High performance motion sensing is gaining interest in many industries. In the military & aerospace areas, the use of Inertial Measurement Units (IMUs) and other systems based on high-performance gyroscopes has been widespread for navigation, flight control or stabilization functions for decades.

Today we now see many industrial and healthcare applications emerging, driven by the possibility to integrate new functionality at low cost, mostly thanks to the recent developments in MEMS accelerometer and gyroscope technology.

The market for IMUs is estimated to be $1.55B in 2009, dominated by defense and aerospace applications. Yole sees this market growing at a 9% annual growth rate, to reach $2.60B in 2015. Industrial, commercial naval and offshore applications will be the most dynamic with 16.5% yearly growth, when the aerospace and defense markets will be limited to a 5.5% and 6.8% annual growth.

Several technologies are currently on the market, RLG and FOG-based systems being the most widespread and still benefiting from progresses in photonics. However the recent and rapid development of tactical-grade MEMS gyroscope technologies has the largest impact on the market landscape and on the competition. It is crucial for the companies involved in those markets to invest in the right technologies and partners, depending on the end-markets which are targeted. Different strategies are observed: some companies carefully invest in selected technologies like the market leader Honeywell, while others love all inertial technologies, like Northrop Grumman.

MEMS industrial and tactical-grade type of sensors is the most dynamic technology. Yole sees the market growing from $361.8M in 2009 to $604.6M in 2015 for single MEMS accelerometers and gyroscopes or assembly of MEMS accelerometers / gyroscopes. However many technical and commercial challenges are predicted for the players involved in MEMS: how to guarantee a high level of vacuum for keeping high performance over the years, how to bring down the costs when most of the applications are in the 100 or 1000 unit z like ITAR, what are the best business partners to enter new markets which are sometimes captive...

The recent availability of tactical-grade MEMS IMUs is clearly attractive for a wide range of applications. Indeed many applications will find interest in low-cost devices while it also opens new market opportunities such as precision guided munitions or small size UAVs. This explains why nearly each major IMU manufacturer has a MEMS technology today, although the status of developments is not the same for all players.
This report is more than a simple update of the "IMU market 2007-2012" report. The involvement of Yole Developpement on the high-end inertial market has continued to grow in the last couple of years, with discussions with key companies involved in the field all over the world and participation in many conferences. Although this market remains very complex to monitor, with a wide range of technologies, applications and players, Yole has been able to make a few modifications since the last version to be closer to the reality when it comes to IMU prices, penetration, number of systems in each vehicle, and market shares. Moreover, a complete analysis of the impact of MEMS technology and on the geographic description of the market (including the dynamic Asian and Israeli markets) has been included. Yole also had the chance to have Mike Perlmutter, who has more than 30 years of experience in the inertial navigation industry, provide an important contribution to this report.

The objectives of this report are the following:

- **Gyroscope technologies:** DTG, RLG, FOG, HRG, Quartz, MEMS
- **Accelerometer technologies:** Electromechanical pendulous type, Piezo, MEMS
- **Level of performance:** Industrial, tactical, inertial navigation and strategic grade
- **Worldwide market metrics:** 2009 – 2015 market ($M, M units, ASP)
- **2009 market shares**
- **150+ companies cited in the report**
- **Report is a 300+ slides PowerPoint presentation**
- **Excel datasheet included**
- **20+ key applications for IMUs are described:** Civil aircrafts, General aviation, Civil helicopters, Space satellites, Spacecrafts & skyrockets, Civil & paramilitary UAVs, Military fighters, Military transport aircrafts, Defense UAVs, Military & special mission helicopters, Missiles, Guided munitions, Combatant ships, Armored vehicles, Soldier equipment, Commercial ships, Underwater vehicles: ROVs, submarines, Oil drilling, Trains, Healthcare & sport, Antenna stabilization & pointing, Mapping instruments...
- **15+ applications described for MEMS accelerometers:** Pacemakers, Blood pressure monitoring, Physical activity monitoring, Seismic sensors – Geophones, Inclinometers, Antenna stabilization, Vibration monitoring, Directional drilling & borehole survey, Mapping instruments, Model helicopters & high end toys, UAVs flight control, Aircraft backup instruments, Cockpit instrumentation/AHRS, Missile Guidance, Precision Guided Munitions, Bombs & Rockets, Armored vehicles, Military training systems...
- **15+ applications described for MEMS gyroscopes:** Human motion capture, Physical activity monitoring, Antenna Stabilization, Directional drilling & borehole survey, Camera stabilization, Model helicopters and high-end toys, UAVs flight control, Backup instruments, Cockpit instrumentation, Missile Guidance, Precision Guided Munitions, Bombs & Rockets, Platform stabilization, Military training systems, Agriculture...

**KEY FEATURES OF THE STUDY**

- Architecture of the systems, functions that are used, new features and specification requirements
- Insight about future technology trends & challenges
- Pricing analysis and expected evolution
- To provide a deep understanding of inertial sensor value chain, level of integration & players
  - Quasi-exhaustive list of sensor manufacturers worldwide with technology offer
  - List of key integrators worldwide
  - Analysis on the new players and potential new entrants with MEMS technology

**REPORT OUTLINE**

- Gyroscope technologies: DTG, RLG, FOG, HRG, Quartz, MEMS
- Accelerometer technologies: Electromechanical pendulous type, Piezo, MEMS
- Level of performance: Industrial, tactical, inertial navigation and strategic grade
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**BIO**

**Main author: Laurent Robin**
Laurent is in charge of the MEMS & Sensors market research at Yole Developpement. He previously worked at image sensor company e2v Technologies (Grenoble, France). He holds a Physics Engineering degree from the National Institute of Applied Sciences in Toulouse, plus a Master Degree in Technology & Innovation Management from EM Lyon Business School, France

**Contributor: Mike Perlmutter**
Mike has worked in the inertial navigation field for over 30 years. He was director of strategy and planning at Northrop Grumman in 2007 when he retired from the company and established Skylight Navigation to consult in the area of inertial systems, navigation, corporate planning and strategy. Mike has published papers, chaired conference sessions, given talks and authored 10 US patents on inertial sensors, GPS and navigation technology.
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WHO SHOULD BUY THIS REPORT?
- High-performance accelerometers and gyroscope suppliers
  - Understand the system level technology trends and requirements for each application
  - Evaluate market potential for your components depending on performance and technology
  - Understand the differentiated value of your products and technologies
  - Identify new business opportunities and partners
  - Monitor and benchmark your competitor’s advancements

- IMU module and AHRS or INS suppliers
  - Evaluate the market potential of your product portfolio
  - Define diversification strategies on new applications
  - Find the best technologies to integrate and the best suppliers depending on your target markets
  - Identify new business opportunities and partners
  - Have an exhaustive analysis of the competition on a broad range of IMU field

- MEMS material, equipment, or foundry / packaging service suppliers
  - Identify new business opportunities and prospects
  - Understand the level of activity of your customers
  - Understand what are the applications that will drive the volumes in 2015

- Integrators of inertial solutions (INS, AHRS, sensors...)
  - Find the best technologies to integrate and the best suppliers depending on your target markets
  - Understand what will be the future applications to develop by taking benefit on the recent advances in inertial technologies

- Financial & strategic investors
  - Understand the structure and value chain of the high-end inertial industry
  - Estimate the potential of new devices such as tactical-grade MEMS gyroscopes
  - Get the list of main key players and emerging start-ups of this industry worldwide

COMPANY INDEX

Aigitron, AIMs – Zetiq Development, Airbus & ATR, Al Cielo, American GNC, Analog Devices, Applanix, Ascension, ASM (Automation Sensorik Messtechnik), Astrarium, Atlantic Inertial Systems, Autoflug, Azimuth, BAE, Boeing Aerospace, Serie PETRUS, Thinker, SBT, Space, TMS, TUV, UV, VSL, WSL, Yaskawa Electric, Xsens, Yishay Sensors, and many others...
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