

TECHNICAL NOTE:

Where No Machine Has Gone Before: Automated Assembly Verification that Surpasses Manual Inspection for Speed, Accuracy and Consistency.

For high-precision, highly-detailed, complex, or low-contrast assembly inspection tasks, Radiant's INSPECT.assembly solution is more accurate than human vision, and offers the speed, consistency, and data advantages of automation



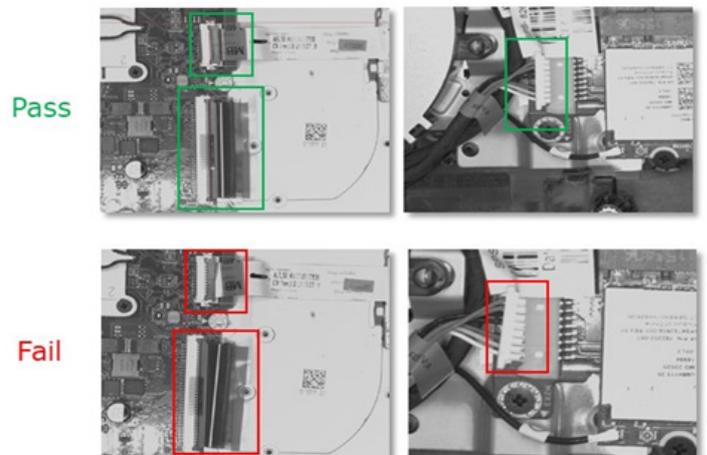
The more complex an assembly, the greater the chance an error will occur during production—and the more challenging it becomes to visually verify assembly integrity. Standard machine vision systems are unable to capture images at a high enough resolution to detect all defects in a complex electromechanical assembly, especially when errors are defined by very small or subtle tolerances.

For this reason, many manufacturers use human inspectors for complex assembly verification of high-value devices. They rely on an inspector's heightened visual acuity and excellent judgment to identify and grade critical defects. However, human inspectors are, well, human. They are easily fatigued when studying intricate arrays and configurations of components for extended lengths of time. Their determinations may be inconsistent from person to person. And sometimes they miss small details like a misrouted cable that could lead to latent failures once the product is in customer hands.

Despite these drawbacks, some manufacturers continue to rely on human inspectors simply because machine vision and other automated technologies have been unable to detect critical defects or match the accuracy of human judgment to evaluate defect severity. Photometry-based imaging systems—like Radiant's INSPECT.assembly solution—now offer the best of both worlds for high-precision assembly verification: visual detection capabilities that match or exceed the acuity of human inspectors, with the speed, repeatability, and quantifiable data of machine vision systems.

Limits of Human Performance. Although a wide variety of defects are easily detectable to the human eye, the accuracy of human inspection decreases precipitously as the complexity of a surface or assembly increases. Defects on products that exhibit visual patterns ranging from complex arrays to entirely random features are more likely to be missed by human inspectors. The human eye is easily fatigued by scrutinizing parts with a high degree of detail and a variety of contrasts and colors within a small area. Human inspectors require frequent eye rest breaks to avoid a decline in performance. The most demanding inspection tasks may require breaks as frequently as every 10-15 minutes, increasing staffing requirements.

Photometric Inspection. Because INSPECT.assembly's software is based on Radiant's leading photometric software for light measurement, the system can inspect assemblies in intricate detail using the same techniques employed to evaluate properties of light. Software tools for detecting just-noticeable differences (JND) in visible light uniformity (in illuminated components) can detect anomalous contrast variations (on non-lit components).



Loose connectors are an example of the type of small gaps and angles on a complex assembly that are difficult for humans to detect and judge in just a few seconds (top), but which can result in latent failures if they detach during movement or vibration. Photometry-based imaging systems can spot these defects (bottom) and prevent escape.

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This capability allows the INSPECT.assembly system to identify unknown defects (unpredictable features and shapes) in unknown locations (unprogrammed points of interest), just like a human inspector.

Exceeding Human Accuracy. The INSPECT.assembly system leverages an imaging system with broad dynamic range enabling it to detect hairline contrast variations on part surfaces caused by reflections of light (like shadows that indicate a drill hole, or spectral reflections that indicate a metal component). The system can capture and classify defects with extreme precision, processing images at high speed with minimal image noise. INSPECT.assembly's cameras offer resolutions that far exceed traditional machine vision systems, enabling detection of defects so subtle that they go unnoticed by human inspectors (for example, a gap variation between components of less than 1mm, or the absence of tiny black screws on a black surface).

Improving Consistency & Repeatability. Humans provide heightened visual acuity and judgment to identify and grade critical defects. However, this judgment tends to be inconsistent. In cases where absolute defect detection of complex assemblies is required, manufacturers may employ several human inspectors to provide repeat inspections of parts to ensure all errors are detected. This is a costly method, especially on production lines where downtime is limited, requiring several shifts of multiple inspectors on the line for consistent quality control.

By contrast, automated imaging systems can operate continuously for repeatable defect detection. These systems do not lose their efficacy over time. You can apply consistent defect evaluation regardless of part's complexity, since performance is not affected by limited data capacity. Imaging systems can also analyze images to quantify defects using precise spatial measurements compared to pre-programmed tolerances, ensuring consistency across multiple lines and factories.

Quantifying & Recording Data. Unlike humans, a machine can process multiple data points simultaneously, quantify and evaluate each data point, process and communicate data with speed (even wirelessly) and store large amounts of data for long periods of time. The INSPECT.assembly system can detect and classify defects of specific types, assigning values to each defect and matching exact tolerances for acceptable severity, scope, or proliferation of the defect over the visible area.

INSPECT.assembly is a production-line inspection station that provides the objectivity, endurance, and repeatability of a machine vision system, combined with detection capability

equal to and even surpassing human perception. More capable of precise visual detection and analysis than standard machine vision systems, photometry-based imaging systems offer a specialized solution for the most challenging visual inspection applications.

Bridging the gap between human and machine vision inspection, manufacturers using INSPECT.assembly can improve product quality and production efficiency for a clear return on investment.



The turnkey INSPECT.assembly station performs sophisticated pass/fail analysis right on the manufacturing line, providing the acuity of human inspectors at production speeds

Recognized for Innovation

Radiant Vision Systems was honored with a Silver-level award at the *Vision Systems Design* 2017 Innovators Awards for our INSPECT.assembly system (formerly the VIS-I system).
