BY ANDREW BROOKS

Hand & EYE

3D quality inspection benefits from optical and contact metrology

Laser scanning has come a long way over the last few years. Fueled by advances in information technology and the continuing march toward Industry 4.0, the devices have become more accurate and more affordable, capable of gathering millions of data points much more quickly and easily. The process has become steadily more intuitive, requiring minimal training, and the software has continued to enable more functionality and improve existing processes.

Compared with contact metrology, laser scanning is undoubtedly faster, more portable and capable of gathering a much greater volume of data points in a single pass. But there are unique use cases for each kind of metrology.

A 2016 article on Engineering.com referred to a poll that found users of laser scanning technology valued it for accuracy, speed and portability. Other advantages include colour capture/high definition resolution, cost and ease of use.

The article's headline provocatively suggested that laser scanning is simply better than contact metrology, but while the article did tout the advantages of optical scanning, it also made the point that optical and contact metrology each have

MEETING OF THE MINDS

There isn't always a gap between contact and optical metrology, depending on the kind of system being used. Certain variants of contact metrology can gather huge volumes of data points, or even deliver analog—i.e. line or continuous—results rather than a series of discrete points. In such systems, the touch probe is dragged or swept across the surface of the work piece, remaining in direct contact throughout the process.

Such systems are most commonly used for measuring larger threads, gears and turbines, says Jamie King, Canadian regional manager for Blum-Novotest. "A turbine's a good example, because they're difficult to scan by means of points. If you've got a line in a part, or some kind of deviation on the surface where it's not smooth, you might actually skip over that if you're just checking from one point to another. Dragging the probe along the scan is going to pick up everything."

Blum-Novotest's Digilog touch probe employs analog contact scanning, accumulating a continuous profile or path while mounted on the production machine. Data gathered from the work piece is compared with data previously registered from a master part. "Physically it looks like a normal touch probe, but instead of collecting points you actually use the tool path," King says. "You drag it across. Normally this is a scenario where you're going to look at every part, because they need to check a particular feature before the part comes off the machine."

Application of laser sensors for direct surface measurement is increasing but technical and procedural obstacles are significant, says Bill Miller, vice president, sales and service for Kapp Technologies, Boulder, CO. "Contact probes utilizing sophisticated internal optical systems are greatly impacting the industry."

Kapp's German parent company, Kapp Niles, manufactures gear and component finishing machines. On-board measurement was offered on its machines beginning in 1994. Building on this experience, a new company, Kapp Niles Metrology GmbH, was founded this year.

Kapp-Niles Metrology has chosen to opt for contact measurement using Renishaw probes. "It's not part of our portfolio to have direct laser measurement for now. We focus on proven, reliable measurement by contact probes," Miller says.

"Laser scanning has come a long way, especially for some applications where it's possible to demonstrate a much higher accuracy and repeatability than you might

their advantages.

Any choice between options entails a compromise, and with laser scanning the big compromise is–and will continue to be for the foreseeable future–accuracy of measurement. Optical methods will continue to be most appropriate where the highest possible degree of precision isn't required. But because line of sight is required, they are susceptible to poor environmental conditions and are more difficult to bring to bear on deeply recessed features or oblique surfaces. The degree of surface reflectivity can also create problems.

However the increased data point density of laser scanning is crucial when inspecting a free form surface, says Peter Detmers, president of Mitutoyo Canada. He uses the example of a car body.

"If you want to make sure the front doors are flush with the rear ones, or the truck is flush to the fenders, you don't have big issues with those surfaces. Gathering points data around locations where those gaps would be is highly important in order to verify those values. You want high speed and anticipate. I think in some respects that's what we're seeing with the application of lasers."

There's been a drastic increase in the use of optical scanning devices, says Jérôme-Alexandre Lavoie, product manager, Creaform. "A lot of people are turning to 3D scanning and optical technology instead of touch probing devices. It's mainly because they provide more information, not necessarily more accuracy–though they do in some cases. It's the amount of information that is driving the market towards this type of technology."

When data gathering volumes reach the level of 500,000 points per second or even higher, the result is virtually an organic, analog profile, Lavoie says. "It's like you're spray painting a part. You see the entire surface appearing over the areas that you have gone over. It becomes very easy to make the connection between the digital world and the piece in front of you on the shop floor." The volume of information makes it easier for the user to assess how their mould, jig or fixtures need to be modified, and ultimately reduce scrap rates as a result.

Blum-Novotest's Digilog probe inspecting a part.

Lavoie adds that some optical systems can compensate for factors such as vibration, an important consideration as metrology increasingly moves out of the quality lab and onto the shop floor. "Conventional portable articulated arms don't have a tracking system in between the part and the measuring device, and so the device has to be very rigidly anchored."

Lavoie says that technologies like Creaform's C-Track dual-camera sensor have this capability. "With the targets applied to the part, even if the part moves or the C-Track or the tracker moves, it doesn't affect the measurement because every time you take a picture, it also registers the measurement device in real time."

With hybrid positioning, optical scanning goes a step further. Hybrid positioning uses adhesive targets, but also enables the user to use the geometry of the part itself to do the positioning of the scanner. "It also allows you to use the colour and texture of the part to register the scanner positioning in real time," Lavoie says. "You can position based on colour only, based on geometry only, based on colour and geometry, and also using targets."

Aside from portability, the key advantage to optical scanning is ease of use. Lavoie takes the sale of some 100 of Creaform's HandyScan 3D scanner to customers in the oil and gas industry for pipeline corrosion inspection as an illustration.

"This is a conservative industry that's used to working with pit gauges and depth gauges. For them, going from a pit gauge to a 3D scanner, there's a degree of reluctance." That feeling is similar in different industries, Lavoie says. Customers are hesitant to jump from a metrology lab scenario where a trained quality control technician is doing the work, to a portable device on the shop floor–or, in this case, in the field–where the user likely isn't highly trained in metrology.

"You have to have systems that are very simple to use, but intelligent enough not to record bad data," Lavoie says. "When you buy a can of spray paint you don't get a user's manual with it: you just open it and start painting. That was the idea with the HandyScan 3D. The goal was to have people open the box, connect the scanner and start right away.

the high data point collection, but relatively low accuracy is required."

For higher degrees of accuracy, Detmers says contact measurement or a traditional CMM will still be the preferable option.

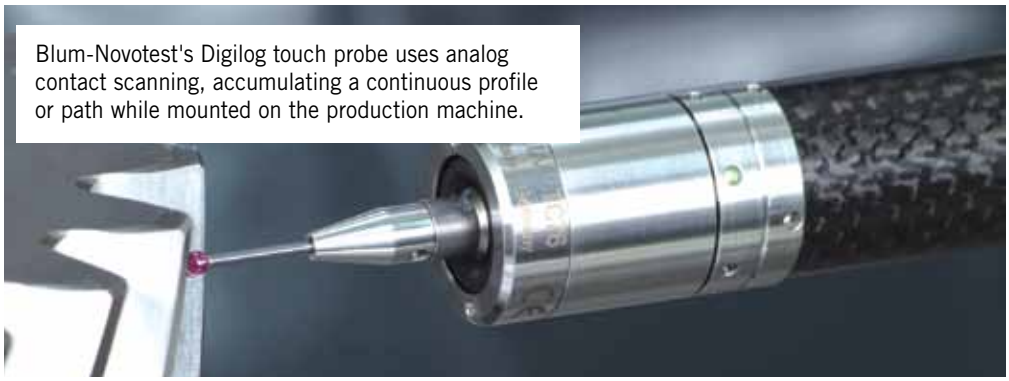
"If you look at an example like an engine block, there's nothing, aside from the casting, on an engine block that would be conducive to that type of laser or optical measurement," Detmers says. "What's important is that cylinder bore. You can only 'see' the surface, you can't see 50 mm down from the front face, and what you can't see, you can't measure.

"Once you machine something, you're starting to get out of that realm of optical scanning technology and more into tactile type probing, or a three-dimensional vision system where you can employ either type of measurement–optical and tactile." Mitutoyo's Quick Vision is one such platform.

The Engineering.com article also noted that laser and contact metrology can be useful in tandem. In one example taken from the aerospace industry–which is notorious for demanding a high degree of precision–a company acquired laser scanners to reduce the workload on its CMM. It still uses the CMM for post machining inspection, but it puts the lasers to work scanning the part before machining begins to ensure there's enough material to be machined.

"That's a great application for [laser scanning], and it's quick," says Jamie King, regional manager, Canada for Blum-Novotest. "They don't want to find out six hours into machining that one part of the casting didn't have enough material on it to actually machine a feature. So they scan first. You don't need micron accuracy; you just need to make sure there's material." SMT

Mitutoyo's Quick Vision employs optical and tactile measurement methods.



Blum-Novotest's Digilog touch probe uses analog contact scanning, accumulating a continuous profile or path while mounted on the production machine.

www.blum-novotest.com
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A bank of Renishaw's Equater gauging systems being used in a machine shop.

A key advantage of Creaform's HandyScan is ease of use, says Jerome-Alexandre Lavoie.