



מערכות ממוזערות וחומרים

פרופ' סלבה קרילוב (640-5930)
vadis@eng.tau.ac.il

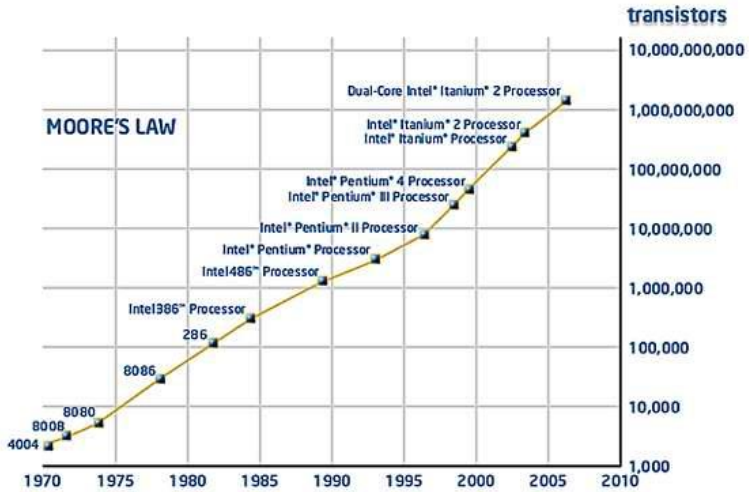
טכנולוגיה של מוליכים למחיצה + רכיבים מכניים = מערכות זעירות

מס' קורס	שם הקורס	מס' שעות
0542-4722	מבוא למערכות זעירות (עם מעבדה)	4
0542.4720	התנהגות מכנית של חומרים	4
0542.4291	מעבדה בחומרים הנדסיים	1
0542.4220	תורת התנודות	4
0542.2300	מכניקת מוצקים (2)	4

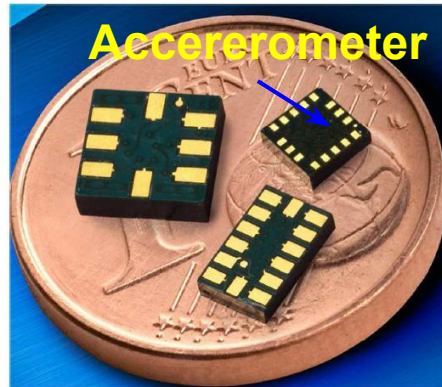
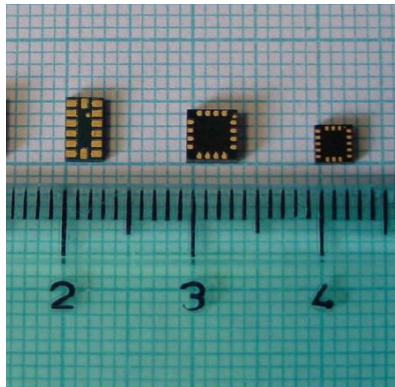
ההודעה על הקורס המחליף את ההתנהגות המכנית תבוא בהמשך

What is MEMS About?

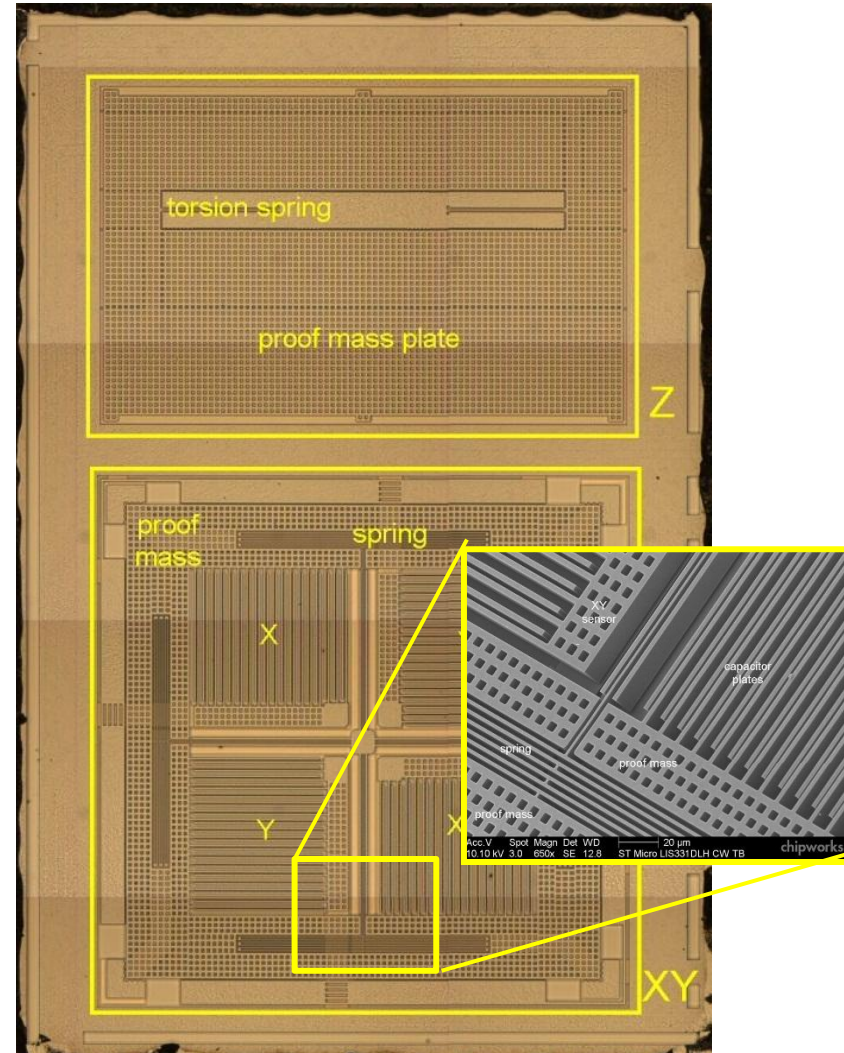
Semiconductor technology and miniaturization



+mechanical elements = MEMS



iPhone Accelerometer



by St.J. Dixon-Warren



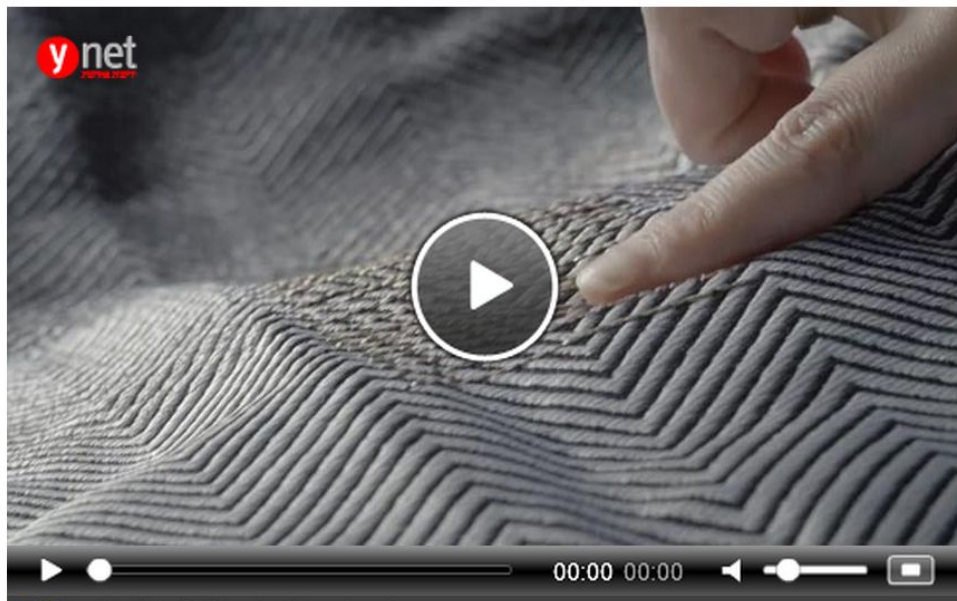
Outlook

לשלוח SMS מהחולצה: הקיץ תלבשו "גוגל ג'ינס"

ענקית האינטרנט מפתחת יחד עם ליוויי'ס בגדים שיפעלו בדומה למסכי מגע. איך זה יעבוד?

 Recommend 33

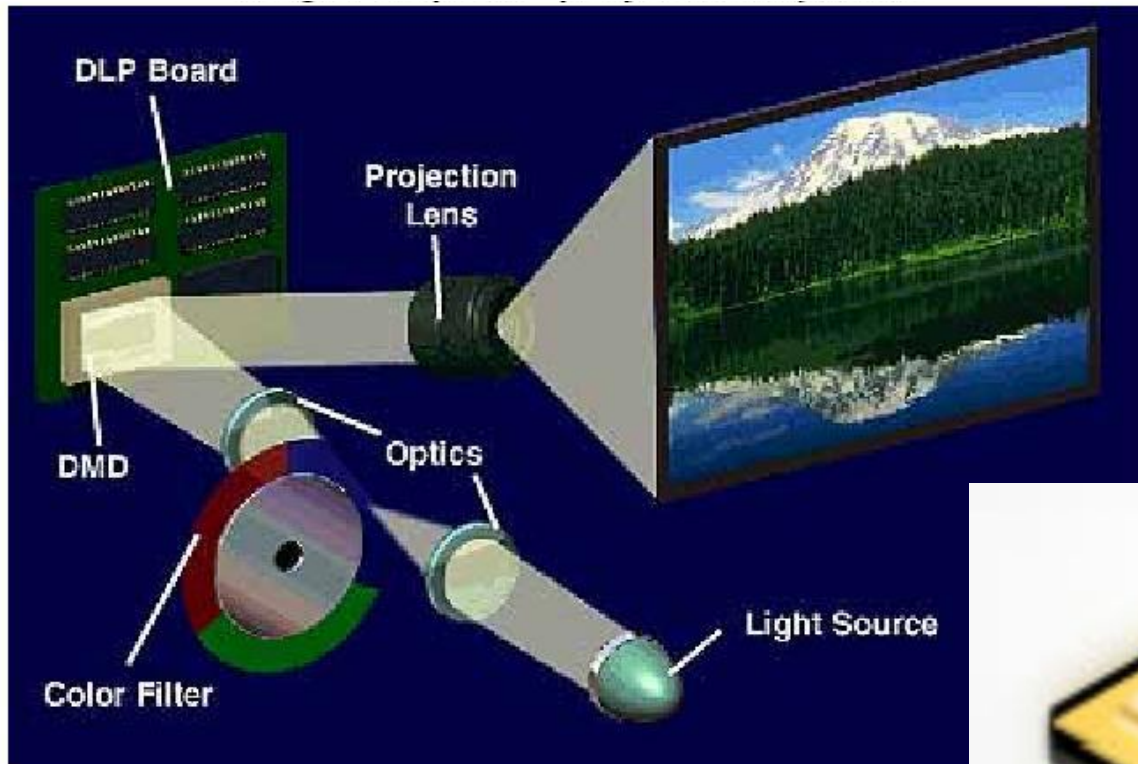
פורסם: 30.05.15, 10:02 |  AFP





יישומי MEMS

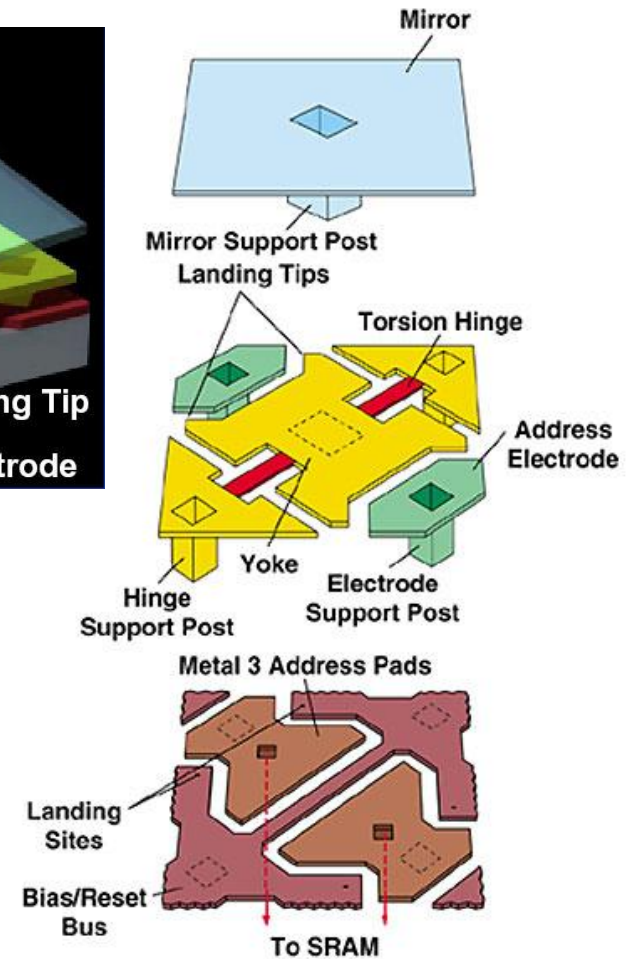
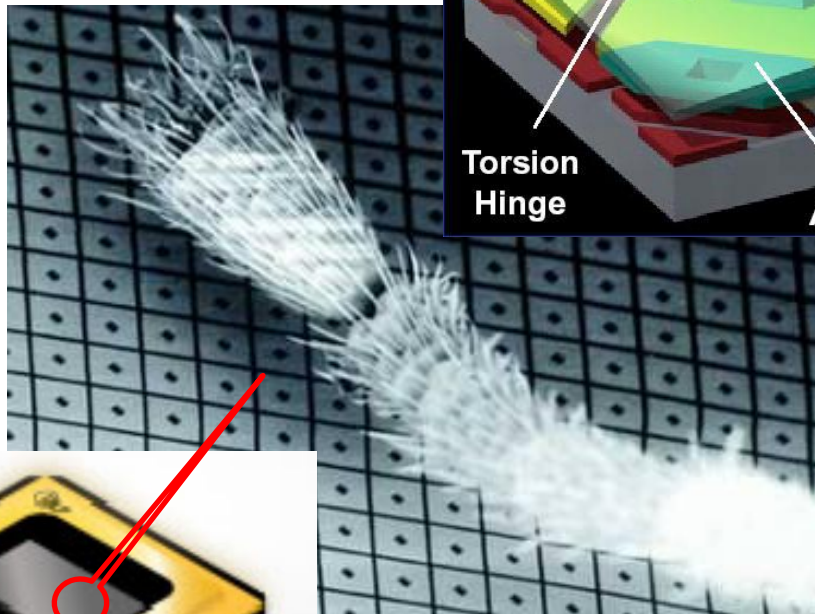
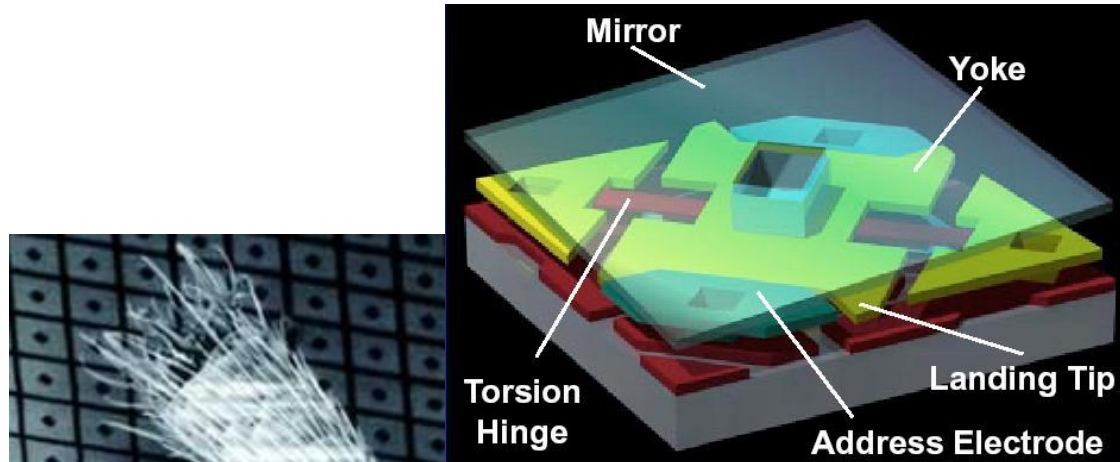
TI chip-the most complicated mechanical system ever built





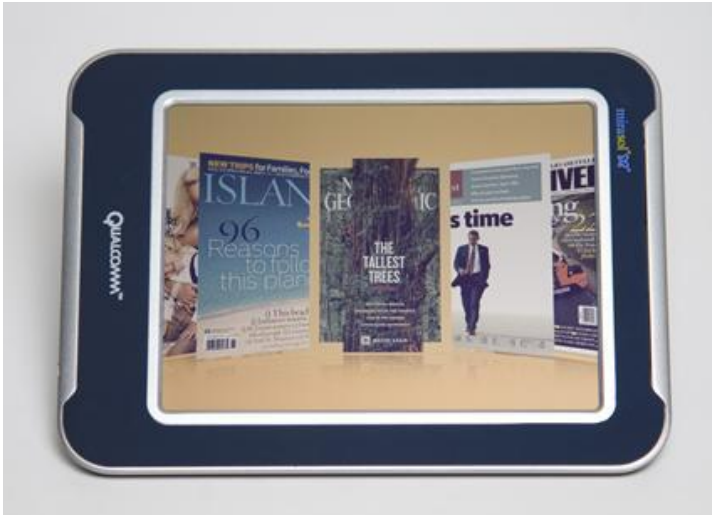
יישומי MEMS

TI chip-the most complicated mechanical system ever built

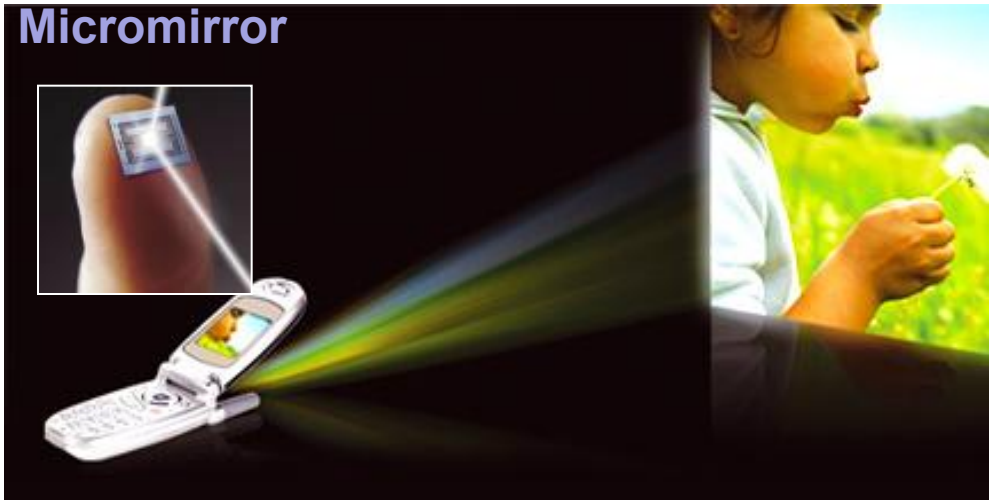


יישומי MEMS

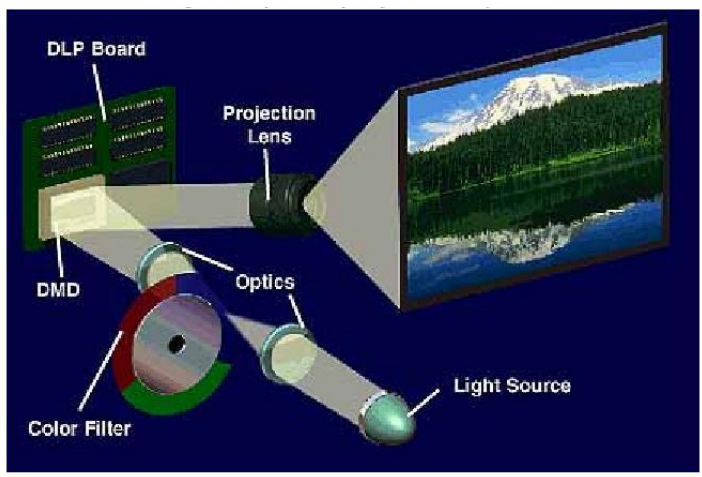
מסכים



מקרנים

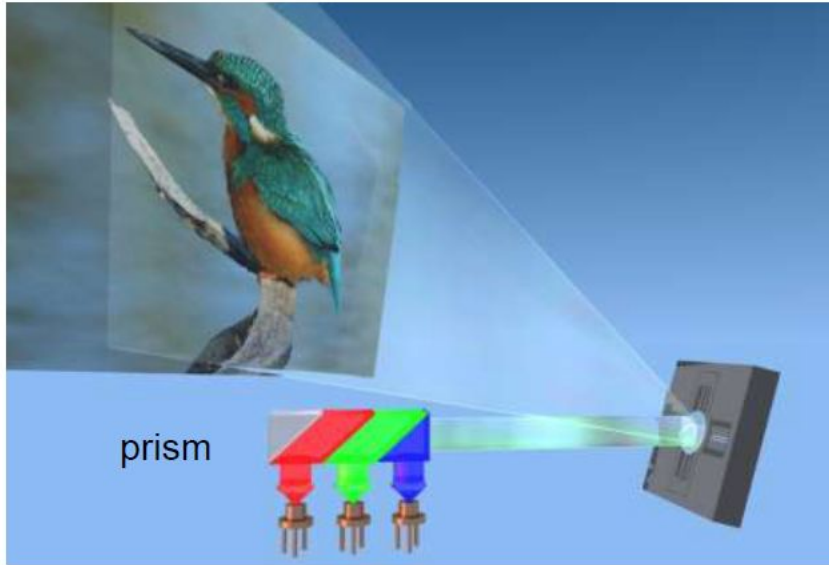


Wearable displays





Laser Scanners



prism

laser

MEMS mirror



embedded pico-projectors



Automotive head up & dashboard displays



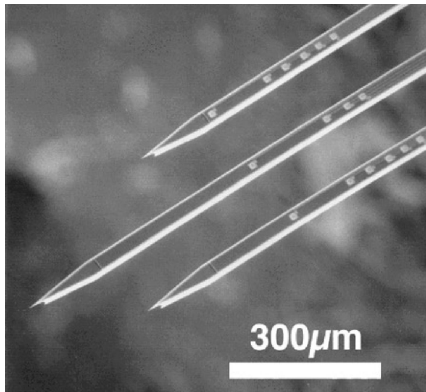
Fraunhofer ISIT





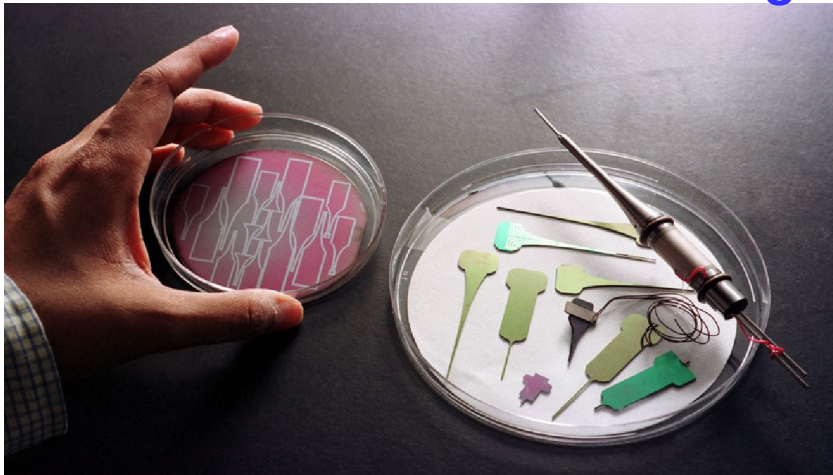
Examples of Medical MEMS

Microfabricated neural probes



D.T. Kewley et al, Sens Act. 58, 1997

Micromachined ultrasonic cutting tool



A. Lal, IEEE Eng. in Med. Biology Soc.1998.

Implantable wireless sensor for blood pressure monitoring

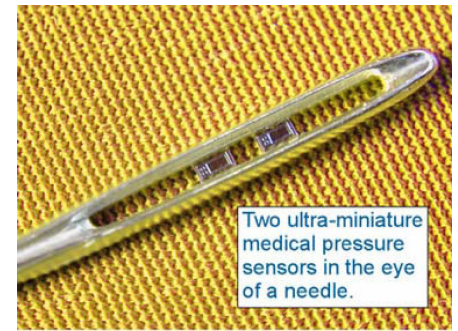
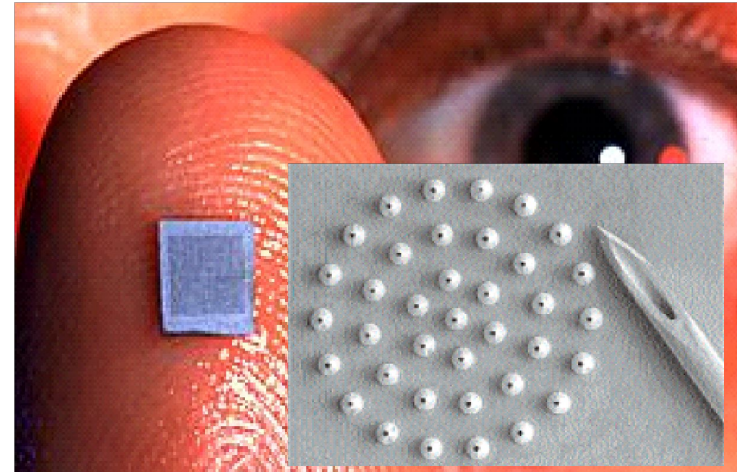


Figure 2 From ISSYS

CardioMEMS

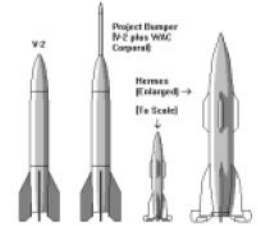
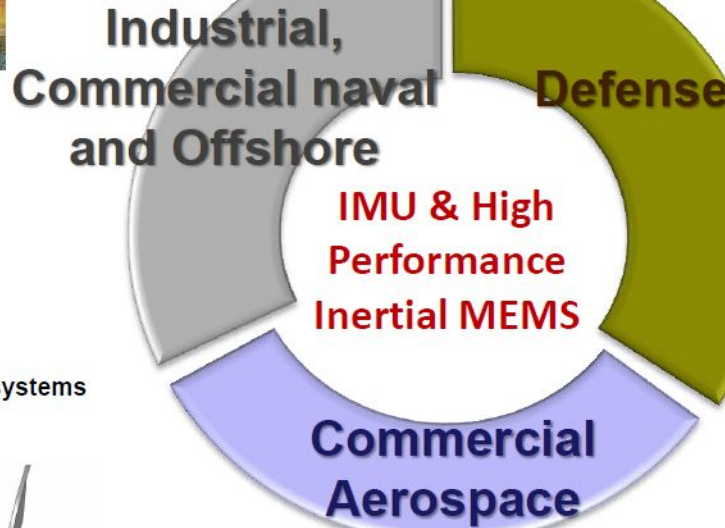
Drug delivery, painless



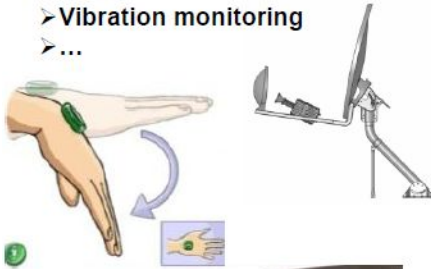
Inertial Sensors –Applications



- Agriculture
- AUVs
- Freight transport ship
- Healthcare
- High speed train
- Inclinometers
- Oil drilling heads
- ROV
- Satcom antenna stab
- Stabilization of optical systems
- Survey instruments
- UGVs
- Vibration monitoring
- ...



- Defense ships
- Defense transport aircraft
- Defense UAVs
- Guided munitions
- LAV/Artillery Guns
- MAV/Tanks
- Military & special mission helicopters
- Military fighters
- Military submarines
- Nuclear missiles
- Short, medium and long range missiles
- Soldier
- ...

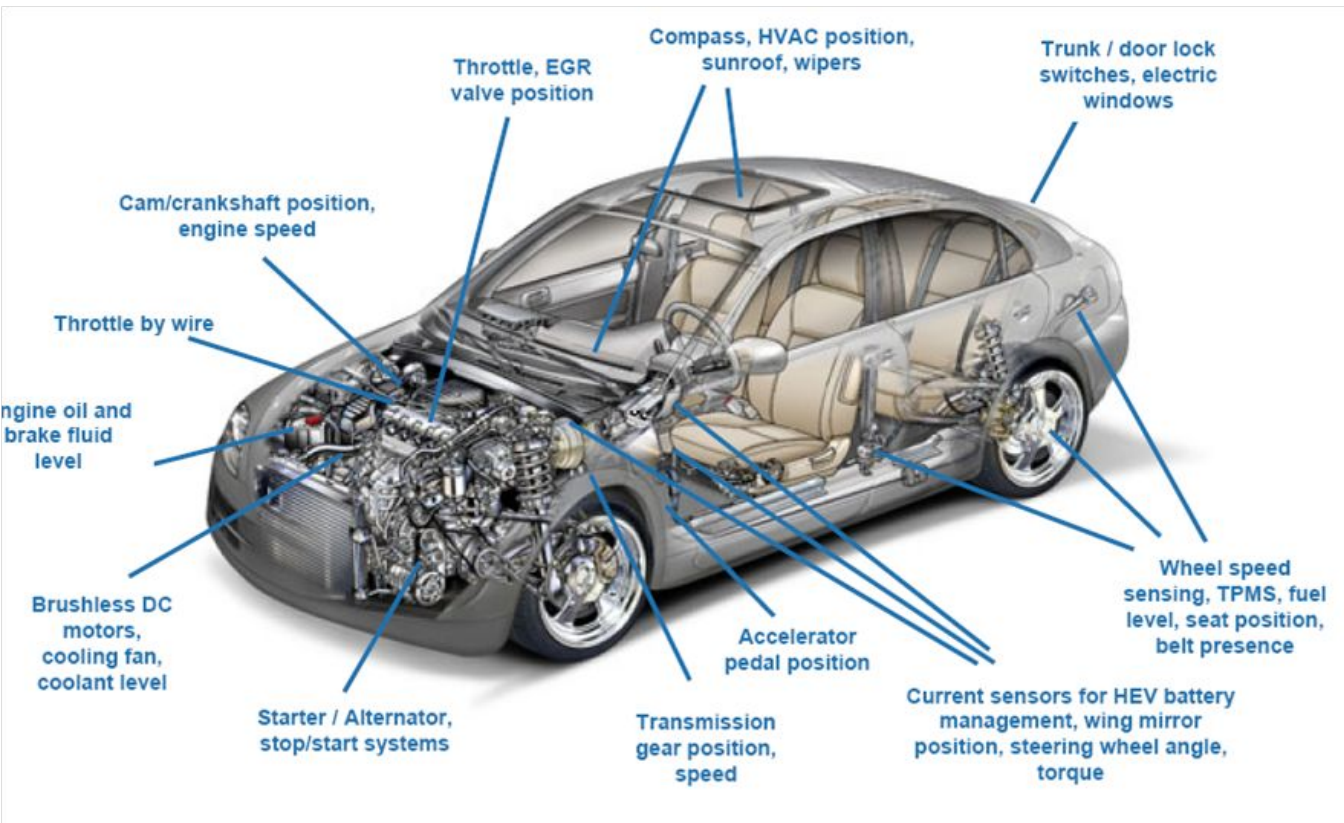


- Business Jets
- Civil aircraft
- Civil helicopters
- Civil and paramilitary UAVs
- General aviation
- Satellites
- Spacecrafts & skyrockets
- ...



Inertial Sensors – Automotive

Today's high-end vehicles feature up to **100 different sensors**. About 30 these are now MEMS. The market is made up of accelerometers, gyroscopes and inclinometers as well as pressure and flow sensors. Emerging applications include IR sensors for air quality, microscanners for displays and, further out, MEMS oscillators and energy scavengers for tire pressure monitoring (TPMS).



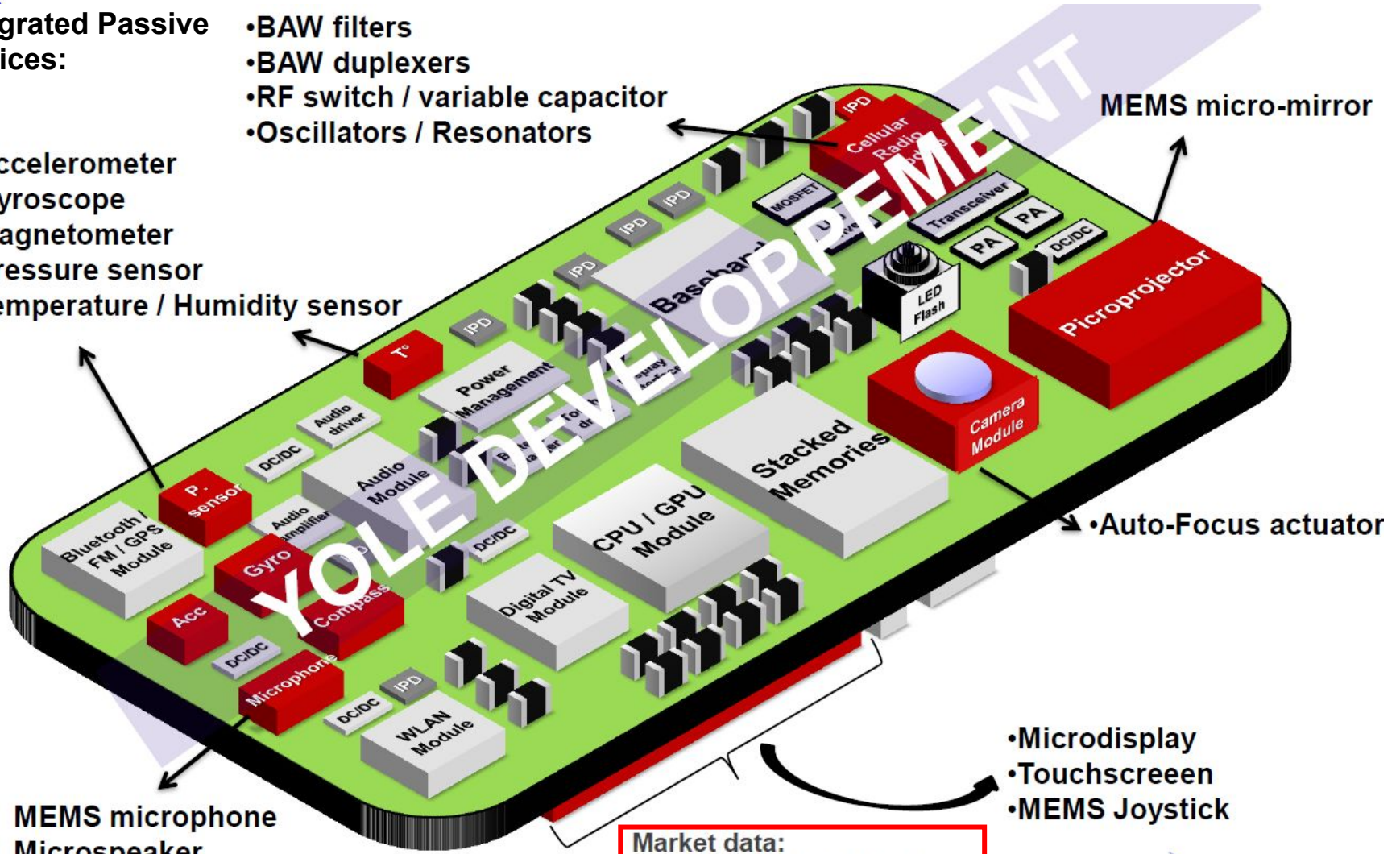


יישומי MEMS

Integrated Passive Devices:

- BAW filters
- BAW duplexers
- RF switch / variable capacitor
- Oscillators / Resonators

- Accelerometer
- Gyroscope
- Magnetometer
- Pressure sensor
- Temperature / Humidity sensor



- MEMS microphone
- Microspeaker

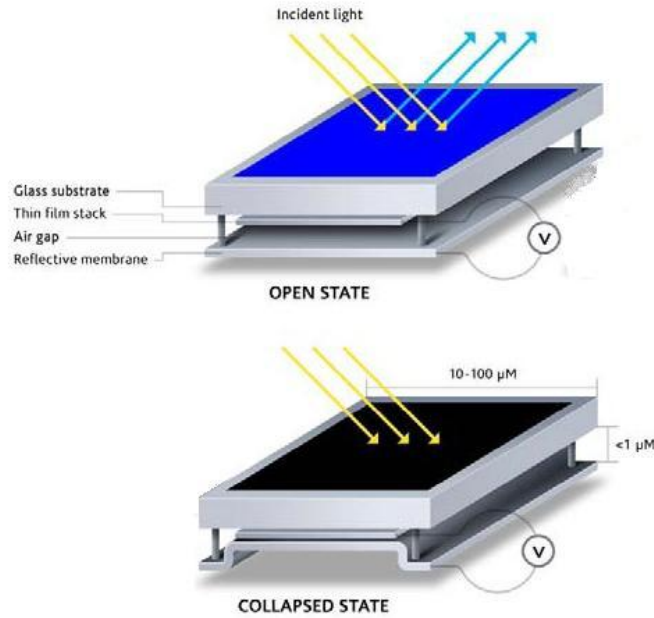
- Microdisplay
- Touchscreen
- MEMS Joystick

Market data:
 2013: \$451M; 472 Munits
 2018: \$1.40B; 3333 Munits
 CAGR₂₀₁₃₋₂₀₁₈: 30% (in value)

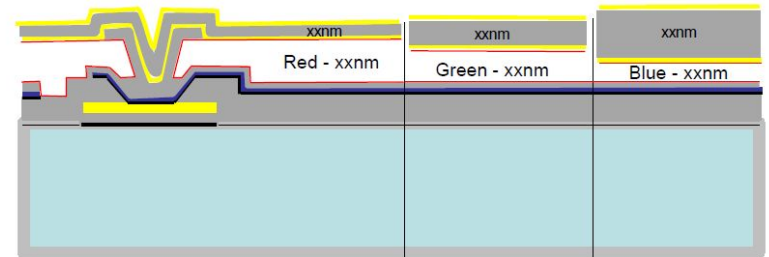
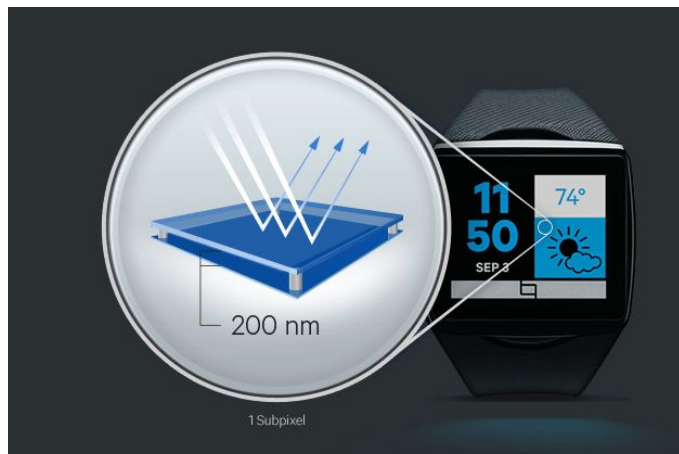
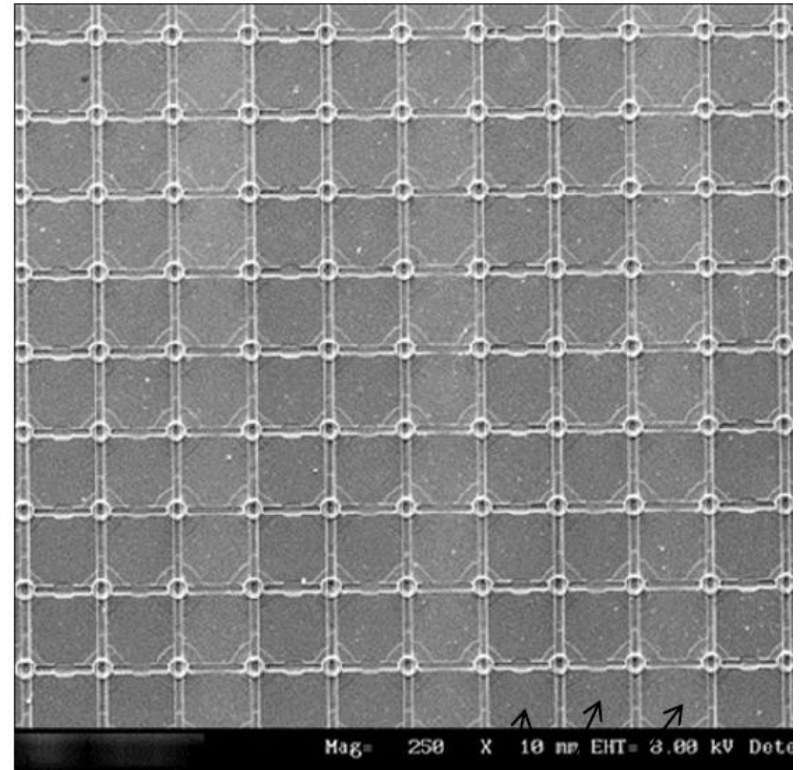
Source: Yole Développement

Reflective MEMS Display

The color is defined by the thickness of the gap



Arrays of the mirrors



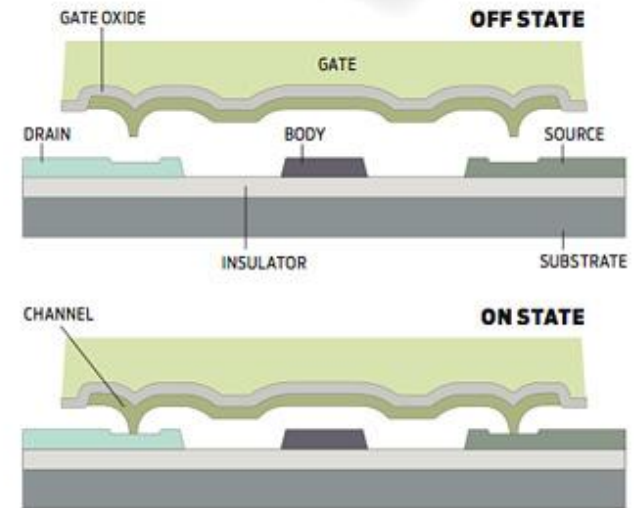
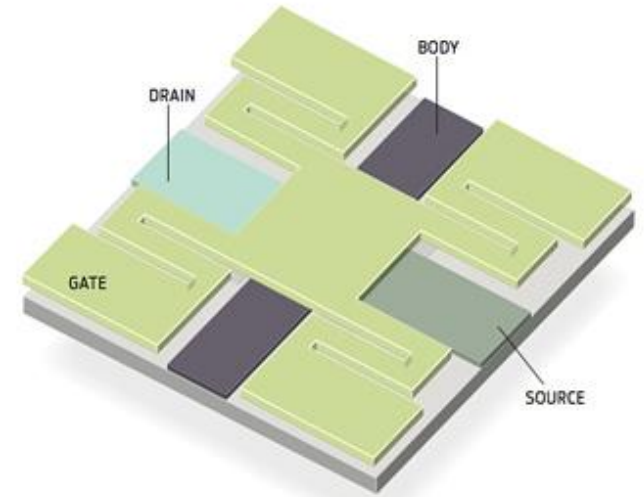
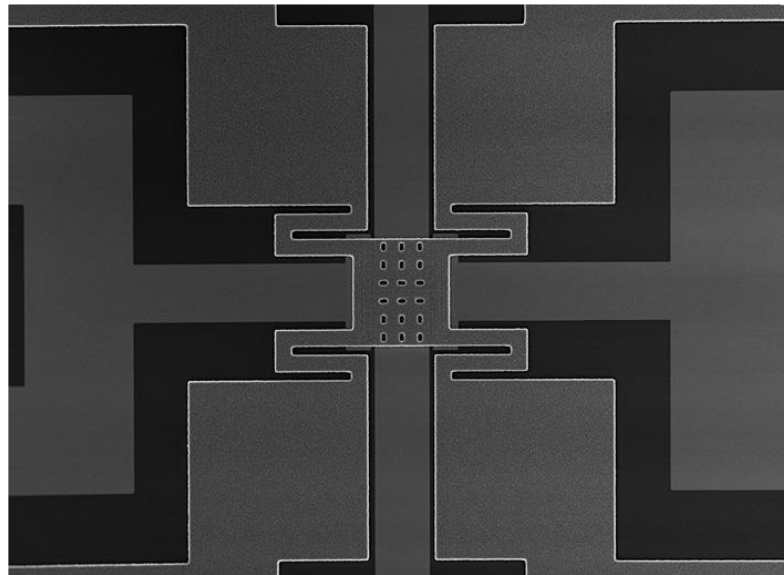
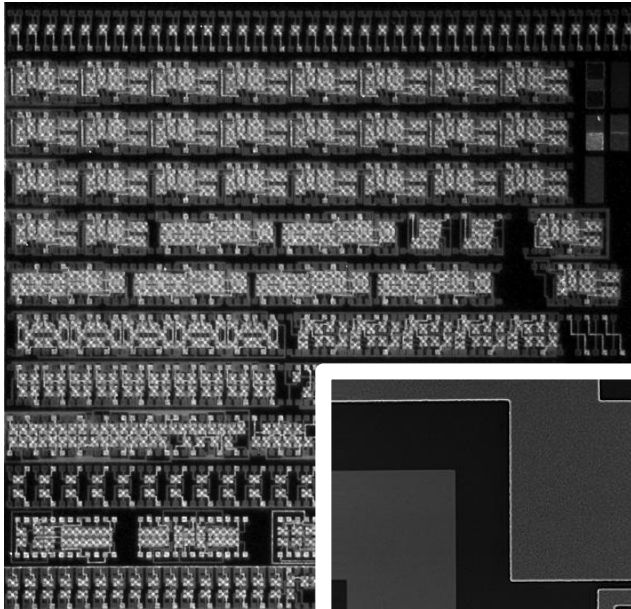
Source: Yole Développement

available at www.qualcomm.com



MEMS Logic

MEMS Switch array



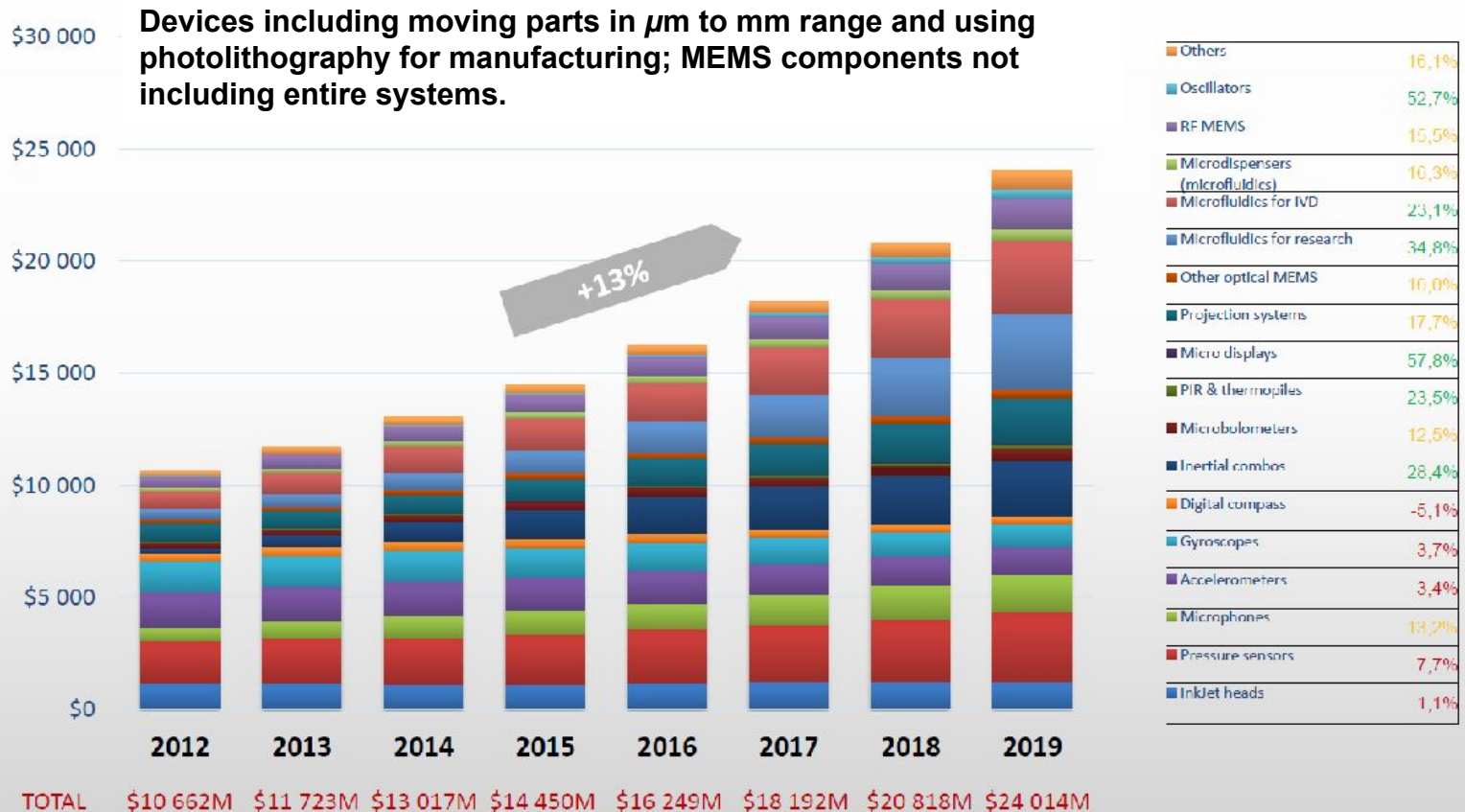
9- by 9-millimeter relay test chip contains a 100-relay multiplier (University of California, Berkeley, MIT)

IEEE Spectrum April 2014



MEMS Market

2012-2019 MEMS Markets (US\$M)



Yole Développement Copyrights 2014 - MEMS Tech Seminar 2014



Source: Yole Développement 2014

<http://www.yole.fr/index.asp>

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Devices Fabricated at TAU

