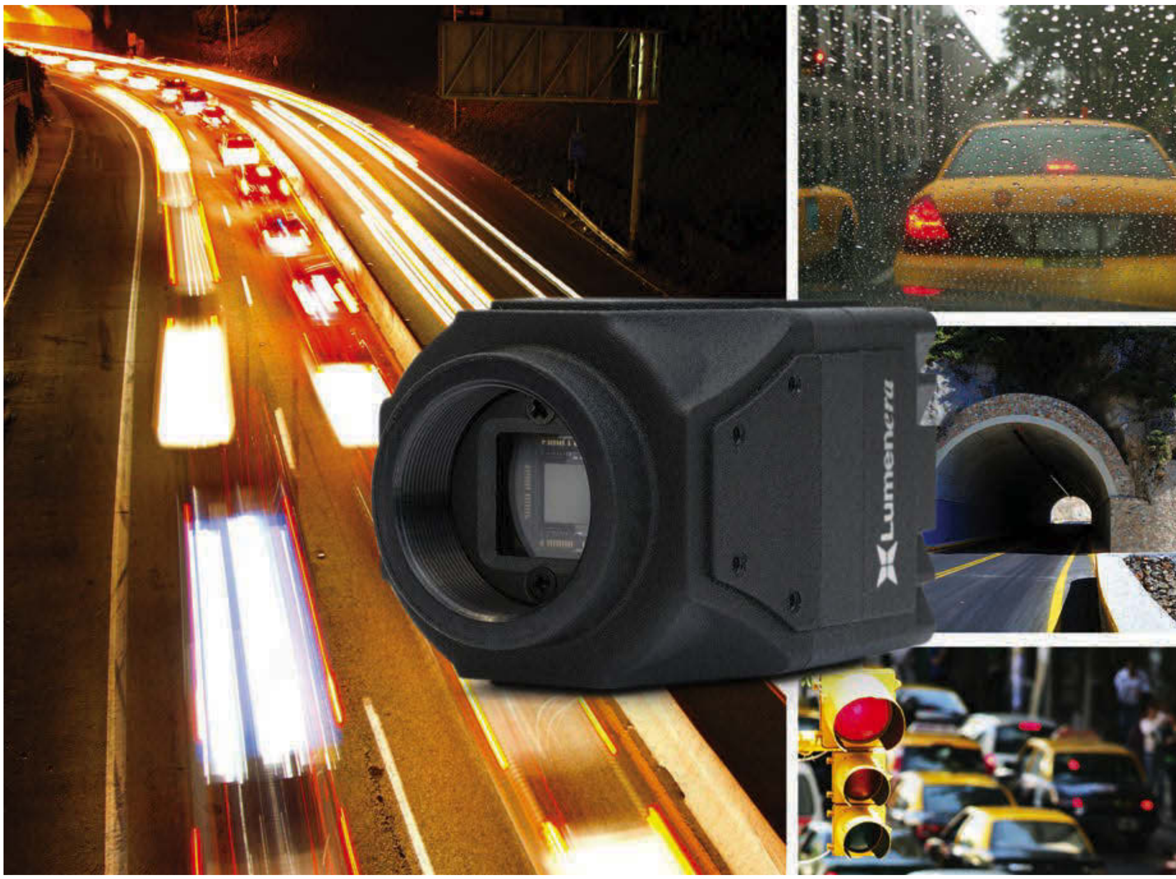
Using sensors to optimize image capture in traffic applications



With dynamic imaging conditions, design restrictions and local laws heavily impacting the way that traffic imaging systems can be designed and deployed, ITS companies are continually looking for ways to improve their technologies in order provide the best possible hit rate. Environmental conditions, for example, can impact the ability of a system to capture details in a field of view (FOV) in varying day/night conditions. It is essential that traffic and tolling systems can capture detailed images of fast-moving objects while dealing with reflections from vehicle components as the sun moves through the sky.

Twice as effective

One scenario that requires a solution beyond standard imaging is red light enforcement at night. How can authorities effectively capture an image of the vehicle license plate and also the face of the driver? As many license plates have strong reflective properties, the intensity of the camera flash needs to be scaled back, or timing adjusted, to ensure the details of the plate can be recognized.

However, if the camera exposure is lowered to avoid saturation and blooming, it usually results in there not being enough dynamic range to capture the face of the driver in the vehicle. The dynamic range of the sensors is limited by the depth of the pixel well capacity and the noise floor. However, there are a limited number of sensors available that can support dual-gain amplifier configurations in the camera architecture. These enable the dynamic range to be increased up to 70dB.

Beyond this, other technologies, such as high dynamic range (HDR), can be used. HDR increases the level of detail in an image by capturing multiple pictures at different exposures or gain levels and combining them to produce an image representative of a broader tonal range. However, when capturing multiple images of moving objects, it can be a challenge to avoid ghosting.

In cases where the motion does not exceed the capabilities of the processing software, de-ghosting algorithms can be applied to the image stack to align the objects and create a final image without any blur. Depending on the application requirements, one might require anything from two to 10 images to create an ideal HDR image, but restrictions for frame rate and exposure will likely keep the count low. One also has to consider the amount of processing power required to effectively merge the images.

Sensor sensibility

In situations where HDR might not be effective for high-speed imaging, an alternative sensor-based technology can improve

Need to know

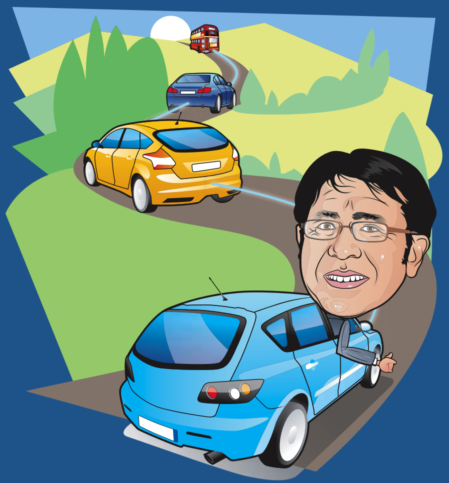
The accuracy of ITS can be improved using enhanced imaging technology

- Lumenera's Lt225 and Lt445 cameras enable high-resolution, high-speed imaging
- The Lt225 has a resolution of 2048x1024 and outputs 170fps. Halving the resolution doubles the frame rate to 340fps
- The Lt425 starts with a 2048x2048 frame size and 90fps at full resolution, with the same proportional increase in frame rate when sub-windowed

(Left) **Advanced sensor technologies optimize ITS in challenging situations and HDR increases the level of detail in an image**

the sensitivity of cameras in low-light conditions. This involves a sparse color array filter being applied to the sensors. These solutions add transparent pixels to the standard red, green and blue pixels traditionally used for color capture. The sensors with sparse filter patterns substantially increase light sensitivity. Another benefit of using image sensors with this design is that they permit end users to use faster shutter speeds to reduce motion blur when capturing moving objects.

As new imaging technologies and techniques are developed, it is important for camera manufacturers to stay at the foreground of innovation. This way, solutions providers can leverage new cameras and technology to provide higher dynamic range, higher speed, higher resolution and improved image quality, all while minimizing costs.



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I am writing this column shortly after the USDOT released its Advanced Notice of Public Rulemaking (ANPRM) for vehicle-to-vehicle (V2V) technologies. Perhaps it's the blush of excitement and the fact that I – and a host of others – have been working with V2V safety technologies since we were young. During the waning days of the National Automated Highway System Consortium (NAHSC), I participated in a workshop in Washington DC that hypothesized 'cooperative systems' – cars that communicate with one another and to roadside infrastructure wirelessly. This was to usher the larger vision of automated systems. Sound familiar? This was in the spring of 1998.

In the USA, research in this area has literally and figuratively taken the long and winding road. The program that replaced the NAHSC was the Intelligent Vehicle Initiative, which ushered in research, government guidance and nowadays deployment of advanced driver assistance systems (ADAS) in North America. As a parallel development, in 1999 the Federal Communications Commission issued a dedicated short-range communication (DSRC) Report and Order, allocating 75 MHz of free licensed spectrum, primarily for transportation safety applications, or the very V2V ANPRM we can read today.

Fast-forward through a blur of more recent developments, starting with the thousands of research reports, papers, small-scale experiments and standardization activities, and culminating with the Ann Arbor Safety Pilot. The promise of safety fueled this journey and we stand today at the threshold of contemplating mandatory use of one DSRC channel to broadcast what is termed a Basic Safety Message (BSM). The BSM is akin to a 'super sensor', providing standardized broadcast movement information for a couple hundred (or more) meters of every DSRC-equipped vehicle. Voila! Trajectory traces of any vehicle that could cause harm float in the airwaves. Very useful. Very life-saving.

Where do we go from here? Well, the ANPRM will be commented on, and rest assured there will be many comments: safety advocates will comment; privacy advocates will comment; self-driving car advocates will comment; those who advocate spectrum sharing or other uses of the DSRC channels will comment. More research will be conducted and standards will further congeal; armed with these inputs, the USDOT may issue a Notice of Public Rulemaking (NPRM). Then the cycle will repeat, but with more urgency and more intensity. Then there could be a rule, maybe in the form of a Federal Motor Vehicle Safety Standard (FMVSS), or basically that sought-after mandate.

For me, at that time, the long and winding road will have reached an end. That odyssey since the NAHSC days and those visions elucidated in 1998 – a veritable half of many careers – will have finally spawned many successful and safe journeys taken by our driving public.

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