Implementation of SSL front-lighting improves vehicle safety

There is a 60% greater likelihood of serious accidents occurring outside daylight hours (according to research conducted on behalf of the European Commission). Vehicle manufacturers are now exploring lighting hardware that has a higher degree of sophistication.

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Emergent Pixel Light technology can be supported by different control techniques. Each option has potential for deployment in the next generation of automobiles.

There has been a steady shift in how vehicle lighting is implemented over the last decade, with incandescent lamps being supplanted by solid state alternatives. At first this was only for less essential tasks, such as in-cabin illumination, parking lights and instrumentation clusters, but in more recent times LEDs have been specified for use in the front-lighting systems of both mid-range and luxury cars. Furthermore, LED-based front-lighting systems are now offered as an optional extra in economy car models too. Among the key factors in this migration is the fact that LED devices offer both greater reliability and lower power consumption. It is, however, the flexibility of solid state lighting (SSL), with the output power from each of the emitters potentially being adjustable, that can have such a huge influence on vehicle safety.

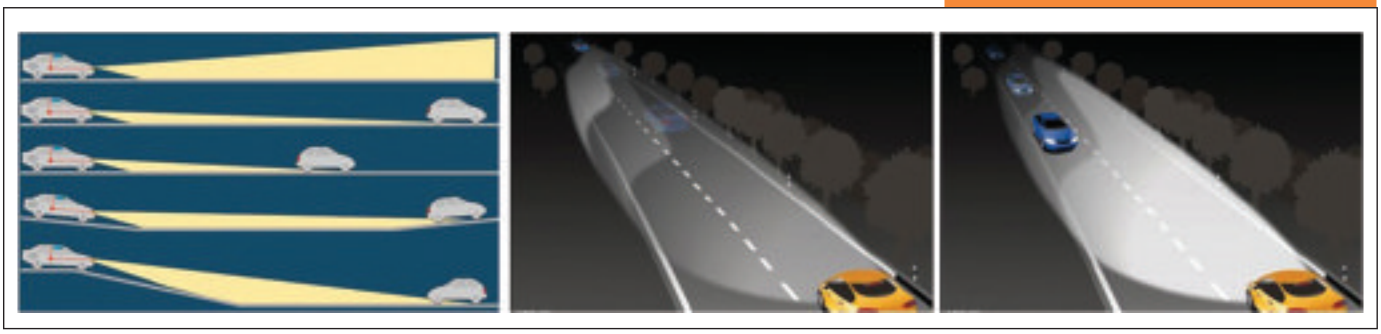
The advent of innovative new, highly adjustable optoelectronic technology seems set to revolutionise how adaptive front-lighting systems (AFS) are deployed in automobiles, enabling major safety improvements to be witnessed.

Pixel Light technology

Through use of Pixel Light it is now possible to generate any particular shape of illumination beam necessary to enhance the driver's visibility, with discrete LED emitters being activated, de-activated or dimmed to form an AFS light profile that precisely matches requirements at every point on the journey.

In comparison to AFS implementations

Figure 1: Raising/lowering of illumination beam using Pixel Light, without AFS (left) and with AFS Using Pixel Light (right).



using conventional incandescent lamps (that rely on motor controlled beam adjustment), control of multiple LED emitters using Pixel Light offers a far more effective strategy. Through access to the vehicle's GPS, it is possible to manipulate the light output of the emitters in order to form a beam that better illuminates the curves on the road ahead, as well as raising and lowering when dealing with hills (also Figure 1). In addition, by combining this technology with imaging systems, major improvements can be made to the illumination of road signs, pedestrians and other objects in the line of sight of the driver, while markedly lowering the glare that oncoming traffic is subjected to. Figure 2 shows how the area from a vehicle approaching from the opposite direction can be taken out of the high beam, so that the glare effect is removed.

Since LED-based AFS implementations using Pixel Light allow the bending and swivelling of the illumination beam to be done at the emitter level, they basically eliminate the need for a bending motor to be included in the lighting system. Pixel Light also allows the beam shape to be modified, so the need for a beam shaping motor is also dispensed with. Likewise through adaptive cut off line (ACOL), though it does call for a higher pixel count within the front lights, the need for a levelling motor is removed.

The flexibility of solid state lighting, with the output power from each of the emitters potentially can have a huge influence on vehicle safety

Topologies

There will be two basic drive topologies employed by Pixel Light AFS systems.

For systems using a parallel drive topology (PDT), a high power buck converter needs to be used as the current source. As PDT has a high current rail there is one connection for each LED emitter. Variation in each emitter's electrical characteristics has a major effect on the overall performance of the lighting implementation. As there can be sizeable differences in the anode-cathode voltage of the emitters, high levels of heat may need to be dissipated. This will increase the power consumption and lead to the inclusion of more extensive thermal management mechanisms (adding to the cost and the space taken up too). It is unlikely that this topology will witness widespread deployment in AFS applications unless better LED matching becomes available.

Unlike the PDT topology, where there is a constant current source per LED emitter, for systems based on a serial drive topology (SDT) two connections per LED string are required and an LED string driver is used to ensure that a constant current is provided to each of these strings. The individual emitters in the pixel array are deactivated/dimmed to alter the beam's shape via short-circuit switches. If a companion chip is added into the circuit it is possible, through the process of system partitioning, to avoid the power consumption and thermal management issues inherent in parallel topologies. As the serial topology enables a constant current source per string it means that, in contrast to PDT, no current matching is required - with clear cost advantages thus being realised.

SDT seems to present the industry with a much better topology through which to drive AFS systems based on Pixel Light

Figure 2: Comparison of AFS Implementations (left) with anti-glare high beams using Pixel Light and without (right).

technology. However, if these systems are to become commonplace in vehicles entering the market over the next few years, then they will need to be implemented via use of highly cost-effective, modular electronics. A driver circuit that uses the

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serial topology with system partitioning uses an NCV78763 buck-boost LED driver IC, from ON Semiconductor, to provide a power current source for the system. This integrated device is supported by a combined pixel controller/companion chip. The modular nature of such an implementation matches well with the product development strategy generally followed by vehicles manufacturers. It lowers the component costs, streamlines the implementation process and expedites completion of the system's design and implementation.

The superior functionality and fast switching of Pixel Light, thanks to its better performance characteristics, has potential for improving road safety, under all manner of difficult driving conditions. Illumination beams can be formed into the most suitable shape or bent as required - with higher levels of accuracy and responsiveness exhibited. It also allows the placing of multiple blanking zones within the beam when they are needed. All this can be done while avoiding the requirement of motors (and their supporting drivers ICs). As a result the electronics needed for the front-lighting system can be considerably less complex and the associated bill of materials can be lowered substantially.

SDT, through its intrinsic current matching will make it possible to create a streamlined, efficient control solution for AFS systems using Pixel Light technology. In addition, by specification of high performance semiconductors, the modular approach that car manufacturers have come to insist upon can be applied.