Manufacturers of LEDs and MEMS (microelectromechanical systems) are always concerned about improving yield and quality, and they work to prevent dies with visible defects from entering the expensive packaging phase. That requires greater sensitivity to critical process defects, said Mike von den Hoff, director of marketing for KLA-Tencor’s ICOS Wafer Inspection Division, who commented on techniques for improving both speed and sensitivity in wafer-inspection systems.

Q: What are the biggest inspection challenges for manufacturers of LEDs and MEMS?
A: Two problems need to be addressed in the LED space. In outgoing wafer-quality check, manufacturers must catch bad dies that pass probe test but still have defects that can cause reliability or performance problems. The dies need to be marked as bad so they don’t get packaged or put on a die sort sheet. But it’s also increasingly important to find defects inside the wafer fab before probe test. The process for MEMS, which represent a much smaller market, is totally different—bigger dies and very different devices and defects—but the overall issues are very similar.

Q: How can wafer-inspection speed be improved?
A: Increasing the tool speed requires improvement in the image sensor, the image-processing computers, the mechanical stage that’s moving the wafer, and the illumination intensity. The speed of our ICOS WI-2250 is two to four times faster—depending on inspection-mode sensitivity and lighting—than the speed of the previous-generation WI-2200.

Q: What’s involved in boosting inspection sensitivity?
A: Sensitivity is really about the signal-to-noise ratio, meaning finding the defects that matter rather than those that don’t matter. We needed to reduce noise sources on the tool to improve overkill and underkill in post-die inspection.

Overkill is when you reject a die that’s actually good. The economic impact is simple: You’ve thrown away a good die. In underkill, you don’t find a bad die and it goes into packaging. Since the cost of a chip’s packaging can be higher than the cost of its entire manufacturing process, your underkill costs could be even higher. Many of our customers are more concerned about underkill than overkill, because of cost reasons, but also to avoid possible returns from their customers.

Q: What else has KLA-Tencor done to help address the challenges of LED manufacturing?
A: Once you find certain post-processing defects, you want to classify them so you can make better decisions for disposition of the dies and for yield improvements. In addition, accelerating root-cause analyses requires an improved correlation between front-end and back-end inspection steps. We’ve taken classification algorithms developed for previous KLA-Tencor systems that inspect higher-end semiconductors and integrated those into the WI-2250. These algorithms are very effective and have been proven in the industry for many years.

In solid-state lighting, as die sizes increase, defects will have a much bigger yield impact, and yield improvement will have a much higher priority. For example, at a typical LED wafer fab with 12,000 wafer starts a month, a 1% improvement is worth roughly $1 million in savings per month.
The Only Test Solutions Provider You’ll Need for SMT Manufacturing!

TRI is the global leader in AOI, AXI, SPI & Board Test

Test Research, Inc.
Headquarters, Taipei, Taiwan
7F., No.45, Dexing West Rd., Shilin District, Taipei City 11158, Taiwan
TEL: +886-2-2832-8918
FAX: +886-2-2831-0567
E-Mail: sales@tri.com.tw
http://www.tri.com.tw

USA
E-mail: triusa@tri.com.tw

Singapore
E-mail: trisg@tri.com.tw

Europe
E-mail: trieurope@tri.com.tw

Japan
E-mail: trijp@tri.com.tw

Korea
E-mail: trikr@tri.com.tw

Shenzhen, China
E-mail: shenzhen@cn.tri.com.tw

Suzhou, China
E-mail: suzhou@cn.tri.com.tw

Shanghai, China
E-mail: shanghai@cn.tri.com.tw

Tianjin, China
E-mail: tianjin@cn.tri.com.tw
Vision software uses statistical analysis

Unlike inspection technologies that use signal processing to detect surface defects during production, the Vision-Pro Surface software from Cognex monitors the appearance of a material and uses statistical analysis to identify potential defects on the material’s surface. The software then classifies the defects into user-defined groups based on similarity in contrast, texture, or geometry. Hardware components such as cameras, lights, and cabling can be purchased separately from Cognex or third-party vendors. www.cognex.com.

SDK drives FireWire and GigE cameras

The AVT Universal Package SDK (software development kit) from Allied Vision Technologies supports both FireWire and GigE Vision interfaces. It also includes the company’s UniAPI universal application programming interface, which was previously available only for FireWire cameras. The Universal Package, which is compatible with Windows 32-bit operating systems, is available for AVT camera users as a free download. www.alliedvisiontec.com.

Smart camera runs Windows XP Embedded

The Matrox Iris GT camera now includes the Windows XP Embedded operating system, enabling system integrators to develop applications using standard Windows development tools, such as Microsoft’s Visual Studio, in conjunction with the Matrox Imaging Library. The Iris GT camera offers a choice of monochrome or color CCD sensor teamed with an Intel Atom embedded processor. Resolutions range from VGA to 2 Mpixels. www.matrox.com.

3-D increasing in AOI systems

According to a recent study from market research firm ITM Marketing, the primary end-user applications for AOI (automated optical inspection) systems worldwide are SPI (solder-paste inspection) and process optimization. The study, titled “Automated Optical Inspection (AOI) Benchmark Report,” looks at trends in key market dynamics of AOI systems used for inspecting PCBs (printed-circuit boards) and for SPI applications, said Bob Klenke, the firm’s managing director.

Klenke explained that although the AOI market is fragmented regarding specific imaging technologies, SPI and process optimization remain the two primary applications for AOI systems. “Some view SPI as a separate entity,” he said, “but continuous monitoring and feedback of solder-paste deposition is considered the ‘holy grail’ of process refinement.”

The study also showed an increase in the inclusion of emerging technologies in AOI systems, such as 3-D AOI and optical-measurement capabilities. Increasingly, users want 3-D for accurately measuring processes such as very fine-pitch solder-paste deposition.

Klenke noted that more companies are using smaller benchtop systems for offline inspection. Many of these are smaller companies that choose the benchtop systems to reduce capital costs. But companies that place larger AOI systems in-line can not only inspect products but also gain continuous feedback, which gives them an opportunity to refine their processes.—Ann R. Thryft
Make no mistake.
EZ-LIGHT™ is the better indicator.
Colors appear brilliant when lit and neutral gray when off.
• Quick and easy installation
• Robust, durable and aesthetic design
• IP67/IP69K-rated models
• Long-lasting LED technology
• Low-power consumption
• Up to 5 colors in one device
• Steady and flashing colors, and audible alerts
• A complete range of housings, connection options and mounting solutions

40-plus years of engineering, support and cost-effective solutions:
• Banner quality with global availability
• Rapid customization with most products shipping in 3 days or less
• Industry’s largest application team
• Over 3,000 factory and local field representatives to serve your needs

For more information, call: 1.888.373.6767
www.bannerengineering.com/ivu

NEW Touch Screen for Remote Monitoring
Get more Vision

DALSA’s Next Generation Smart Camera Technology

BOA is a powerful, inexpensive and ruggedized optical inspection solution for the factory floor.

Multiple processing engines combine DSP, FPGA and CPU technologies.

Ideal for Color/Mono applications:

- Packaging
  - Bottle cap color and label confirmation
- Pharmaceutical
  - Verify pill count and color in blister pack
- Automotive
  - Inspect color or texture of interior parts
  - Verify order of color wires in harness

BOA’s tiny form factor and easy mounting capabilities allow it to integrate easily into existing production lines, machinery or moving equipment. In addition, with an IP67 rating, BOA is ready for deployment in harsh or washdown factory environments without the need for costly protective enclosures.

Embedded point-and-click software - easy to use & nothing to install.

Capture the power of DALSA

Download your BOA product brochure here: www.dalsa.com/boa/t4
Camera Link 2 is on the way

By Ann R. Thryft, Contributing Technical Editor

Over the last decade, the Camera Link parallel interface standard (Ref. 1) has served the needs of industrial machine vision for real-time, high-bandwidth, digital image acquisition. But today’s high-end systems demand bandwidth greater than the standard’s 6-Gbps maximum. Many machine-vision systems now employ line-scan cameras with 1k, 2k, or higher pixel lines and line rates above 100 kHz, more than double the speed that was common when the standard was being developed in the late 1990s. Meanwhile, fast CMOS image sensors are becoming available with machine-vision-friendly features.

“Camera Link needs a future for machine vision, and specifically for machine vision in industrial manufacturing,” said Steve Kinney, chair of the AIA (Automated Imaging Association) Camera Link committee. “CMOS image sensors have been gaining features like global shutter and higher image quality that are required for industrial applications. They also provide higher speeds than comparable-resolution CCDs, but that means dealing with a much higher data rate, which is why we need Camera Link 2.”

Builders of high-speed vision systems are also looking for a solution that’s more convenient and easier to implement than the current Camera Link “full” interface, which requires two cables and is limited to 10 m. “Camera Link revolves around real-time, high-bandwidth image acquisition, so speeds in next-generation Camera Link 2 should be in the 20-to 40-Gbps range,” Kinney said.

The Camera Link technical committee has examined Dalsa’s HSLink proposal (Ref. 2), which will probably serve as a basis for Camera Link 2, said Kinney. “HSLink is thorough, well thought-out, and a good platform for development,” he said. “If we do use it as a base proposal, we will make changes to it as determined by the technical committee’s findings.”

Although the HSLink draft specification is not complete, it does have a structure, said Jeff Fryman, director of standards development for the AIA. “We may decide to make several changes, such as in cabling, or change some of the capabilities.” The figure illustrates the concept behind the HSLink architecture for connecting a frame grabber and a camera. The design of HSLink focuses on using some of Camera Link’s key strengths, said Mark Butler, product manager for Dalsa. The protocol carries lower-jitter, real-time triggering signals; image data; and configuration data, and the specification is based on off-the-shelf components, each with a clearly defined, long-term roadmap for performance improvements. HSLink bandwidth is scalable from 2.4 Gbps using one lane to 48 Gbps using 20 lanes, in steps of 2.4 Gbps. Unused lanes can be turned off to save power.

To meet demands for low cost, ease of use, flexibility, and data reliability, the serial, packet-based protocol was designed from the system point of view, using a simple network topology that supports cameras, frame grabbers, and intermediate devices such as those that interface to GPIO. HSLink’s main components are the physical-layer SerDes chip, cabling, and FPGAs. “All of these are widely available from multiple sources and are used in industries with volumes much larger than machine vision, in order to keep the costs low,” said Butler.

HSLink also makes possible some new configurations. Because bandwidth is so high, some customers want to distribute the image from one camera to multiple frame grabbers for processing to help reduce system costs, while others want to connect multiple cameras, sometimes at different speeds, to one frame grabber.

(continued)

Fig. 1 These figures show a simplified version of the HSLink system architecture for a) a frame grabber and b) a camera. Courtesy of Dalsa.
JIIA hosting coax-based camera standard

Another standard that could soon play a role in machine-vision applications is CoaXPress, which is being hosted by the JIIA (Japan Industrial Imaging Association). The CoaXPress Consortium handed over ownership of the serial, high-speed, packet-based camera interface standard to the JIIA in December 2009 as the first step toward seeing it published as an international standard.

CoaXPress has a base speed of 3.125 Gbps for distances of up to 100 m, or a maximum sustained speed of 6.25 Gbps up to 40 m, said Jochem Herrmann, CTO of consortium member Adimec. Higher speeds are possible by using multiple cables in parallel, and the standard does not limit the number of cables that can be used.

Although CoaXPress currently depends on a single-source transceiver chipset from consortium member EqcoLogic, the standard will not specify that silicon, said Peter Helfet, EqcoLogic's CEO. "We've arranged an escrow agreement with JIIA for safe storage of our IP and all related information," he said. "We are also talking with other companies about second sourcing, and JIIA is supporting this effort."

A key feature of CoaXPress is the fact that it runs on coax cable at all speeds. "Coax is easy to use, low-cost, and reliable," said Colin Pearce, CEO of consortium member Active Silicon. It is also available in many different varieties, partly driven by the extensive use of coax in industries such as broadcast, where the progression to HDTV has also resulted in a demand for high-quality coax. Given the huge legacy of coax cables installed in industrial applications, CoaXPress provides an easy and cost-effective upgrade path for the introduction of high-resolution digital cameras. "In fact, 60% of Japan's machine-vision industry still uses analog cameras and associated cabling," Pearce said. "This is one of the reasons JIIA was keen to host CoaXPress as a standard."

The draft standard was implemented in several products demonstrated by consortium members at Vision 2009 (November 3–5, Stuttgart, Germany), including cameras, frame grabbers, cable solutions, and CoaXPress-to-Camera Link converters, said Adimec's Herrmann. Production shipments are expected by the early second quarter this year.

Although the physical interface won't change, some firmware may change during the standardization process, and all draft standard products will be firmware-updatable. "We expect that the first version of the standard will be backward compatible with draft standard products," he said. "By the end of 2010, we hope to present the formal standard at either Vision 2010 in Stuttgart in November or at ITE [International Technical Exhibition on Image Technology and Equipment] in Yokohama in December." The consortium will provide JIIA with technical input during the standard-development process.—Ann R. Thryft

The CoaXPress standard allows a coax cable to operate bidirectionally, carrying image data and control signals including triggering and general-purpose I/O. Up to 13 W of power at 24 V is transmitted to the camera from the frame grabber.

Courtesy of CoaXPress Consortium.
Vision standards groups to cooperate

Last November at the Vision 2009 show in Stuttgart, the AIA (Automated Imaging Association), EMVA (European Machine Vision Association), and the JIIA (Japan Industrial Imaging Association) standards organizations signed an agreement to cooperatively develop and promote global machine-vision standards. In the future, when all three organizations agree on the need for a standard, one will develop the specification and all three will promote the result globally. Each association retains the right to develop standards on its own when there is no consensus on a global need.

The original initiative for the agreement came from JIIA in 2006, when its representatives talked to those from the AIA and EMVA about the necessity of a framework for global standardization, said JIIA chairman Shigeo Oka. As the variety of interfaces for cameras and frame grabbers has increased, and quite a few digital interfaces and high-resolution imaging cameras have emerged, the types of applications for machine vision are expanding. Developing standards independently for local markets could be uneconomical and confusing. “We are very confident that this global coordination will play a key role in accelerating the adoption of machine-vision standardization, and will help to maximize dissemination and applications of the standards,” he said.

The agreement is about making machine vision easier to use, said Jeff Burnstein, AIA president. “If there are standardized ways of doing things in machine vision that make it cheaper, faster, better, and easier, then our job as a trade association is to help promote them,” he said. It’s taken about three years to finalize the agreement, since each association has its own procedures for developing standards and each operates in a different country, governed by different laws. “We needed to make sure that we’re following open procedures that are transparent and that benefit the members of our associations and users in the industry,” he said. “If we all endorse a standard, we all need to be aware of the way it’s developed and satisfied with its outcome. Standards are complicated, but we’re confident that working cooperatively across the globe will be good for the machine-vision industry.”

The agreement starts a global discussion of standards that can avoid overlapping functions or duplication of tasks, as has sometimes happened in the past, said Cor Maas, VP of the EMVA. The EMVA has proposed a new standard for consideration within the agreement based on a technology Intel is developing called Light Peak. The 10-Gbps optical cable communications technology could become an alternative to USB 3.0 and Camera Link. “If Intel eventually puts it on motherboards, consumer adoption would drive prices down low enough to use this technology in machine vision,” he said.

Some legacy standards of the individual associations may move into the context of the cooperative agreement, said Maas. Possible candidates include the EMVA’s GenICam and 1288. Moving legacy standards into consideration by all three associations lets members of the other two organizations join those initiatives and work on their next steps, without needing to become members of the other associations. “It also ensures that these standards will be promoted by the three associations to the machine-vision industry in all geographical areas,” he said.—Ann R. Thryft

Piranha HS 12k camera and the Xcelera-HS PX8 frame grabber—use CX-4 cable, said Butler. The Piranha HS 12k runs at over 90 kHz and requires five video lanes to operate at its full speed of 12 Gbps. “We wanted to make sure everything works at this speed first, because it’s what our customers need to satisfy their line rate and resolution requirements,” he said. “If we use Infiniband x12 cables, we can expand to 48 Gbps.”

The path for approval

The AIA standard development process includes multiple steps to make sure the whole committee agrees with what’s being developed, said Kinney. “We have a discussion with the full Camera Link coordinating committee, and then it goes to the technical committee for action,” he said. “Then, it’s a matter of how many companies are participating and how long it takes to work out all the details.”

Fryman explained that the Camera Link technical committee, which is a subset of the larger coordinating committee, will approve and maintain the standard, develop and write support documentation, and establish technical certification and validation requirements. “The technical committee concept is new to Camera Link now that we’re entering the full-blown development process in Camera Link 2, although we use it in GigE Vision,” he said. “This is the first time we’re taking a clean sheet and starting from scratch, albeit with guidance. Because of our development process, by the time we finalize a standard, all of the material that went into its making has been fully vetted and there are no surprises.” The AIA hopes to have a Camera Link 2 roadmap in May, said Fryman.

“At this point, Camera Link is nearly 10 years old, and we want to make sure we develop Camera Link 2 so it lasts for the next 10 years,” said Kinney. “That takes time, especially considering all the input that’s required for a worldwide standard. Our goal is to finalize Camera Link 2 within the next year.”

REFERENCES