More Efficient Processes with Multi-Strobe Imaging

Fast lighting control in complex applications

The high speeds at which many industrial processes run today leave vision systems with little time to accurately capture all the necessary information. Multistrobe imaging with sequence functionality – where two or more images are captured in a single pass – can be a solution here, as it allows multiple features to be inspected using different lighting scenarios.

Various defects on test parts may require different lighting methods depending on the type of defect. For example, front lighting generally provides a good basis for detecting scratches or other surface defects, while the dimensional accuracy of geometric shapes is often easier to assess with backlights. When components need to be inspected for multiple types of defects simultaneously, using different lighting setups in parallel can lead to interference. Therefore, sequential inspection is often unavoidable, which increases cycle time. This is particularly significant for line scan cameras, as the same object must be scanned multiple times under different lighting conditions.

An efficient alternative to this approach was demonstrated by Rauscher at last year's Vision trade fair. A key component of the showcased system is an Ipulse lighting controller from Rauscher's partner Icore, explains Thomas Miller, one of the company's Managing Directors: "Ipulse controllers enable highly efficient lighting control by generating precise current pulses of less than 1 µs and currents of up to 200 A. This allows for stable and precise strobe lighting even with high-power LEDs." The main advantage of this approach is the ability to consolidate multiple sequential inspections, leading to more efficient and cost-effective processes.

Compared to conventional lighting controllers, Ipulse controllers offer two key advantages: First, the extremely fast current pulses significantly reduce response times when activating the connected lights. Second, the short pulse duration with high currents ensures that the lights are active only for the required time, delivering their full performance – up to ten times the nominal LED current. This enables a faster strobe rate, which is essential for multi-strobe technology.

Fast switching between scenarios

Using the IP-2P2S-5C controller, the Rauscher experts have developed a system that enables versatile, fast, and highly accurate machine vision with multi-strobe technology. The key to success is rapid switching

Based on the IP-2P2S-5C lighting controller from Icore, the experts at Rauscher have developed a system that enables versatile, fast, and highly accurate machine vision with multistrobe technology. The key to success here is the ability to switch quickly between different lighting scenarios.

between different lighting scenarios, Miller emphasizes: "An Ipulse lighting controller allows for very fast changes between multiple lighting conditions by operating different connected lights with different intensities or lighting angles. Depending on the setup, it is also possible to vary the wavelengths to set different spectral distribution focuses in multispectral systems. This technology can be applied in both area scan and line scan applications."

This makes it possible to create highly flexible vision systems capable of capturing dynamic scenes, high-speed imaging, strobe applications with reduced motion blur, or multi-angle imaging for capturing depth information in 3D. With multi-strobe technology, cost-effective image acquisition of user-defined sequences can be achieved, which can also be adjusted in real time.

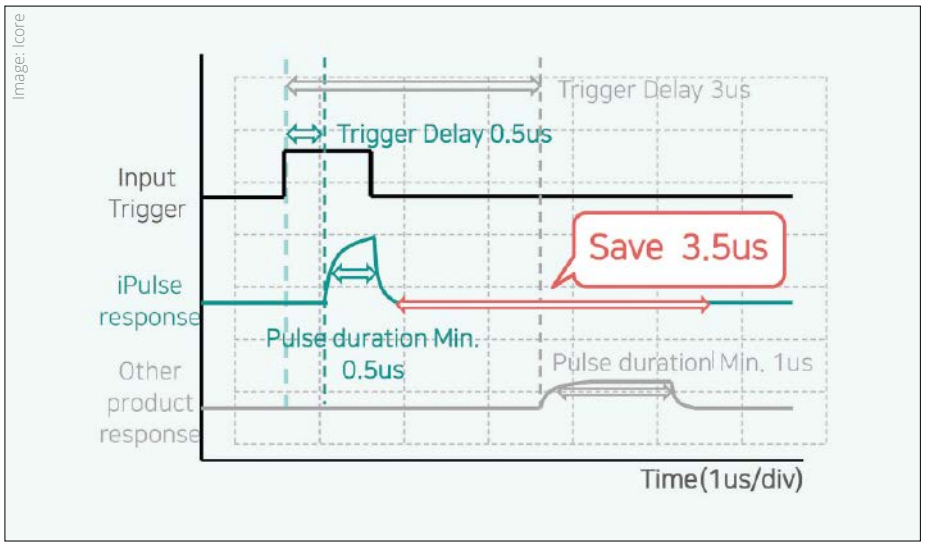
The following graphic illustrates the basic functionality of multi-strobe technology: In this example, four LED lights positioned at different locations are triggered sequentially at very short time intervals. The four resulting images can be combined into a single image using the software, merging information from all lighting conditions. Defects visible in only one of the individual images will be included in the composite image, ensuring a more

Technology in detail

Lighting controller with up to eight channels

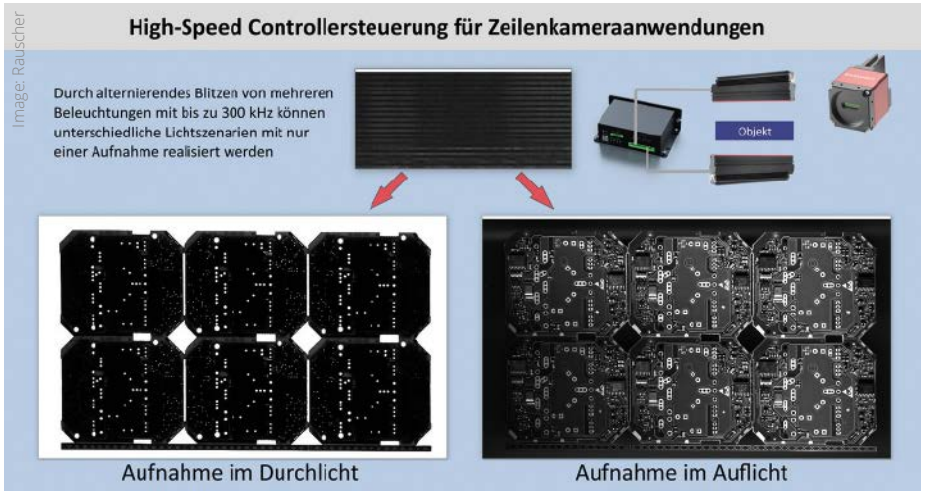
The Ipulse family of lighting controllers from Icore currently includes 20 models with one, two, four, or eight channels, offering continuous currents between 0.2 and 20 amperes, or between 2 and 200 amperes in strobe mode. Depending on the model, the controllers cover an output range per channel of 60 to 500 watts and a total power range of 60 to 1,000 watts. These versatile technical features enable users to select the most suitable model for each task. The experts at Rauscher provide professional support in choosing all vision components, including the appropriate controller.

Image: Icore



The speed and height of the current pulses from Ipulse controllers enable efficient control of lighting, which is a prerequisite for multistrobe technology.

Image: Rauscher



Screenshot of the demo system used by Rauscher to demonstrate the basic principle of multistrobe technology at Vision 2024.

Image: Rausc

reliable identification of undesired object features. Thanks to the extremely precise and fast control of lighting in the sub-1 µs range, systems equipped with Ipulse controllers can capture images of inspection objects in nearly the same position, even when the objects are moving at high speeds, such as on a conveyor belt.

One camera, multiple perspectives

To demonstrate the capabilities of such systems at a trade show, Rauscher's technical team combined the Ipulse lighting controller from Icore with a Vieworks VL series line scan camera, along with front and back lighting from Advanced Illumination. The Zebra Aurora Imaging Library was used for image processing.

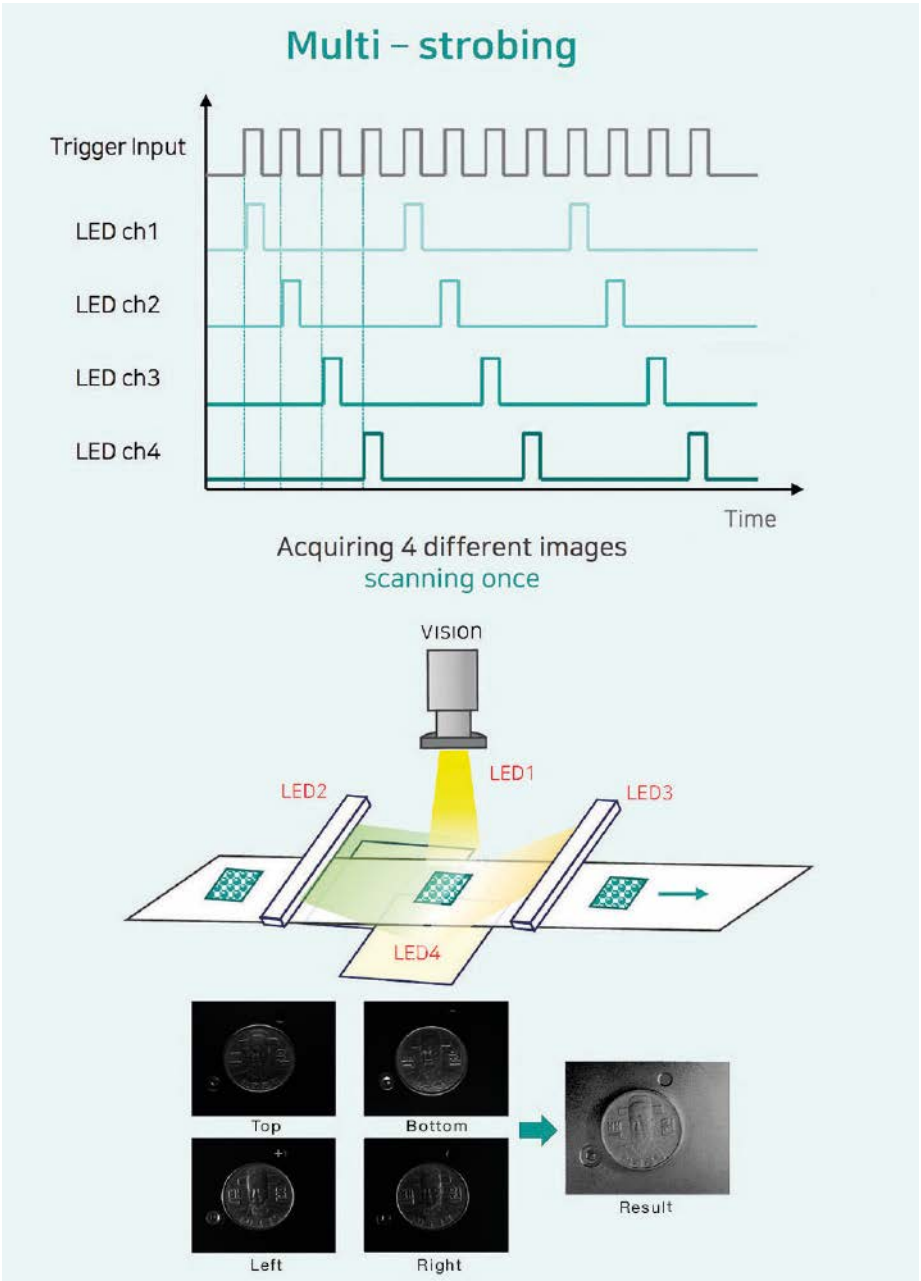
"With each capture by the line scan camera, two images are generated," Miller explains. "The controller activates the two lights in such a way that one image row is taken during frontlight and the next during backlight operation. Each image row is thus captured under different lighting conditions. The software then separates the even and odd rows to create two complete images."

For flawless system operation, a light barrier is mounted on the horizontal axis where the test object – an unpopulated PCB in this case – is placed. This serves as a frame trigger to activate the camera's capture process. The motor driving the horizontal axis is coupled with an encoder that measures its speed and generates the necessary line trigger signals for the camera to start capturing each row. Each time the camera exposes, it sends an exposure active signal to the lighting controller, which then generates a predefined sequence to activate the connected lights one after another.

"For our Vision demo, we operated the camera at double the line rate to illuminate each row twice and then separate two complete images from the captured data," Miller continues. "Our goal was to demonstrate the basic principle of multi-strobe technology. However, thanks to the extremely precise Ipulse controllers, two images per row are far from the limit. Depending on conditions, defect types, and the integrated lighting, multi-strobe systems can capture virtually unlimited amounts of information in a single pass and convert it into meaningful images using the software."

Multi-strobe imaging in industrial applications

According to Miller, multi-strobe imaging presents a cost-effective option in many industrial applications for inspecting test objects for various features and defect types using a single vision system instead of multiple sequential systems. "Of course, this technology is not a one-size-fits-all solu-



The graphic illustrates the basic principle behind multistrobe technology: In this example, four LED lights mounted at different positions are triggered in quick succession. The software combines the four resulting images into a single image that combines the information from all the shots taken under different lighting conditions. Errors that were only visible in one of the individual images are thus included in the overall image, enabling more reliable identification of unwanted object features. Because the lights can be controlled precisely and quickly in the range of less than 1 µs, systems equipped with Ipulse controllers can still capture images of the test objects in almost the same position even when the objects are moving through the process at higher speeds, for example on a conveyor belt.

tion. However, when multi-strobe imaging is feasible for a given task, it can significantly reduce hardware costs for users and lead to more efficient, cost-effective inspection processes." Miller sees particular potential for this technology in applications such as material inspections, surface inspections, or 3D shape analysis. "Our experts are happy to assist in evaluating whether the multi-strobe approach offers advantages for a specific application," Miller adds. ■

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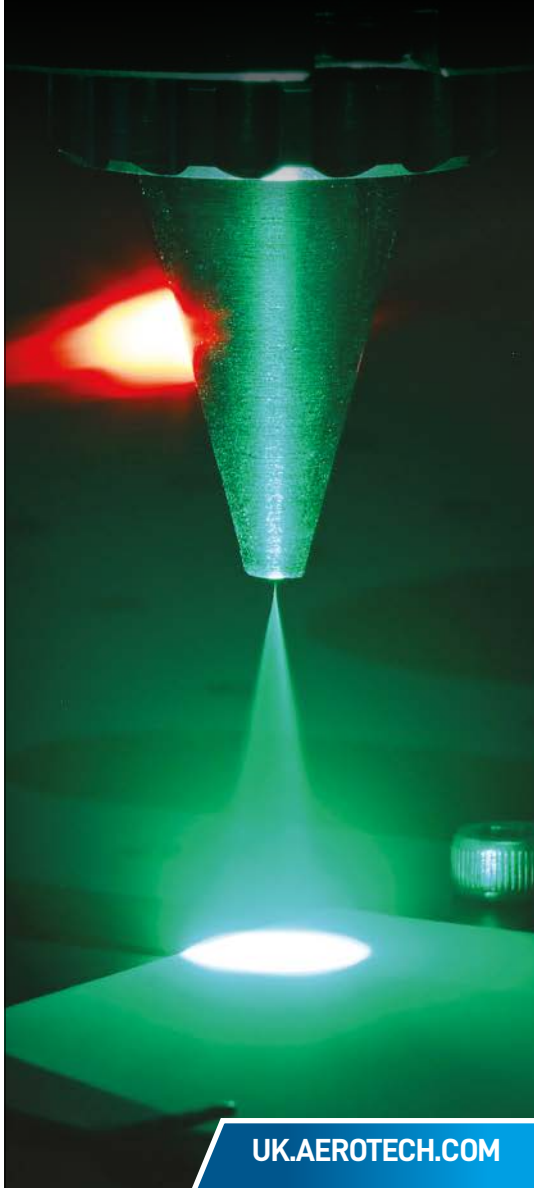

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