HIGH-END INERTIAL SYSTEMS

Market & Technology report - November 2017

Fueled by geopolitical risks rising defense investments, commercial aerospace and fast-growing applications, this new prosperous cycle of the high end inertial business will bring the market to new heights

KEY FEATURES OF THE REPORT

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- Market projection for gyroscopes, accelerometers and IMUs in Munits through 2022
- Market projection for gyroscopes, accelerometers and IMUs in $M through 2022
- Gyroscope, accelerometer, and IMU ecosystem and player map
- Market share by technology and system type
- Application trends and volume breakdown for industrial, commercial aerospace and defense
- Technology trends for MEMS, fiber-optic gyroscopes (FOG), ring laser gyroscopes (RLG), hemispherical resonator gyroscopes (HRG), dynamically tuned gyroscopes (DTG), and more
- Associated software and electronics

WHAT'S NEW

- Updated forecasts of volumes, market values and average selling prices (ASPs) of gyroscopes, accelerometers, IMUs and inertial navigation system (INS)
- Update of the supply chain
- Extensive look at accelerometer market
- Short look at the software and ASIC business associated with

INCREASING GEOPOLITICAL RISKS, THE ENDING OIL CRISIS AND THE UPCOMING ROBOTIC ERA ARE FACTORS FUELING THE HIGH-END INERTIAL SYSTEM MARKET

Defense and commercial aerospace markets have always been the backbone of the high-end inertial system market, and that is still true today. The traditional markets, like defense, commercial aerospace and space applications, have returned to growth after a big slowdown from 2010-2015. For the last two years, the market has been evolving positively thanks to increasing geopolitical risks, and benefiting from the reinvigoration of the commercial aerospace business. And the end of the oil crisis in 2015, combined with increasing purchasing power coming from eastern regions, especially China, has definitely benefited this market. The space market is still evolving at its own pace, with the increasingly important robotic approach coming from players like SpaceX, Blue Origin enabling reusable rocket launchers, democratizing the space market.

In other words, the high-end inertial system market is recovering from a lean period that could bring it, in the long term, into a prosperous time with higher volumes. At long term, the market should be propelled by two major trends: the robotic approach and the growth of industrial applications. Yole Développement estimates that the high-end inertial system market has reached the $3B milestone in 2017. Defense makes up 36 % of this, with commercial aerospace comprising 33 %. Industrial, offshore and maritime applications account for the remaining 31 %. With a compound annual growth rate (CAGR) estimated to be 5% for the five next years, the high-end inertial system market is on a good track. The industry is now looking for emerging opportunities to sustain its growth, and this is what we highlight in this report.

Defense, commercial aerospace and industry are back in business, 2017 - 2022

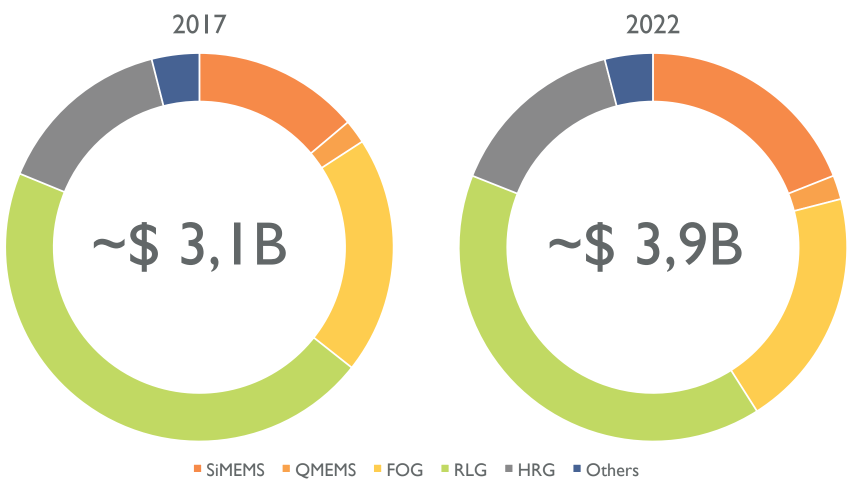
(Yole Développement, November 2017)

RING LASER GYROSCOPES (RLGS) ARE COMPETING STRONGLY AGAINST FIBER OPTIC GYROSCOPES (FOGS) AND HEMISPHERICAL RESONANT GYROSCOPES (HRG). ON THE LOW-END, SILICON MEMS BENEFIT FROM INDUSTRIAL OPPORTUNITIES AND TESTING OF EMERGING APPLICATIONS

For over 20 years, silicon MEMS technology has been predicted to fill the gap between other high-end inertial system technologies. This is now obviously happening, but at a slower pace than expected. Evolution of silicon MEMS technology opens new opportunities at the lower end of the market, above 1°/hour bias stability, fueling applications like industrial monitoring.

Although silicon MEMS is pushing FOG technology out of low-end applications, it is still too immature to conquer applications that require bias stability below 1°/hour. FOG technology players such as KVH and iXBlue are instead trying to expand their capabilities to compete against RLG technology and silicon MEMS. An internal battle is happening in the FOG technology with open-loop and close-loop approach RLG technology is also being challenged at higher performance levels by HRG technology. HRG has achieved huge improvements in recent years thanks to the investments from two major players in the field, Northrop Grumman and Safran. If cost-effectiveness and production complexity issues with this technology are solved quickly in the coming years, it could seriously impact the RLG business. However the necessary steps will probably take time. Know-how and involvedness of HRG technology also impose a high entry barrier to any other companies. Honeywell still dominates the RLG market thanks to its reliable, cost-effective technology that perfectly fits technology requirements for the commercial aerospace business. Analog Devices, Inc. (ADI) and Silicon Sensing Systems dominate the MEMS segment addressing low-end industrial applications thanks to a wide product offering.

Technological musical chairs



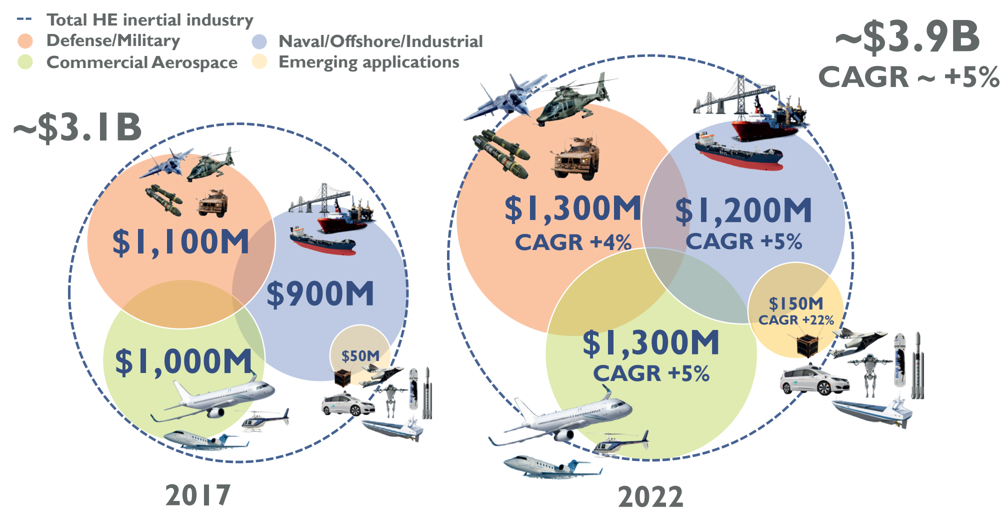
(Yole Développement, November 2017)

Verticalization of the market is still going on and is a key element in the race to get a competitive advantage, because it allows optimization and cost reduction. This requires mastering manufacturing entire systems, including accelerometer, gyroscope, application specific integrated circuits (ASICs) and software. This report describes the applications, technologies, and players associated with high-end inertial systems' impending changes.

A TRADITIONAL MARKET DOMINATED BY GIANTS, BUT LOTS OF OPPORTUNITIES ARE APPEARING FOR EVERYONE

Among all applications, emerging ones identified in our last report are still gaining interest. These new applications span from robotics to industrial automation, autonomous cars, ships, planes and drones, structure monitoring, space conquest with reusable rockets and microsatellites. Such uses are expected to add growth. Most players are looking at these new opportunities, partnering with end-users to understand the needs and requirements to adapt the specifications of high-end inertial systems in term of accuracy, volume, shielding and cost. Currently, most of those applications are in R&D and prototyping phases, but requirements and standards are being defined today, and should impact the market for years. The race into the robotic era is under way and many sensors are in competition. Inertial systems have advantages, and will definitely take part in this revolution that will have a deep impact across the whole industry.

Long-term opportunities



(Yole Développement, November 2017)

This report provides a detailed vision of the industry landscape, as well as the applications trends and shipments forecasts for high-end inertial systems for traditional and emerging applications, whether covered by International Traffic in Arms Regulations (ITAR) or not.

COMPANIES CITED IN THE REPORT (non exhaustive list)

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REPORT OBJECTIVES

Ecosystem identification and analysis
- Determination of the application range
- Technical market segmentation
- Market trends and forecasts
- Key players by market, and analysis

Analysis and description of markets and technologies involved:
- Detailed applications by market segment
- Major players, worldwide
- Technology trends
- Main technical challenges

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The "More than Moore" market research, technology and strategy consulting company Yole Développement, along with its partners System Plus Consulting, PISEO and KnowMade, support industrial companies, investors and R&D organizations worldwide to help them understand markets and follow technology trends to grow their business.

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