QUALITYDIGEST
Published on *Quality Digest* (http://www.qualitydigest.com)

Integrating 2-D and 3-D Inspection Capability in a Single Sensor

By: Walter Pastorius

Minimize complexity, mounting, and cabling tasks

In sawmills, optimization is an in-process procedure that maximizes output of the highest-value board size and quality from the limited and environmentally valuable input of randomly shaped logs. During the optimization process, 3-D profiles of each raw board are analyzed before positioning saws. This way, each board can be optimally edged to exact width and trimmed to length, which removes defective areas and improves quality and productivity at the end of the line. When optimization is properly implemented, yields can improve by 15 percent or more. In a larger sawmill with a two-shift system, cutting an average of 80,000 board feet per shift, results in 40 million board feet (MMBF) per year. This means that an additional 15-percent yield improvement results in 6 MMBF per year. At $225 per thousand board feet (MBF), an impressive return of $1.35 million per year is possible.

During board production, traditional optimization involves mounting banks of 3-D laser sensors above and below board conveyor lines to provide high-density, 3-D geometric profiles of each rough board as it passes the inspection station (figure 1). The differential configuration, with sensors above and below the conveyor line, provides true board profiles even if boards aren't sitting flat on the conveyor. Typical inspection rates are up to 120 boards per minute, with some systems running as high as 200 boards per minute. Depending on the length of the boards, 20 or more sensors may be implemented for full-surface coverage.

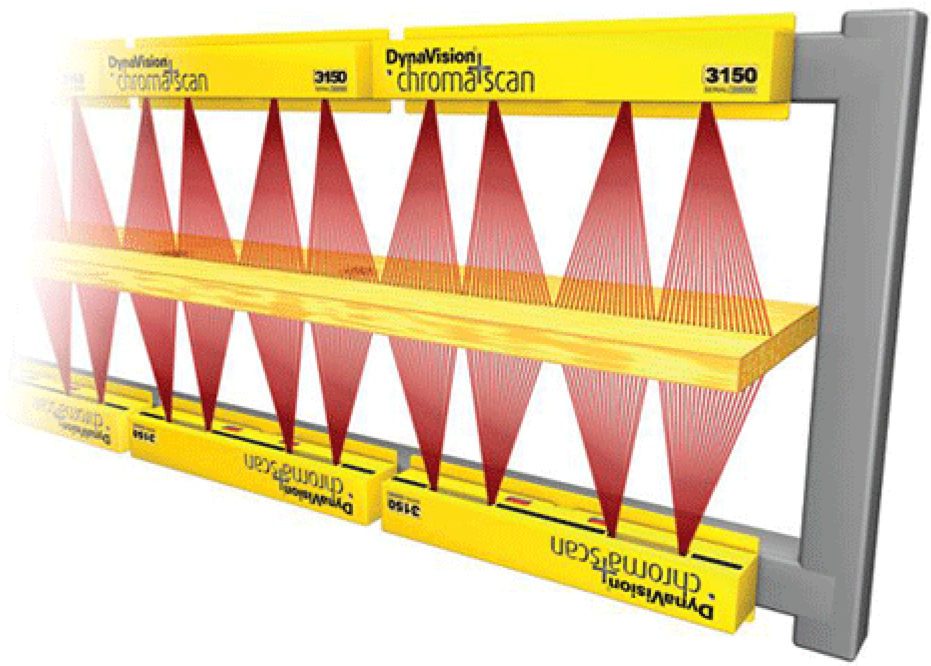

Figure 1: Typical board inspection system

During the past three decades, 3-D sensing has evolved significantly, with profile resolution improving from 3 in. (76 mm) to 0.3 in. (7.6 mm) spacing; frame rates have increased to 2 kHz. These improvements provide much higher density data input to the optimization process, detecting smaller defects and allowing much better decisions on cutting paths.

The next step to improve yield is implementing automated detection of surface defects such as knots, splits, and stains on the boards, using 2-D, full color surface inspection. Implemented early in the process, 2-D information is analyzed to automatically cut out surface-defect areas from the boards. This eliminates the cost and time required to process defective board sections, only to discard them at the sorting station at the end of the process stream.

Adding a separate 2-D surface-color inspection station to the line would be a challenge. The integration task would be significant, involving mounting separate 2-D and 3-D sensors, cabling all components, transporting, tracking workpieces through the two inspection areas, and synchronizing data from all sensors to match the 2-D and 3-D data to the same zone on each board to ensure proper decision making on each piece. The resulting system would consist of many separate elements, with the end-user faced with high system-acquisition cost, increased floor space requirements, and the need to support and maintain all the components and their interconnections.

To simplify the integrator's challenge for these types of applications, LMI Technologies has introduced a family of sensors, which combine in the same sensor package 3-D high-density profile scanning with true-color 2-D imaging for automated visual inspection of surface defects. Built into each sensor are laser projectors for 3-D profiling as well as high-power LEDs and imagers for surface imaging. With a frame rate of 2 kHz or higher, these sensors provide high-speed inspection capability. One such sensor, the LMI DynaVision chroma+scan 3300 3-D profile and color sensor, is shown in figure 2.

Figure 2: The chroma+scan 3300 3-D profile and color sensor

Integrating 2-D and 3-D inspection capability in a single sensor package is only the first step in simplifying the inspection task. Implementing “smart sensor” technology further reduces the integrator’s work. Sensors are provided with internal processing, which applies the optical calculation equations and factory-developed linearization factors. This provides automatic gain control to ensure accurate readings that are independent of the object’s surface texture and color, and converting measured values to engineering units.

In many sawmill and other applications, obtaining high resolution requires implementing multiple sensors, each inspecting a zone of the workpiece. In a system built from discrete and separate sensors, this creates challenges of synchronizing data and stitching multisensor data streams into a single data file. To simplify these tasks, LMI has developed a synchronization platform known as FireSync. This platform is designed to accept and integrate data from multiple vision sensors, as well as other local inputs such as encoders and photocells monitoring the part conveyor.

Combining 3-D measurement and 2-D color data in the platform also allows for internal parallax correction of the 2-D map that can be caused by the workpieces’ variation in thickness or movement toward the sensors. This ensures the 3-D profile and the 2-D color map match exactly, no matter how the workpiece is positioned. Figure 3 shows the 2-D color and 3-D profile data outputs from the sensor.

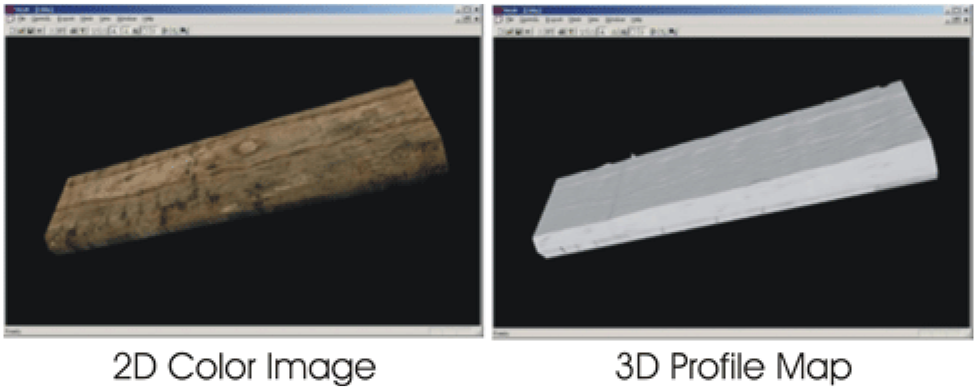

Figure 3: 2-D and 3-D data outputs

Connecting high-speed sensors to a host system processor can still present challenges. Even with smart sensors that internally reduce optical information to engineering measurements, it is common for sensors to output hundreds or thousands frames per second, with each frame containing hundreds to thousands of data points. Adding complexity is the frequent need to locate the sensors remotely from the system processor, which requires reliably transmitting masses of data over long cable lengths. Using an industrial standard communication protocol simplifies the integrator's job and reduces cost and implementation risk. Although a number of standards are available—such as USB 2.0, FireWire, and Camera Link (developed specifically for industrial and scientific gauging)—each has useful features. Gigabit Ethernet (GigE) has proven to be broadly accepted and easy to apply, with inexpensive cabling running up to 100 m without repeaters. Data are sent from the platform over a single GigE output cable to the host computer, reducing wiring costs and improving reliability.

A typical example of chroma+scan 3300 sensors carrying out combined 2-D and 3-D inspection of boards is shown in figure 4. In this case, 10 sensors are used, five above and five below the conveyor for full-surface inspection.

Figure 4: chroma+scan 3300 sensors inspecting boards
Photo courtesy of Comact Equipment Inc., (Saint-Georges, Quebec, Canada).

Sensors with combined 2-D and 3-D sensing simplify the task of integrating complex, multifunction inspection systems. With internal data processing in the sensor, multiple-sensor synchronization and data-stitching provided by the FireSync platform, and standard GigE communications, risk and development costs for the integrator are minimized. Combined function sensors minimize complexity, mounting, and cabling tasks, and reduce system cost. When the system is installed, the end-user benefits from system simplicity, with reduced maintenance costs and ease of operation.

Metrology Article   Quality Insider Article   Twitter Ed

- Home
- the Insider
- Videos
- Magazine
- Privacy Policy
- Resources
- Search
- Subscribe
- Advertise
- About Us