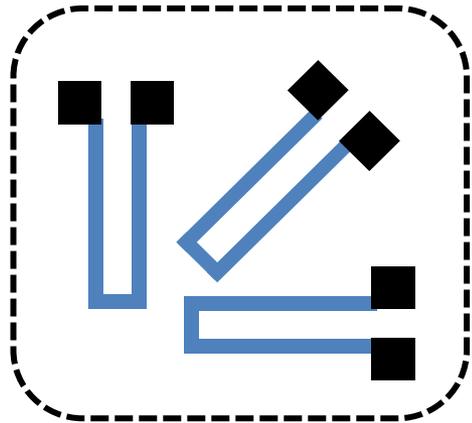


HRG,
 \$100k per axis

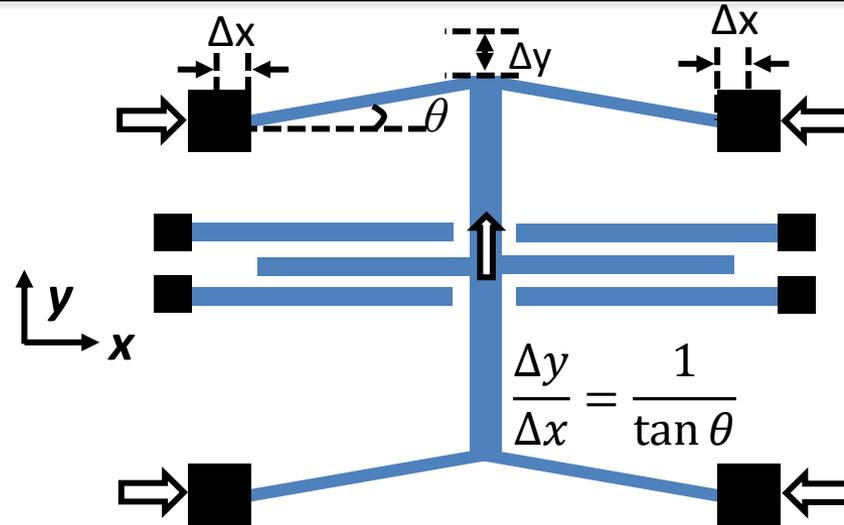


- A circular gyro with by circular stress sensors
- More accurate stress measurement

- Distributed anchors
- Anchor stresses cannot be measured directly



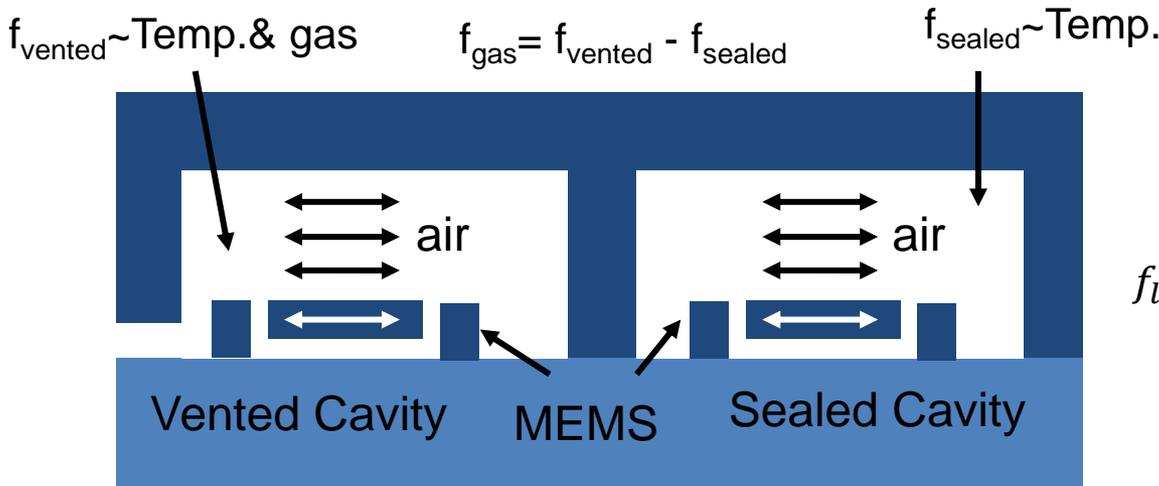
Stress rosette for x, y and shear stress



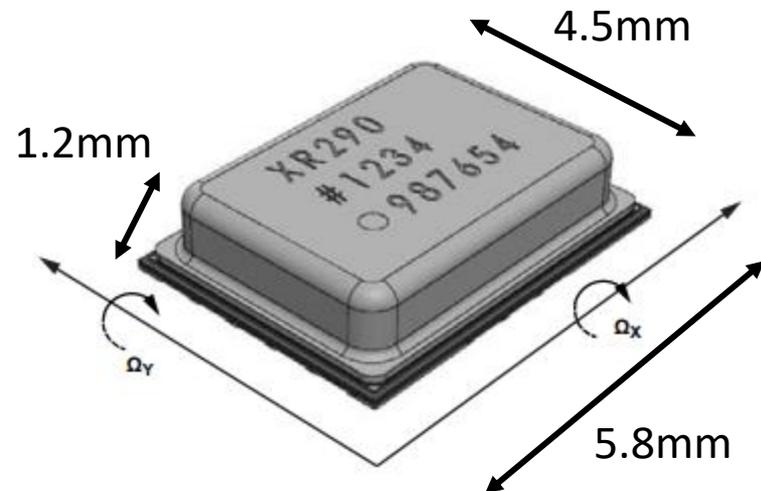
- Capacitive bent beam stress sensor
- Y. B. Gianchandani, JMEMS 2002

- Capacitive stress sensing also possible
- Die attaches, a universe. Investigation of die stress for different die attaches and die mount techniques with a rosette

- Exciting an acoustic resonance in a cavity with MEMS
- Universal gas sensor
- Speed of sound c_{ideal} in each gas is unique
- Also monitor damping for gas selectivity



$$f_{lmn} = \frac{c_{ideal}}{2} \sqrt{\left(\frac{l}{L_x}\right)^2 + \left(\frac{m}{L_y}\right)^2 + \left(\frac{n}{L_z}\right)^2}$$



ADXRS290, 2 axis roll-pitch
gyro from ADI

- Industry and academia experience on MEMS inertial sensors
- MEMS sensor research
- MEMS gyroscope drift problem
- Acoustic gas sensing
- More research on neural imaging with E field sensing
- Developing sensors based on the principles nature senses the environment