Panel and Sheet-Based Circuit Inspection

It's no secret that electronics manufacturers employ machine vision inspection systems as part of their manufacturing processes. This is an industry that understands that locating defective parts before they are shipped to a customer improves the product's quality and saves time and money.

An Ontario-based company that builds processing systems for the PCB, electronics assembly, and medical device markets, has developed a solution that uses vision to inspect panel and sheet-based circuit features.

The system combines machine vision with integrated material handling automation for high-volume production. With multiple cameras operating in parallel, the system acquires images at a resolution better than 5 microns and implements algorithms to make highly precise and accurate measurements. The machine architecture allows for real-time image acquisition, processing, and analysis of multiple parameters per object, at over 60 parts per second. The system is scalable to higher resolution and throughput.

Screen-printed medical sensors are arranged on the sheet in 20 columns and 40 rows. The five bi-directional TDI line-scan cameras are spaced 4 columns apart. The sheet is scanned in 4 passes, so the first camera sees columns 1, 2, 3, 4, the second camera sees 5, 6, 7, 8, and so on. The odd numbered columns are scanned from top to bottom, and the even numbered columns are scanned from bottom to top. The three Matrox Odyssey XCL vision processors are connected to cameras 1 and 2, 3 and 4, and camera 5 respectively. At the sheet's Y axis, an encoder provides a quadrature signal through a custom-designed circuit that triggers each Matrox Odyssey XCL to acquire a line every 5.1mm.

A flexible printed circuit panel is shown on the vacuum platen, in front of the five inspection cameras and LED light sources.

At the start of each scan, the Matrox Odyssey XCL boards begin grabbing small frames into a circular buffer. Every time one of these buffers is filled, a call-back function copies a portion of the image into another buffer - one that is large enough to store the entire image of the sheet and wide enough to contain the ROIs (Regions of Interest). Processing threads wait until enough image data is acquired before processing the next sensor location.

Each camera locates a fiducial and measures the grayscale colour of several swatches on the sheet. The fiducial location is used to adjust the sensor ROI locations, and the grayscale measurements are used for determining binarization thresholds. The image processing performs several binarization and blob analysis operations to prepare the images for the measurement operations that are performed on the sensor geometry. In order to ensure measurement accuracy, images of USAF 1951 calibration targets are acquired and measured at the start of every automated inspection task. A combination of blob analysis and marker measurement functions was used to determine the vertical and horizontal pixel scaling factors of each camera.

The acquired image data can be saved to disk for viewing; the operator can also set options and save either all sensor images or only those that have failed inspection.

The biggest challenge faced by the design engineers was how to acquire and process large amounts of data without overhead. "The engineers felt that a parallel structure was the way to go, so the Matrox Odyssey XCL boards both capture image data and process that data in parallel," says Young. Process Photonics also needed to synchronize multiple TDI linescan cameras with the motion of the parts, while the Matrox Odyssey XCL performed the image processing from each camera. The image data is acquired and processed on the Matrox Odyssey board, without needing to be transferred to the PC over the PCI bus.

Original article courtesy of Matrox Imaging.

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