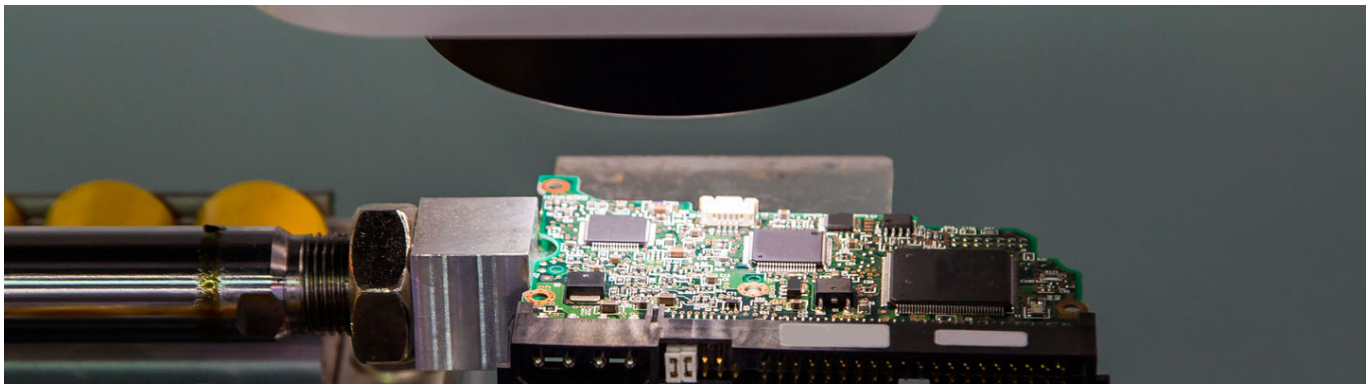

Machining

Up Close with Metrology Equipment: Vision Inspection Systems

Don Sears | Aug 20, 2019

Vision inspection systems have been incredibly affected by today's digital and data-driven technology. Learn how it has changed, become less prone to errors and helped ramp up part quality in efficient and automated ways.

The tools and machines for inspecting parts have evolved in pretty big directions. To better understand today's vision inspection system technology, it helps to understand how it's changed—and why.

We spoke to an engineering and product specialist at Mitutoyo to find out.

The Evolution of Metrology Equipment: Profile Projection Comparators vs. Vision Inspection Systems

The first comparators were commonly known as "shadowgraphs." They allow for measurement via a shadow "cast from a magnified image of a workpiece onto a screen with an overlay chart," writes Quality Magazine in the ***article*** "Comparators: More Than Meets the Eye."

"That technology has been around since the 1950s, but it's still used in shops today," says Mark Sawko, a product specialist at ***Mitutoyo***. Sawko has been with the company for 15 years and was a former optical application engineer.

Mitutoyo still sells comparators—but the technology itself has come a long way. They used to be very large, six-to-seven-foot machines with a big light that illuminates the part from behind.

Today's comparators are smaller.

Source: Mitutoyo

“People still like it because it’s easy,” says Sawko. “They’ve been using comparators in machine shops their whole professional lives. Some shops want to stick with what’s comfortable for them.”

Today’s comparators are also digital. You line up the crosshair on the screen with one edge of the part and then take a digital readout, or “DRO.”

“So you move that crosshair to one side of the part, you hit zero for the X value of the DRO, for example, then move the crosshair over to the other side of the part and then just read off with that number’s value, and that’s your distance, in inches, millimeters, whatever you’re measuring,” Sawko explains.

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Another Layer of Inspection: Touch Probing

There are vision systems that also allow a part to be better understood. Enter probes. While probing has a different role than vision for part accuracy, they are sometimes combined to help give a complete and accurate picture of measurement for quality.

“So let’s say you have a hole cut through your part and you want to measure the diameter, that’s easy with a vision system: The camera can do that, no problem,” says Mark Sawko of Mitutoyo. “But if you want to know the cylindricity of the hole, in other words, you want to make sure that that entire length of the hole is cylindrical or if you want to know how perpendicular that hole is to the top surface of the part, the camera on a vision machine can’t see that. It can never see down the axis of a hole, it's always seeing the top of that hole.”

So you need a touch probe. You add that to a machine and probe down inside of the hole to get an accurate reading. If you do not have a touch probe in the vision system, you’re likely to need to use a CMM, or coordinate measuring machine—which will add time to the process, Sawko explains.

Some vision systems actually use lasers to help measure. Cameras are great tools in vision systems, but they also have some limitations when a part has many features that need measuring and you’re looking for speed.

“If you’re measuring the height 1,000 times on a part, say you have 1,000 pins, adding a laser doesn’t make it any more accurate … But it speeds up that height measurement process a ton,” says Sawko.

How the Computer and Data Influenced Vision Inspection Systems

Comparators are a very straightforward way of measuring and serve their purpose quite well. But there’s a catch. They come with some built-in limitations.

“The accuracy of comparators is limited to how well the operator can line up the crosshair with the part edge,” says Sawko. “With a vision system, you’re taking the operator out of it and gaining a ton more accuracy than you get with a comparator.”

With a vision system, the edge of a part is determined automatically. It uses today’s advanced computer software and a camera that can capture much more detail than a backlit part that is projected.

“The camera gathers light better than a comparator does,” says Sawko. The comparator uses profile lighting, which is good for seeing the outside edges, but not for seeing the surface of the part.

Some of today’s comparators have more than one source of light, but because it is still a projection, it is limited by mirrored light. A vision system with a good camera allows a quality inspector or machine operator to capitalize on profile lighting and a uniform surface lighting—some of which include a ring light around the edge of the camera—to see and measure more of a part to a greater level of certainty.

And because of the automated nature of today's vision inspection systems, measuring the quality of parts becomes that much more efficient. There's simply less room for error—and the inspection process is much faster. And as everyone in manufacturing today knows, speed matters.

"Most visions systems are CNC, i.e. motorized and controlled by computer. So basically you write a program and the machine automatically moves around and measures the edges and surfaces," says Sawko.

What else is happening in today's inspection technology? Read "Where Metrology Meets Today's Precision Manufacturing."

In very advanced vision inspection systems, they can be palletized, so they can potentially inspect many more parts at once than a comparator. And because they are machine programmable, efficiency really gets ramped up.

"You can write a program and then the software can tell the machine and the camera, OK, move to this location, take a measurement now, move to the next location, etc.," says Sawko. "So basically, you can have an operator walk up, put a part down on a vision machine, call up a program, hit the 'go' button, and then they could go off and do something else while that machine's measuring either that part or have a pallet of several parts."

Understanding the Variety of Vision Systems

Mitutoyo breaks its product lines into three distinct areas. There are those that are always CNC-based, what it brands as "***Quick Vision***." For those shops that do not need speed and automation or who may have smaller budgets, there is "Quick Scope" and "Quick Image." The scope line is always a manual operation. The Quick Image product line can be manual or motorized.

"Quick Vision" is for shops that have prioritized accuracy over everything else. The top of the line is known as the "ultra" and is known for being "one of the world's most accurate vision system," according to Mitutoyo. This high-end product is used a lot by governments for sophisticated measuring to meet standards. Think NIST, the National Institute of Standards and Technology.

Manufacturers that work in fiber optics also use the high-end ultra system.

"If you're running light down a bunch of tiny fibers, and you have one end of one fiber lining up to another end of another fiber, if the two ends don't line up exactly right, then you lose signal because all the light doesn't get through it," Sawko explains. "So these connectors are challenging. The tolerances are really, really tight, to insure the fibers snap together as accurately as possible."

Quick Image, on the other hand, uses "telecentric" optics to get a depth of field shot quickly and accurately.

"All of the part is in focus the whole time it is being measured," says Sawko. "So it's much faster than a comparator—and sees more of the part."

How sophisticated is your quality inspection operation? Are you using vision systems and touch probes? Talk to your peers in the metalworking forum. [registration required]

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