Sensing for safety

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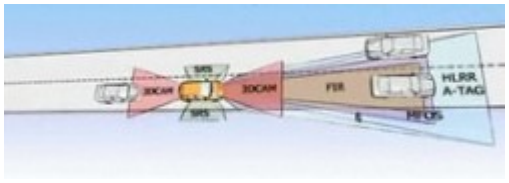

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As the everyday mobility of people becomes more and more important, will road safety rely on increasingly expensive and sophisticated systems? EU-funded researchers are developing a suite of smart solutions that will make our future driving experience safe, but still affordable.

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Look at the engine compartment of a modern-day car and it is clear that the days of 'tinkering with your motor' are gone. All vehicle components and subsystems rely on clever sensors and complex electronic control units to implement their safety and comfort functions. Advanced technologies are widely adopted; from GPS-enabled, smartphone-compatible navigation and media systems to complex hybrid engines and dynamic fuel-efficiency controls.

But what we all ultimately want is a vehicle that gets us from A to B - in one piece. Safety must come first.

Of course, car makers apply their best knowledge and capabilities to safety systems, so everything from ABS brakes, electronic skid protection and the soon-to-be-standard eCall emergency communication system all use the latest developments in smart sensor and control systems.

A project funded through the Seventh Framework Programme (FP7) has supported researchers and car makers in developing next-generation safety-oriented products.

'Reliable application specific detection of road users with vehicle on-board sensors' (ADOSE [2]) focused on the development of new sensors which can be integrated into sophisticated on-board safety systems. The project ran in parallel to other large-scale projects (e.g. INTERACTIVE, HAVE-IT) which looked at the development of safety systems rather than sensing devices.

Breakthrough technologies

The ADOSE partners adopted five sensing technologies to build breakthrough prototypes and solutions, with higher performances or lower costs compared to the current state of the art. The sensor prototypes have been integrated into pilot systems which can detect obstacles, measure distances and assess visibility.

The Far Infrared (FIR) imager and a batch moulding process for FIR optics were developed to lower the cost of key components in car night vision systems. 'Night vision is only an option for high-end cars at present,' says Mr Herrmann from Robert Bosch, 'but collision rates could be dramatically reduced if they became a standard safety system. We wanted to make night vision highly attractive and make this technology available for a broader market. We had to develop a sensor which was considerably cheaper to make than existing systems on the market.'

The ADOSE team also developed a 'Multi-functional optical sensor' (MFOS) which measures environmental parameters (such as fog, rain, twilight). This information can complement driving-related data (such as spotting oncoming vehicles) in real time. The MFOS device is based on a low-cost plastic optical light guide coupled to a standard 'Complementary metal-oxide-semiconductor' (CMOS) imager.

The third device is a low-cost 3D Range Camera (3DCAM) which can recognise and measure distances to objects travelling at high speed such as oncoming vehicles. It is suitable for pre-crash warning systems.

Road safety is not just about protecting drivers, of course; pedestrians and cyclists - who typically come off far worse in collisions - will also benefit from ADOSE research. The project has developed a radar system that locates obstacles and unambiguously identifies road users equipped with passive and active transponders (RFID tags). The project has successfully integrated signal processing into the radar system to help remove background 'noise' and mask poor weather conditions.

The last prototype is an innovative 'Silicon retina stereo sensor' (SRS). This system is a low-cost sensor, inspired by biology, for very fast and less power-intensive object detection. The sensor can pinpoint objects moving quickly relative to the sensor (and vehicle) in real time, due to a 'stereo-matching' technique similar to the way our binocular vision allows us to judge distances.

'The SRS technology has been recognised by industry as very new sensor type,' says Mr Fresolone of the Austrian Institute of Technology. 'The novel method of object sensing, inspired by biological processes, is suitable for various applications such as roadside traffic-sensing and person-counting; we are already in early-stage negotiations with a number of engineering firms about using the SRS technology for a variety of road safety applications.'

Demonstrating value

Some of the ADOSE prototype sensors were tested in November 2011 on two test vehicles at the Centro Sicurezza test track in Orbassano. As explained by Mr Pallaro, ADOSE coordinator, from the Fiat Research Center, 'a relevant number of life-like test scenarios have been deployed; we tested the ADOSE sensors in the main situations where they show competitive performances with respect to the state-of-the-art.'

The tests allowed validation of the installed sensing devices in realistic outdoor conditions and their adoption in future safety systems is expected. The research which created the MFOS technology also

generated a high dynamic-range CMOS sensor by ST Microelectronics, with microlens and colour filters, which can be made at competitive manufacturing prices. The sensor will go into production as soon as a commercial deal has been signed with a major supplier.

The harmonic radar and passive/active tags system is also generating commercial interest among organisations outside the consortium, who are now collaborating to refine the technology and build a commercial prototype.

Sensing the future?

'By developing sensing technologies suitable for industrial use we have contributed to Europe's leadership in the area of intelligent safety systems and the expansion of this emerging market,' says Mr Pallaro. 'The technologies are now in various stages of development, further testing or refinement and we hope to see further improvements in road safety for years to come.'

The ADOSE project received EUR 6.1 million (of total EUR 10.2 million project budget) in research funding under the EU's Seventh Framework Programme (FP7).

Useful Links:

- 'Reliable application specific detection of road users with vehicle on-board sensors' website [2]
- ADOSE project factsheet on CORDIS [3]
- INTERACTIVE project website [4]
- HAVE-IT project website [5]

Related Articles:

- Road safety: the uncrashable car? [6]

Information Source: Nereo Pallaro, Centro Ricerche Fiat S.C.p.A., Torino, Italy; Ingo Herrmann, Robert Bosch GmbH, Stuttgart, Germany; David San Segundo Bello, imec, Leuven, Belgium; Jone Sabboe, Triad, Lillestrom, Norway; Franco Fresolone, AIT Austrian Institute of Technology GmbH, Vienna, Austria

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