IMAGING TECHNOLOGIES FOR AUTOMOTIVE 2016

Market & Technology report - October 2016

Imaging technology, which is currently mainly cameras, is exploding into the automotive space, and is set to grow at 20% CAGR to reach $7.3B in 2021.

KEY FEATURES OF THE REPORT

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- Market forecast in $US and units of automotive imaging sensors through 2021
- Market forecast in $US and units of automotive cameras through 2021
- Ecosystem analysis, player market share by components
- Market analysis covering visible cameras, solid state lidars, LWIR cameras and 3D cameras
- Technology roadmaps

OBJECTIVES OF THE REPORT

Identification and analysis of CMOS Image Sensor applications:

- Determination of the range of applications
- Market and technology segmentation
- Market trends and forecasts
- Key players at application and system levels

Analysis and description of the sensor technologies involved:

- Sensor forecast by application and technology
- Major global actors
- Technology trends
- Main drivers and challenges

INFOTAINMENT AND ADVANCED DRIVER ASSISTANCE SYSTEMS (ADAS) PROPEL AUTOMOTIVE IMAGING

Since 2008, when a recession acted as a wakeup call to the whole industry, the automotive market has undergone obvious structural change. Capitalizing on technologies initially developed for smartphones, electronics have invaded, and imaging technology is now taking center stage. From less than one camera per car on average in 2015, there will be more than three cameras per car by 2021, which means 371 million automotive imaging devices.

Cameras were initially mounted for ADAS purposes on high-end vehicles, with deep learning image analysis techniques promoting early adoption. The Israeli company Mobileye has been instrumental in bringing this technology to market, along with ON Semiconductor, which provided the CMOS image sensor. Copycat competition will probably pick up as the market now justifies initial investment in design and technology. It is now a well-established fact that vision-based autonomous emergency braking (AEB) is possible and saves life. Adoption of forward ADAS cameras will therefore accelerate.

Growth of imaging for automotive is also being fueled by the park assist application, and 360° surround view camera volume is skyrocketing. While it's becoming mandatory in the US to have a rearview camera, that uptake is dwarfed by 360° surround view cameras, which enable a "bird's eye view" perspective. This trend is most beneficial to companies like Omnivision at sensor level and Panasonic and Valeo, which have become the main manufacturers of automotive cameras.

Mirror replacement cameras are currently the big unknown and take-off will primarily depend on its appeal and car design regulation. Europe and Japan are at the forefront of this trend, which should become slightly significant by 2021.

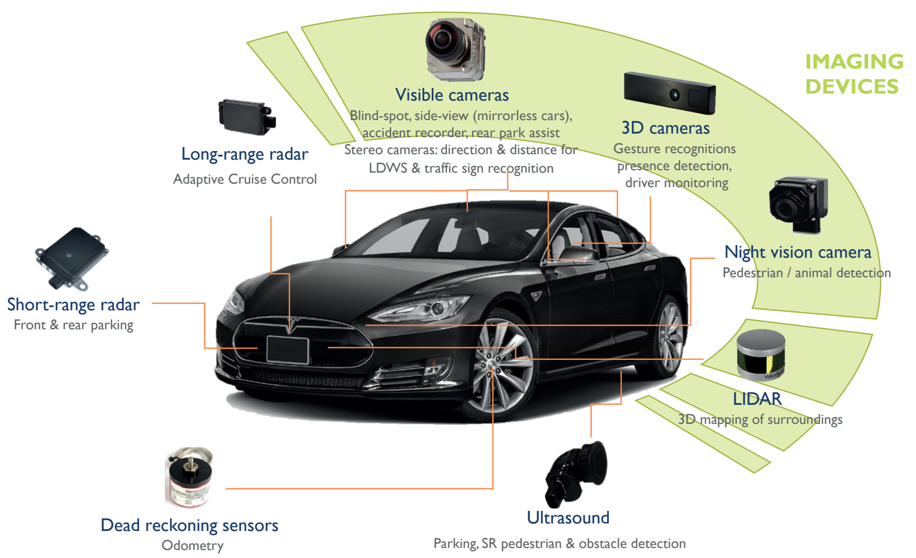
Solid state lidar is well talked about and will start to be found in high end cars by 2021. Cost reduction will be a key driver as the push for semi-autonomous driving will be felt more strongly by car manufacturers. The report will analyse the impact of lidar for automotive vision in detail.

Night vision cameras using Long Wave Infrared (LWIR) technology were initially perceived as a status symbol. However, they're increasingly appreciated for their ability to automatically detect pedestrians and wildlife. LWIR will therefore become integrated into ADAS systems in future.

3D cameras will be limited to in-cabin infotainment and driver monitoring. This technology will be key for luxury cars and therefore is of limited use today.

If any significant semi-autonomous trend picks up, the technology will probably become mandatory, due to safety issues.

From applications to devices



(Yole Développement, October 2016)

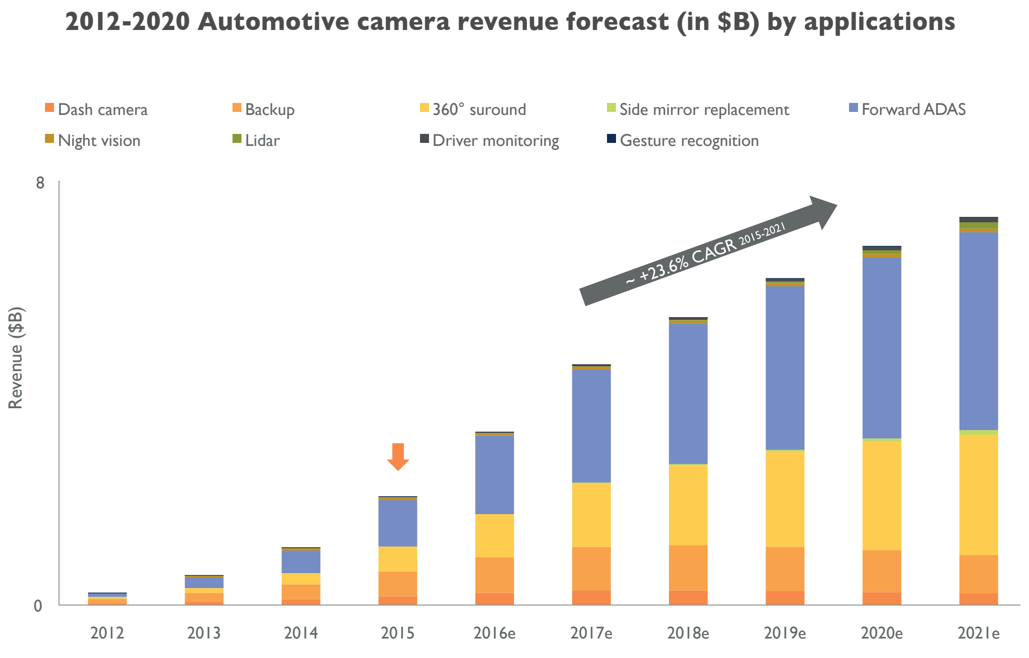
IMAGING WILL TRANSFORM THE CAR INDUSTRY EN-ROUTE TO THE SELF-DRIVING PARADIGM SHIFT

Highly renowned Silicon Valley companies such as Google, Uber, and Tesla are investing in autonomous driving, bolstering consumer imagination. Cameras and video feedback is an obvious technology marker, which is becoming a must-have for car makers to differentiate themselves. Cameras for display purposes such as park assist are growing at 30% annually. However, they will suffer from quick commoditization, although lower average selling prices (ASPs) will be mitigated by increased resolution and increased volume.

Forward looking ADAS cameras are growing 22% annually will get more complex, which will keep prices high. Today tri-focal cameras and stereo-mounting are gaining popularity. New technologies will raise the bar in terms of security and drive the adoption of early semi-autonomous features. Industrial providers such as camera module players and optical lens set players are capitalizing on this technology-driven environment. Asian leaders such as Sunny Optical and Sekonix are clearly benefiting from this trend.

Cameras don't really compete with radar or lidar, and all three could be integrated, depending on price and the level of autonomy targeted. As car price reaches certain levels, cameras are the first to be mounted due to their low ASP, then radars are added, then eventually lidars.

Lidars are currently undergoing a technological and industrial revolution, thanks to companies like Delphy, Quanergy and SensL. By becoming solid-state they should be considered as true imaging devices. Their price point will fall below radars', which are commonly used for ADAS, and consequently they will progressively be adopted by the top end of the automotive market. They will become central to semi-autonomous featured vehicles.

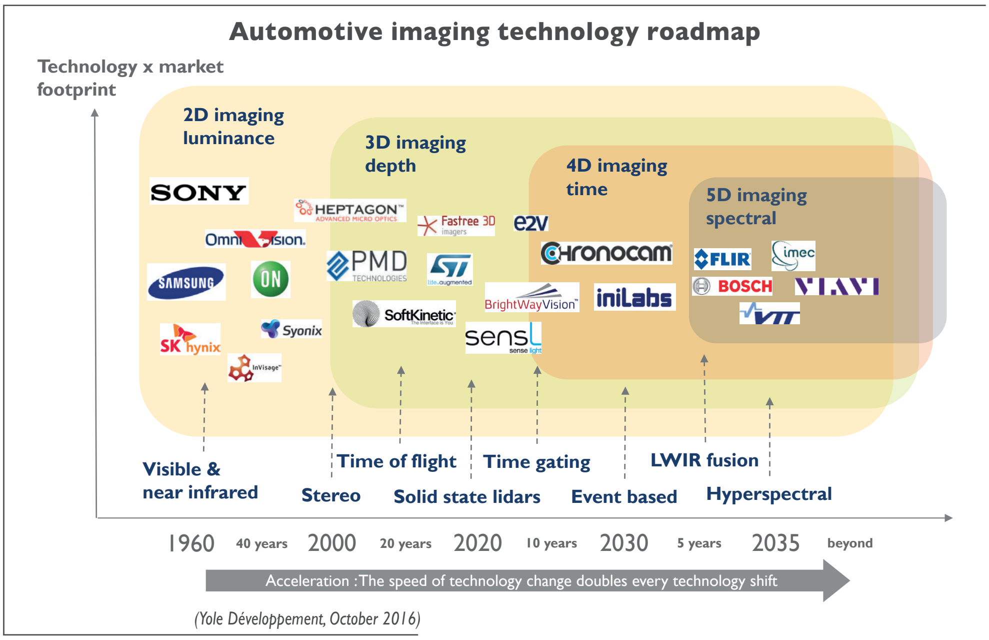


(Yole Développement, October 2016)

A MAZY TECHNOLOGICAL ROADMAP WILL BRING MANY OPPORTUNITIES

Early hurdles such as wide dynamic range and large fields of view have been overcome. New issues such as LED flickering and low light issues are currently being considered seriously. SONY and ST Microelectronics' recent automotive sensor release are examples of the push for technology excellence aimed at displacing ON Semiconductor leadership in ADAS image sensors. The current maturity of CIS technology allows for wide adoption of imaging technologies and is also accelerating research for technical efficiencies. Improvements will drive competition and major breakthroughs like the innovations seen in mobile devices could also happen in vehicles image sensors.

The diversity of applications and the sheer numbers of devices, including conventional, 3D and IR cameras and lidars, allows specialization. Image processing can in turn exploit the devices' capabilities. Multiple processing approaches such as NVidia GPUs, or Kalray's many-core approaches are competing to enter the market. As automobiles undergo electronic metamorphoses, imaging technology has become a key enabling technology.



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AUTHORS

In 1999 **Pierre Cambou** joined the imaging industry. He had earned an Engineering degree from Université de Technologie de Compiègne in parallel to a Master of Science from Virginia Tech in 1998. More recently he graduated from Grenoble Ecole de Management's MBA. Pierre took several positions at Thomson TCS which became Atmel Grenoble in 2001 and e2v Semiconductors in 2006. In 2012 he founded the start-up Vence Innovation (now called Irlynx) in order to bring to market a disruptive Man to Machine interaction technology. He joined Yole Développement as Imaging Activity Leader in 2014.

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 cofounder of Yole. At Yole Développement, Dr. Eric Mounier is in charge of market analysis for MEMS & Sensors, visible and IR imagers (CIS, microbolometers), semiconductors, printed electronics and photonics (e.g. Silicon photonics). He has contributed to more than 200 marketing & technological analysis and 100 reports. Eric is also an expert at the OMNT ("Observatoire des Micro & Nanotechnologies") for Optics.

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