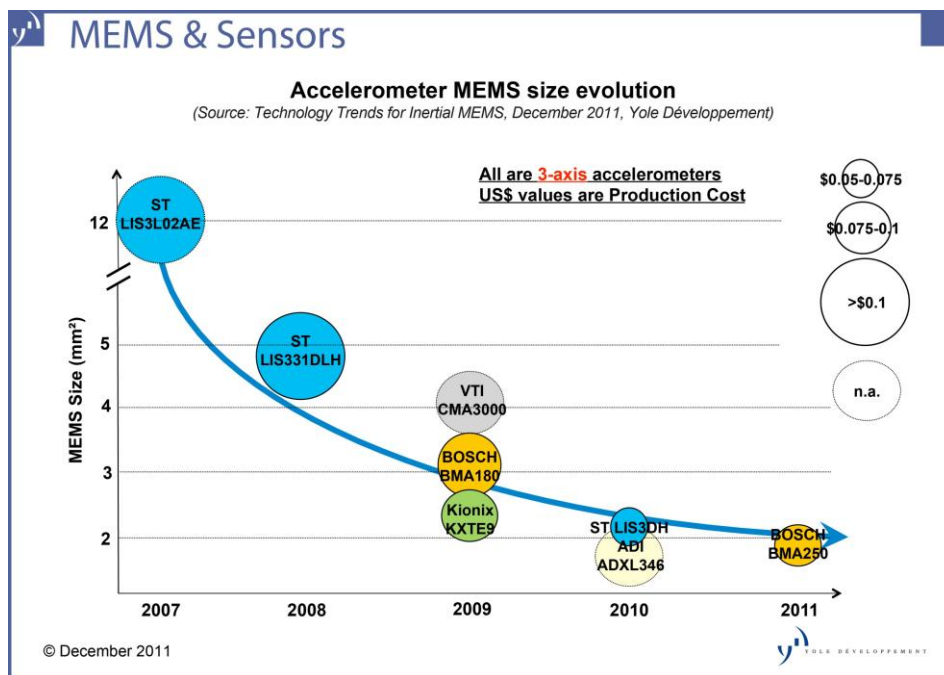


**“A comparative analysis of 23 MEMS devices from 13 different manufacturers!” announces Yole Développement**

**“Technology Trends for Inertial MEMS”**, a report from Yole Développement

Lyon, France - December 22, 2011 – Yole Développement announces its report “Technology Trends for Inertial MEMS”. Yole Développement’s analysis is composed of two volumes: Volume 1 is dedicated to the market & technological evolutions of inertial MEMS & magnetometers. The 2nd part, Volume 2 is the reverse costing analysis.

In this report, Yole Développement provides an understanding of the market drivers for inertial MEMS (Consumer, automotive and high-end applications). It also presents trends about packaging and tests strategies. This analysis includes 23 MEMS devices.



**Major market drivers & technical answers in inertial MEMS & magnetometers**

Over the last 3 years, inertial MEMS & magnetometers have been subject to dramatic market & technological evolutions. This has been driven by a large increase of the consumer market: mobile phones and tablets for accelerometers; gaming for gyros; mobile phones for magnetometers.

Along with “stand-alone” MEMS devices, inertial combo sensors, a combination of several inertial sensors into a single package, are also coming. Main applications are consumer (e.g. accelerometer with magnetometer or accelerometer with gyro) and automotive for ESC and rollover functions first.

“Inertial MEMS & magnetometers are today driven by 4 major market trends”, explains Laurent Robin, Activity Leader, Inertial MEMS Devices & Technologies at Yole Développement.

They are:

- Future generation of sensors will deliver functions and will become “solutions”
- Fusion of sensors (combining data from different sensors) is starting to be widely used

- New architectures are developed
- Price pressure is still very strong (5% drop per quarter for consumer applications).

On the technical side, form factor is ever decreasing with reduced footprint and thickness. And power consumption has been reduced to a few microA while performances are still increasing. The most successful type for inertial MEMS is based on capacitive transduction. Reasons are simplicity of the sensor element, no requirement for exotic materials, low power consumption and good stability over temperature. But will comb-drive architecture for accelerometers continue to be the main detection principle as MEMS die size keeps shrinking?

Regarding gyroscopes, most are falling into the categories of tuning vibrating fork/plate (STM, Bosch) or vibrating shells (Silicon Sensing Systems). This very common design gives ease of fabrication and possible integration in standard IC manufacturing industry.

For magnetometers, Hall Effect has been the dominant technology for a long time, but today it is changing as Magneto Impedance, Giant Magneto Resistance and Anisotropic Magneto Resistance are used. A new approach, Lorentz effect based on MEMS technology, is currently in R&D (VTT and others). This could bring easier integration in MEMS combo sensors.

### **MEMS testing will have to evolve**

*“Testing has been also subject to strong evolution over the last years”*, announces Dr. Eric Mounier, Senior Analyst, MEMS Devices & Technologies at Yole Développement. For example, combo sensors will require new test solutions compared to “stand-alone” sensors. Beyond the usual wafer-level electrical test and package-level electrical and mechanical or functional testing, these sensor combos will need module level testing and calibration of the combined sensors. If they include an MCU in the package, the communication between the sensors and the MCU will also need to be tested. Solutions need to be cost effective with high throughput to test multiple axes of multiple devices, either in parallel or in separate modules, rather like separate chambers in IC equipment.

The world of MEMS testing has moved in the last several years from internal development at MEMS makers to co-development with test suppliers to commercial off the-shelf equipment. So combo solutions that can test all axes of the module in a single tool for higher throughput will also likely be co-developed with the test equipment suppliers and available commercially. Assembly and test houses may also start to offer these test services on an outsource basis for fabless or fab-light MEMS makers. The Yole Développement report will analyze the latest trends in MEMS testing.

### **Comparative analysis of 23 MEMS devices from 13 different manufacturers!**

In order to understand the key evolutionary changes, a total of 23 different MEMS devices (9 accelerometers, 10 gyros, 3 combos and 1 magnetometer) - mostly consumer MEMS – have been disassembled, analyzed and cost simulations have been constructed for MEMS, ASIC and Packaging/Test. One of the key features of the reports is that ASICs have been analyzed as well. The MEMS have been analyzed and production costs have been simulated by System Plus Consulting, the reverse costing specialist company. The teardown analysis results have been compared in terms of performance, total cost, MEMS size, ASIC lithography node, ASIC size, package size, year for market introduction.

From its analysis, Yole Développement found there is a clear MEMS die size decrease over 2007-2011. For example, in 2008, the average size for an accelerometer (3- axis) was 4-5 mm<sup>2</sup>. 3 years later, size is about 2 mm<sup>2</sup>. ASIC size has been following the same trend with a lithography node in the range 0.18-0.35µ today. *“With latest ST announcement about the use of through silicon vias for inertial, we can expect even lower cost and size in the future”*, says Laurent Robin. The same analysis has been performed for gyros comps, combos and magnetometers.

### About Technology Trends for Inertial MEMS report:

- **Authors :**

**Dr. Eric Mounier** has a PhD in microelectronics from the INPG in Grenoble. He previously worked at CEA LETI R&D lab in Grenoble, France in Marketing dept. Since 1998 he is a co-founder of Yole Développement, a market research company based in France. At Yole Développement, Dr. Eric Mounier is in charge of market analysis for MEMS, equipment & material. He is Chief Editor of Micronews, and MEMS'Trends magazines (Magazine on MEMS Technologies & Markets).

**Laurent Robin** is in charge of the Inertial MEMS & Sensors market research at Yole Développement. He previously worked at image sensor company e2v Technologies (Grenoble, France) and at EM Microelectronics (Switzerland). He holds a Physics Engineering degree from the National Institute of Applied Sciences in Toulouse. He was also granted a Master Degree in Technology & Innovation Management from EM Lyon Business School, France.

- **Catalogue price:** Euros 6,990.00 Vol. 1&2 (Analysis & Reverse costing reports, single user license) - Publication date: Dec. 2011.  
For special offers and the price in dollars, please contact David Jourdan (jourdan@yole.fr or +33 472 83 01 90).

- **Companies cited in the report:**

Accutronic, Advanced Microsensors, Advantest, Afore, Aichi, AIS/SSS, AKM, Analog Devices, ASE, Baolab, Bosch Sensortec, CascadeMicrotech, CEA Leti, Colibrys, Epson Toyocom, Freescale, Gladiator Technologies, Honeywell, Invensense, Jyve, Kionix, KYEC, Litef, Memsic, Multitest, Murata, Panasonic, Polytec, Qalitre, Rohm, Sensoror, Sensordynamics, Sony, SPEA, SSS, STM, Systron Donner, TEL, Teradyne, Thales, Tronics, VTI, VTT, Yamaha...

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Beginning in 1998 with Yole Développement, we have grown to become a group of companies providing market research, technology analysis, strategy consulting, media in addition to finance services. With a solid focus on emerging applications using silicon and/or micro manufacturing Yole Développement group has expanded to include more than 40 associates worldwide covering MEMS, Microfluidics & Medical, Advanced Packaging, Compound Semiconductors, Power Electronics, LED, and Photovoltaic. The group supports companies, investors and R&D organizations worldwide to help them understand markets and follow technology trends to develop their business.

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