Plant Services

3D scanning: Measurement, made better and faster

Faster and more accurate than ever, 3D scanning tools can be a powerful addition to a plant's quality control arsenal.

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It's measurement, made better and faster. 3D sensing and noncontact scanning technologies are transforming how many manufacturers gather measurement data both for machinery parts and assembled products – enabling faster and more accurate inspections and improved quality control. And in today's "lean"-obsessed manufacturing environment, the time savings and accuracy that 3D scanning promises for a variety of applications can translate into significant efficiencies for plants.

"I think (3D) scanning is on the cusp of great growth in the next couple of years," says Jerry Hardy, a segment marketing manager for Lake Mary, Fla.-based FARO Technologies, which makes the Focus line of 3D scanners. FARO has one of the biggest stakes in the industrial 3D scanning market, but recent analysis from Allied Market Research seems to back up Hardy's assertion. In a report issued last summer, Allied estimated that the 3D scanning market will reach $4.9 billion by 2020, with a compound annual growth rate of 12.4% through that time.

The fact that 3D scanning has extensive applications in big-bucks industries beyond manufacturing – healthcare (patient modeling), entertainment (think Microsoft's Xbox One Kinect), and architectural engineering among them – may be a boon for the technology's adoption in manufacturing. This broadening proliferation in other sectors "does increase the general awareness" of 3D scanning, says Pierre Aubrey, president of Ottawa-based 3D scanner maker ShapeGrabber. And rising familiarity with the technology encourages manufacturing companies to explore how they can make 3D scanning work for them, especially from a quality control perspective.

Twenty-five years ago, early 3D scanners were a go-to primarily for reverse engineering parts for which duplicates or product specifications were not readily available. Some plant directors still view them narrowly from that perspective, Aubrey says.

"The No. 1 misconception (about 3D scanners) is the purpose of a scanner is to reverse engineer a part," he says. Thanks to advances in hardware and software, today's scanning devices boast a range of quality control applications that take 3D scanning far beyond its original utility.

For example, by enabling computerized 3D visualization of machinery, pipes and more (and how everything fits together, literally), 3D scanning lets plant managers get a 360-degree view of their assets – especially valuable when trying to get a comprehensive view of equipment that resides in poorly lit or hard-to-access places. 3D scanning also allows for the creation of scale models of assets with unprecedented accuracy. And "smart" 3D sensors positioned along a production line enable instant scanning and measurement of items moving along a conveyor belt, allowing those that don't meet product specs to be diverted from the line.

With 3D scanning, "you're taking human error out of the equation," Hardy says. Moreover, measurement processes that used to take several hours can be completed in a matter of minutes.

In the drive to make plants "smarter," then, 3D scanning has the potential to deliver accurate measurement data more quickly, letting plant directors get a better picture of wear and tear on their assets and make better-informed decisions sooner about asset and space management in their facilities.

Evolutions in 3D scanning

A game changer for 3D scanning is the advent of lightweight, handheld sensors that can go virtually anywhere. Boasting accuracy in the range of 0.1 mm to 1.5 mm, depending on the device, and able to capture up to hundreds of thousands of data points per second, these sensors facilitate first article inspections and tooling inspections on the plant floor. Creaform's HandySCAN 3D and FARO's Scanner Freestyle 3D are among the crop of new point-and-scan handheld tools touted for their ease of use, eminent portability and range of applications.

Beyond handhelds are similarly small-profile tools like LMI Technologies' Gocator smart sensors, which can be mounted to a robotic arm to allow for 3D inspection and scanning on an automotive assembly line, for example. (They're called "smart" sensors because they're designed to combine 3D scanning, measurement, and sorting and pass/fail control functionalities within one device, negating the need for an accompanying PC and software.)

What all of these next-generation 3D scanning and sensing systems have in common is that because they don't require contact with the surface of an object, unlike traditional coordinate measuring machines (CMMs), they can capture millions of data points exceptionally quickly – within a few minutes. In addition, they can be an appropriate choice for collecting data on soft surfaces (those that would yield upon contact with a CMM probe, resulting in inaccurate measurements and an inaccurate 3D model) or highly complex shapes.

For digitalization and measurement of large objects and machines and for surveying applications, tripod- or base-mounted 3D laser scanning tools may be more appropriate. FARO notes that the 3D models its Laser Scanner generates can be used for building management, as-built documentation for CAD modeling and other large-scale design and control tasks. With accurate, up-to-date 3D models of their facilities, manufacturers may be better able to plan maintenance and downtime work and identify opportunities for space optimization.

"You have 100 percent confidence that what you're bringing into your CAD programs is truly representative of what's on your floor," Hardy says. "What you see is what's out there."

Tabletop or stationary noncontact 3D scanners can be valuable for smaller, off-site scanning jobs – an obvious application is for periodic parts inspection in a specialized metrology lab – and documentation of new parts and prototypes. Again, when the surface of an object is fragile or intricate, noncontact 3D scanning can allow for accurate measurement and preservation of the integrity of the object.

All of this is to say that the type of 3D scanning tool most appropriate for a given application depends on what's being scanned, where, why, and the degree of accuracy required. Further, a plant's determination of whether to purchase 3D scanning equipment or contract with a 3D scanning service provider will depend on the purposes for which 3D scanning will be used. Infrequent scanning, especially for surveying and asset visualization, may make

outsourcing the task a more attractive and cost-effective option. Plants looking to incorporate 3D sensing and scanning as a quality control tool, especially in production-line applications, likely will be looking at a heftier investment in these new technologies.

Limits of 3D scanning

Mike Knicker, president of Irvine, Calif.-based dimensional measurement services provider Q-PLUS Labs, is quick to point out that 3D scanning isn't a solution for every industrial measurement application.

"It's not the holy grail of measurement that does everything you want it to do," Knicker says. Today's 3D scanning tools aren't as optimal as traditional CMMs for measuring cavities or holes, he says. And 3D scanning represents more of a "brute force" approach to measurement – if all that's needed is accurate measurement of a hole, a contact CMM can get the job done with perhaps a half-dozen points of measurement. Using a noncontact 3D scanning sensor for the same task could result in a situation of, "I don't know what the diameter is but I've got 1,000 data points on it," Knicker says. Furthermore, he adds, "You can't do super-precise measurements like valves that go into aircraft (using 3D scanning) – those still have to be measured conventionally."

Still, the technology has come a long way in the past decade, Knicker notes, and the 3D scanners currently on the market offer much greater accuracy than 3D scanning skeptics may think. "In my travels, I've seen sort of two schools of thoughts," Knicker says. "One is that (a 3D scanner) is a magical device that can do all sorts of things that it can't do." The other, he says, is a "stronger-than-justifiable skepticism" about the usefulness of the devices, based especially on the fact that there's not yet a formal American or international standard for determining a 3D scanner's accuracy.

As with a lot of things, "the reality is somewhere in between," Knicker concludes. Technology improvements and wider adoption of 3D scanners spurred efforts to develop calibrated scanners that allow for National Institute of Standards and Technology traceability of measurements. And the speed of today's scanners is unparalleled.

"I've been in the field for 35 years, and it literally makes some processes 100 or 500 times faster than they used to be," he says.

Adds ShapeGrabber's Aubrey: "I had one customer a while ago that was using a manual CMM ... it was taking them six hours to validate each one of the components" they were analyzing, he says, thanks to the many complex and curved shapes that had to be measured. When a 3D scanner was deployed, "they were able to bring that down to five minutes," he says.

Greater ease of use, especially for portable 3D laser scanners, is another factor that both speeds the measurement and documentation process and is helping encourage wider adoption of the technology. "In prior years, you needed to be an expert in engineering or CAD to understand how to use the device, know what kind of measurements you need, et cetera," says FARO's Hardy. Today's laser scanners, with touchscreen design, are designed to be exceptionally operator-friendly and ready for use within minutes.

The compact size of portable new scanning devices can appeal from other practical perspectives. Of note for engineers and technicians who may want to travel with the devices to perform inspections at multiple facilities, tools like FARO's Focus 3D products can fit in a bag stored in an airplane's overhead compartment. Individuals traveling with a piece of equipment worth tens of thousands of dollars tend to want to be within arm's reach of it, Hardy notes.

An additional benefit offered by today's more-accurate 3D scanners? They can help manufacturers accept imperfection, so to speak: 3D scanning can aid in adjusting a product mold to correct for very small warpages that result in the manufacturing process. "3D scanning allows you to build corrections around that," Knicker says. "When the warpage is taken into account, you wind up with pretty much exactly what you want."

What to look for

Measurement sometimes gets overlooked in terms of manufacturing investments, Aubrey says. But as more manufacturers see the quality control (re: cost savings) benefits that 3D scanning offers – and as prices come down – that may finally change, he says.

The manufacturing industry will see plants "jump a couple of generations of technology" to take advantage of the major advances in 3D scanning, Aubrey says. "It's just a huge jump in performance," he adds.

"I think people are realizing, 'Oh, this does work,' and in many cases it's a good way to do inspection," says Daniel Howe, regional development manager for the Americas at LMI Technologies. The opportunity to automate 3D scanning and sensing tasks through incorporation with robotic elements also represents a step forward in creating smarter, faster, more efficient plants.

"I really think it takes an open mind by a user that this technology can work and does work," Howe says. And while 3D scanning doesn't work for everything, he says, "it's getting more flexible, more affordable, and it comes with a greater amount of embedded solutions."

"When you think of asset management, you think of a living, breathing thing that a (plant director) wants to manage," adds FARO's Hardy. 3D scanning provides "a living inventory that can be created off of the scanning data," he says.

The pace of change in the 3D scanning field is such that Q-PLUS's Knicker cautions warns those standing on the sidelines against paralysis by analysis. "In the end it's like a lot of things," Knicker says. "You can study it and study it and study it, and eventually you just have to dive in."

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