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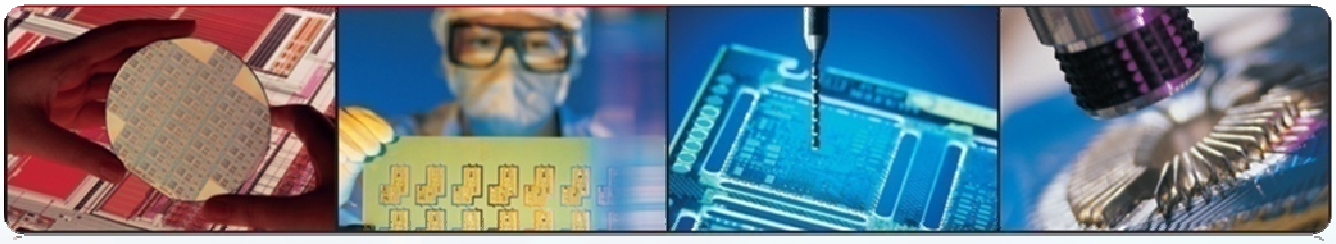
Hannover Messe 2010

Comparison of Key Factors for Successful Commercialization of Micromachined Pressure, Inertial and Flow Sensors

Dr. Thomas Link

Application Centre
MicroMountains Applications

April 20, 2010



The Application Center
MicroMountains Applications

- We are service provider for research, development, and manufacturing in Microsystems Technology

- Accelerating the transfer of technologies and know-how to industrial partners:

Development Process…

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The Application Centre

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…the Application Centre represent extensive experience and know-how of more than 500 technology experts.

Benefit for industrial companies

1. fast and cost-efficient access to micro technologies
2. just one contact
3. "best solutions" concept

Benefit for R&D-institutes:

1. Industrial requests
2. Initiate projects
3. Project Coordination

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-Competences in Microsystems Technology

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TECHNOLOGIES

- Thin film- & Thick film
- Photolithography,
- Wet & Dry Etching
- Bonding, PVD, CVD, Oxidation, Epitaxy
- Molding
- 3D-MID
- Precision Micromachining
- Surface machining
- Laser structuring
- Flexible substrates
- …

ENGINEERING

- CAD & Design
- Modeling & Simulation
- Assembly & Packaging
- Measurement & Test
- Analysis
- Circuit Design (ASIC, SMD)
- Embedded Systems
- System integration
- …

MATERIALS

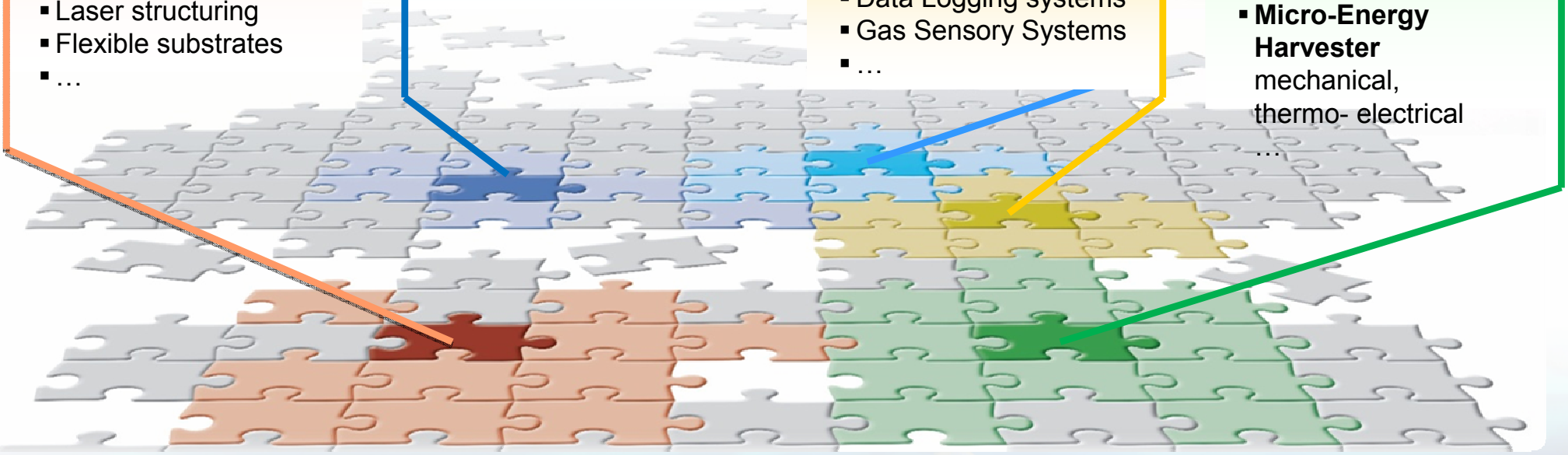
Silicon, Polymers
Metals, Ceramics
Glass, …

SYSTEMS, e.g.

- Multi-sensoric
- Multi-axial
- Dosage (µl-nl)
- Lab-on-Chip
- Data Logging systems
- Gas Sensory Systems
- …

Sensors / Actors

- **Micro sensors**, e.g. for angle, inclination, orientation, distance, position, force, pressure, acceleration, vibration, flow of fluids and gases
- **Micro actors, e.g.** pumps, switches, valves, dosage
- **Micro-Energy Harvester** mechanical, thermo- electrical
- …



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-Competences & Services

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Project Management
… time and cost efficient project management of heterogeneous projects

Technology and Market Analysis
… continuous monitoring of recent and future technologies and market requests

Innovation Workshop
… supporting your strategic planning with future technologies

Business partners
… identify and incorporate partners for the development and production chain

Financing
… incorporate partners and concepts for financing your next project

Patent Research
… supporting patent research with technological expertise

Technology and Know-how Transfer
… transferring processes and product specific know-how to our customer

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Comparison of Key Factors for Successful Commercialization

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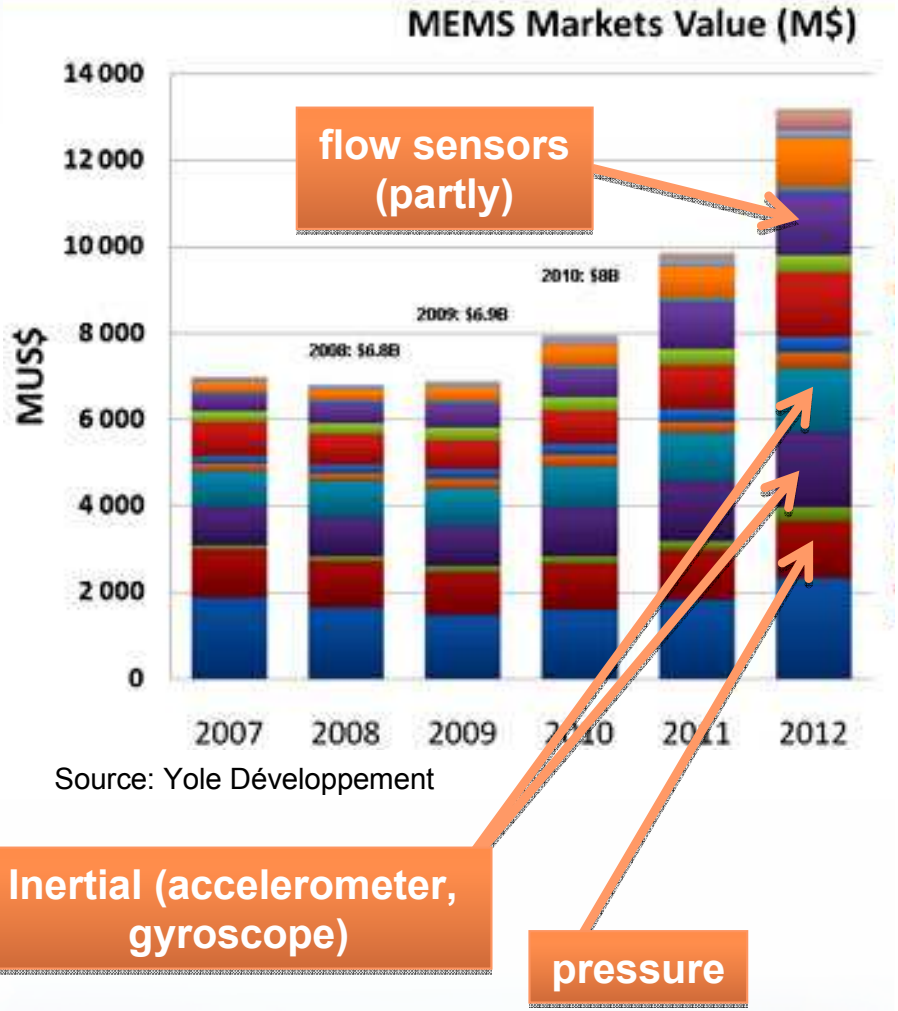
- Why to compare pressure, flow and inertial sensors
  - Some of the most successful MEMS based sensors today
  - … they differ, not only in their measured variable
  - … and successful MEMS sensors do not only have to use „silicon material and clean rooms“
- Benefits from miniaturisation:
  1. higher performance
  2. new functionalities
  3. lower cost



Source: Yole Développement

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Miniaturised / Micromachined Pressure Sensors

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- Pressure Sensors
  - measuring the pressure (force per unit area)
  - absolute, relative, differential pressure
  - often using membranes
  - piezoresistive or capacitive principles

Example of micromachined piezoresistive pressure sensor

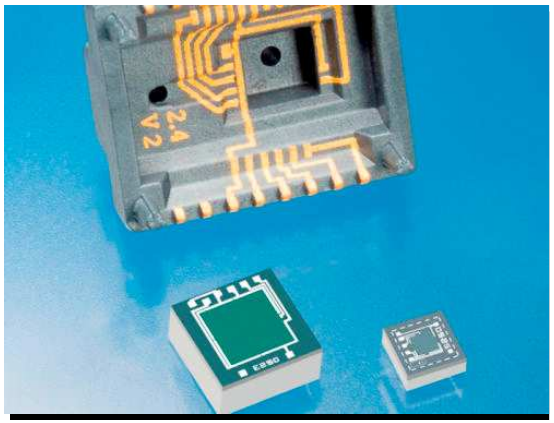
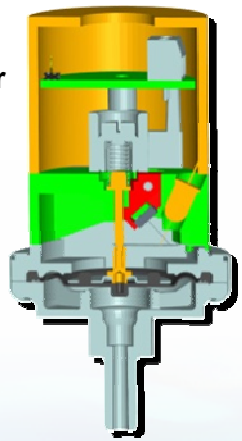


Image: www.harting-mitronics.ch

- General Characteristics
  - Sensor has physical contact to measured variable
  - Complexity (e.g. of piezoresistive) is mid / low, requires no complex readout electronics, sensor often base on standard technologies

Example of low pressure sensor



  - today approx. 5000 manufacturer exists world wide (macro/micro technologies)

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Example: Low Pressure Sensors at MicroMountains Applications

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- Industrial low pressure sensor developed at the application center
  - elastomeric membrane as basis for continuous detection of deformation
  - switch in the low pressure range (threshhold 100mbar) based on optical measurement principle and discrete low cost components
  - partners: Beck Druckmesstechnik GmbH, HSG-IMIT, IMTEK, MicroMountains Applications

beck

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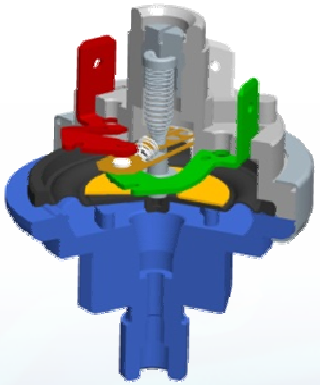
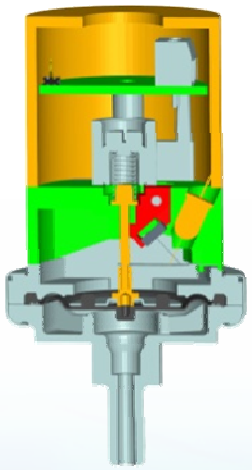
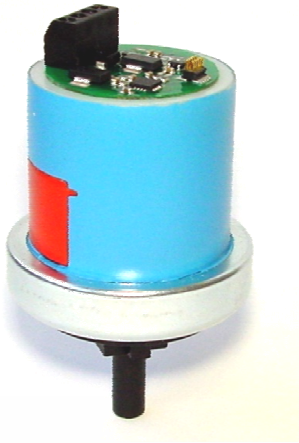
HSG-IMIT IMTEK







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Miniaturised / Micromachined Flow Sensors

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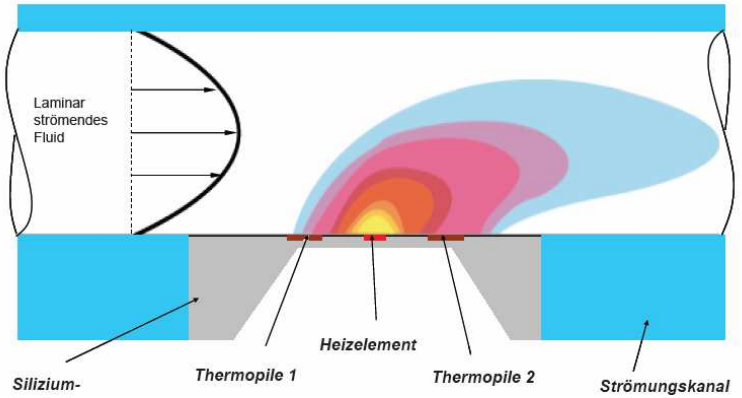
- Flow Sensors
  - measuring the flow of gases or fluids
  - often using thermal (anemometer) principle



- General Characteristics
  - physical contact to measured variable (aspects as flow control, protection against corrosion)
  - complexity (e.g. of anemometer) is mid / low, requires no complex readout electronics, based on standard technologies
  - today approx. 4000 manufacturer exists world wide (macro/micro technologies)

HSG-IMIT

Flow Sensor for air conditioner
Gruner AG

Air Velocity Measurement
Schmidt Technology GmbH

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Micromachined acceleration and inclination sensors

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- accelerometer
  - measuring inertial force (in relation to earth gravity called inclinometer)
  - translational or rotational
  - often using spring-mass-damper systems
  - piezoresistive, capacitive or piezoelectric principle

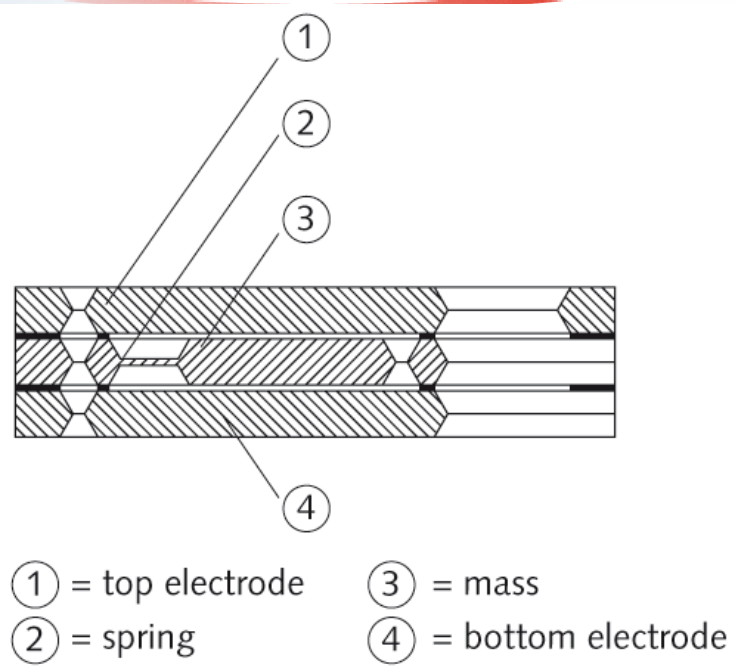


Image: www.kistler.com

- General Characteristics
  - no pysical contact to „media“, hermetical packaging possible
  - complexity is mid
  - today approx. 1000 manufacturer exists world wide (macro/micro technologies)

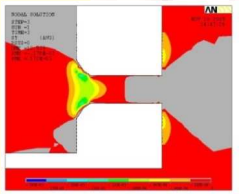
Accelerometer Exmaple
(for movements and inclination)

MEMS Crash-Test-Sensor

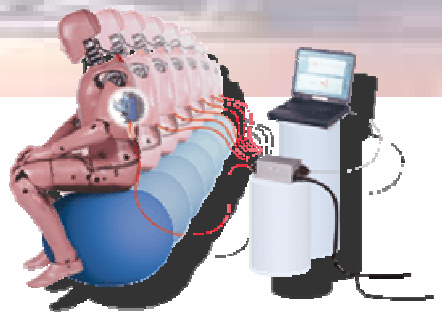
Piezoresistive MEMS acceleration sensors involved in crash test for the car development

KISTLER
measure. analyze. innovate.

Measurement range: up to 1000g
Overload up to 10.000g
High sensitivity and linearity
Small and light weight (< 1 gram)
Non-linearity: < 0.3 %
Dynamic range: <25mg…>500g (> 20000)
Size: < 4 x 4mm²



References of Kistler IGeL GmbH



See more at
Hall 2, Stand C24
Hall 6, H16, E4

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Inclinometer for high precision and low cost based on innovative PCB hybrid technology

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First Products:

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Micromachined gyroscope sensors

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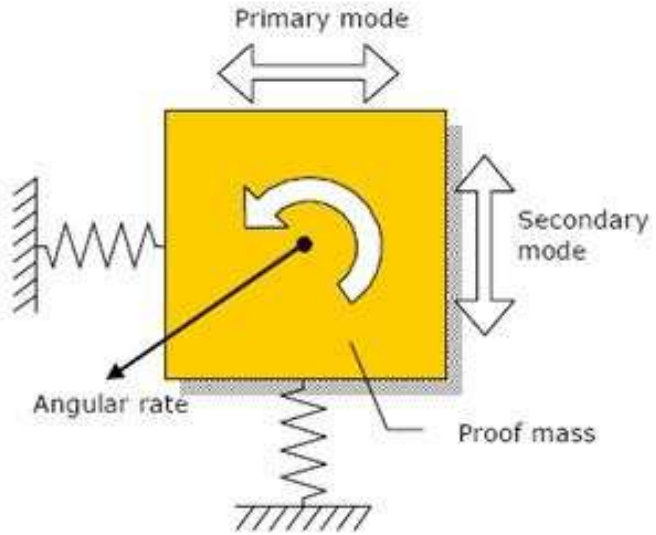
- Gyroscopes
  - Measuring rotational velocity
  - often used coupled spring-mass-damper systems by Coriolis effect
  - capacitive principle



knol.google.com

- General Characteristics
  - no pysical contact to „media“ (hermetical packaging)
  - Complexity: high, due to measuring principle and technological requirements
  - today approx. 20 manufacturer world wide (macro/micro technologies)

MEMS Gyroscope Appliations (ST Microelectronics)

Example: MEMS Gyroscopes at MicroMountains Applications

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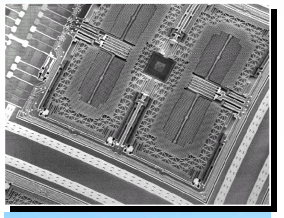
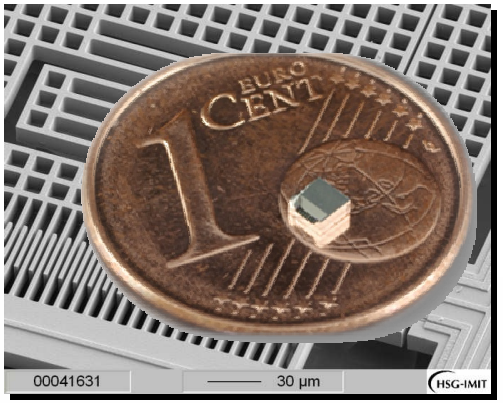
- Low cost, high-performance programmable angular rate sensor for automotive market
  - Applications: Navigation (dead reckoning), Robots, Advanced driving assistant systems (ADAS)

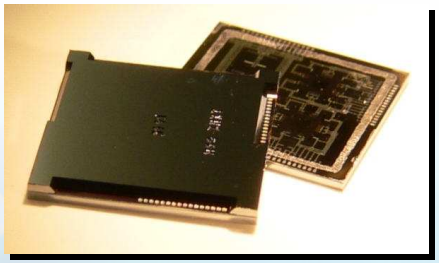


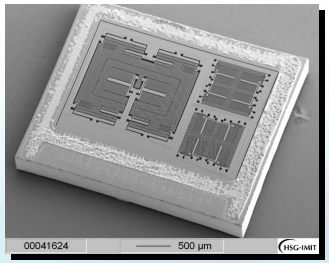
- Latest development
  - One of the world's smallest MEMS Gyroscope
    - DIE size: 1,8mm², MEMS Structure: 800x600 µm²

HSG-IMIT



  - Multi-axis MEMS Gyroscope on one chip





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MicroSystemTechnology is your way - MicroMountains your partner !

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