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VISIONx INC.

The Fastest, Easiest, Most Accurate Way
To Compare Parts To Their CAD Data

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Optical comparators, also referred to as profile projectors, were first introduced in the 1940s and are still widely used today in a broad range of industries to verify that manufactured parts are within tolerance. These instruments are well suited for use on the shop floor as well as in the metrology & QC labs because they are versatile, easy to use and very robust. They also deal well with complex geometries (i.e. shapes not easily described by simple elements like lines and circles) and, up until now, they have been the easiest way to quickly compare a part to its drawing to allow the operator to make an overall PASS / FAIL determination.

No More Overlays!

While optical comparators are generally considered to be a cost effective measuring tool, it is widely recognized that they rely on old technology and suffer from a number of shortcomings. The most important of these is the need to use an overlay, also called a template or a Mylar™. With traditional optical comparators, the part's drawing is scaled to match the comparator's optical magnification (typically: 5X, 10X, 20X, 50X and 100X) and printed on a transparent overlay. This overlay is then placed on top of the comparator's screen and aligned with the image of the part. The operator can then ascertain if the part is within tolerance. There are many problems related to the use of these overlays, including the following:

- The cost of the overlays
- The cost and maintenance of the equipment required to print the overlays
- The cost and maintenance of the equipment required to calibrate the overlays
- The time required to print the overlays
- The time required to calibrate the overlays and verify the calibration
- Using overlays inevitably introduces an error when printing the part’s drawing onto the overlay (no printer is perfect)
- Overlays can tear, be damaged, stained, wear, etc.…
- Overlays need to be physically stored & retrieved. This takes both time & storage space
- There is a risk that the operator selects the wrong overlay
- Overlays can only be used by one person at a time
- If vendors / suppliers are required to verify parts, overlays must be physically supplied to the vendor / supplier resulting in time delays and added costs
- Setting up overlays on a comparator is a slow and operator-intensive process
- It is impossible to “recall settings” for an overlay (i.e. position & orientation). The operator needs to re-align every time that he sets up a part

VISION*x* has recently developed its VisionGauge® Digital Optical Comparator (Patents Pending) which solves all of these problems and many others as well.

This new instrument uses a very high-resolution digital camera and a very low distortion telecentric lens to capture a very high resolution and geometrically exact image of the part. The software that is at the heart of this new instrument then projects this image, along with the part's CAD overlay, onto a very high-resolution quad monitor display. This approach produces images with an on-screen resolution better than that of traditional 30" optical comparators. It also allows for a number of benefits over traditional optical comparators, including the following:

- It produces a very high contrast image so that there is no problem viewing it in full daylight
- It is more accurate than traditional optical comparators
- It can carry out automatic Pass / Fail determinations, completely eliminating operator subjectivity and error
- It can automatically send measurements and data to a spreadsheet, text file, database, etc...
- It allows the user to be more productive and get more work done with a single machine
- It employs direct CAD data so that no overlays / templates / Mylars™ are required
- It can be used to collect images (either with or without the CAD data overlay and with or without annotations), measurements and data.
- It can carry out fully automated measurements (like a video CMM)
- It has a smaller footprint and uses less floor space than a traditional optical comparator
- It can be easily moved without requiring re-calibration (i.e. “rolling cart” configuration is standard)
- It has a greater depth of field, i.e. “everything is in focus all at once”
- It has a longer working distance thus more clearance between the part and the lens
- It allows you to compare a part to its CAD data beyond the optical field-of-view (because the CAD data tracks the part and follows the stage motion)
- It has LED illumination for very stable illumination over a 10 year life. This means that there are no more bulbs to change!

This new instrument is the ideal tool when you need to compare a part to its CAD drawing. It is appropriate for a wide range of industries including orthopedics, medical device manufacturing, automotive, aerospace, energy, precision mechanical components and assemblies, etc... It is also appropriate for higher magnification and very high accuracy applications such as Micro Electro-Mechanical Systems (MEMS) device manufacturing, electronics, semiconductor, etc...

Early adopters include the orthopedics, automotive and aerospace industries, among others. In the orthopedics industry, 100% of all parts must be inspected and compared to their CAD data during the manufacturing process, directly on the shop floor. These parts are implants with complex geometries and tight tolerances. In this application, the Digital Optical Comparator's higher accuracy provides an obvious benefit. Because parts are often be made in small batches, there is a constant need to change the overlay. With traditional optical comparators, this involves removing the overlay, walking over to the overlay storage area, finding the correct overlay, walking back to the machine and positioning the overlay. All of these operations can easily take a few minutes. With the Digital Optical Comparator, the operator only needs to scan in the work order's barcode or press a button on the screen to automatically call up the correct overlay, which comes up already correctly positioned over the image of the part. The productivity gains are immediate and all possible errors are eliminated!

In the automotive industry, this new instrument is used to check flexible parts, among other things. Comparing flexible parts, such as door and window trim, to their CAD data is notoriously difficult and the Digital Optical Comparator's ability to quickly and easily align the part and the drawing using an intuitive 3-axis 3-speed joystick makes the job much simpler.

In the aerospace industry, customers are checking critical areas such as the fir tree on engine blades, impellers, etc....

Like traditional optical comparators, the Digital Optical Comparator uses collimated back illumination to produce very clear and crisp images with sharp edge profiles. However, while traditional optical comparators typically use halogen bulbs that need to be replaced on a regular basis, this new instrument uses up to date LED technology that provides very stable illumination over a 10 year life. As is the case with traditional optical comparators, front illumination is also available (to carry out surface inspection, for example).

Higher Throughput

Customers report that they are getting more than twice the throughput from the new VisionGauge® Optical Comparator. This is because part setup is so much faster with this new instrument. The system's barcode reader allows users to automatically load in a part's CAD drawing by simply scanning the barcode on the router that accompanies the parts. No need to sort through drawers of overlays!

Additionally part recall can be done by pressing a single button. The system brings everything back exactly the way you set it up. Part changeover is therefore much simpler and almost instantaneous.

Increased Accuracy

There are many factors that underlie the VisionGauge® Digital Optical Comparator's much higher accuracy relative to traditional optical comparators. The first has to do with the system's optical system. As with all things manufactured, it is impossible to produce a perfect lens and all lenses have defects and imperfections, to varying degrees. Furthermore, the difficulty in producing a lens increases dramatically with its size. Traditional optical comparators require extremely large lenses to project the image of the part onto their 30" screen. The Digital Optical Comparator, on the other hand, only needs to project the image of the part onto the camera's sensor, which measures approximately 1". This lens can be manufactured much more accurately and the raw image that is projected onto the camera sensor of the Digital Optical Comparator is thus much more geometrically accurate than the image projected onto the 30" screen of a traditional optical comparator.

The Digital Optical Comparator's camera produces a digital image that is sent to the system's on-board computer. The software can then carry out further corrections on this image to eliminate the last, very small geometric distortions and inaccuracies. This is the second reason for this new system's increased accuracy: the Digital Optical Comparator carries out mathematical corrections to the image to make it virtually perfect!

Another reason for this new instrument's significantly increased accuracy is the fact that the software is capable of sub-pixel edge detection which, unlike human operators, can accurately locate edges between pixels and not just on the pixels themselves. The fact that the system works directly with the part's CAD data and does not use Mylars™ - which necessarily have inaccuracies - is a further reason for the system's increased accuracy. Finally, the system's Auto Pass / Fail tool, which completely eliminates operator-dependent subjectivity, is another significant factor in the system's higher accuracy.

The use of a small camera sensor, instead of a large 30" projection area, is at the root of the Digital Optical Comparator's superior optical properties: a much greater depth of field and a longer working distance. It is the principal reason why these systems have a much smaller footprint and require less manufacturing floor space than traditional optical comparators.

Because this new instrument works with a digital image, it is able to carry out fully automated measurements, with sub-pixel accuracy, just like a video CMM.

Compare the Part to its CAD Data Beyond the Optical Field-of-View

Another significant benefit to this novel approach is the fact that the Digital Optical Comparator can compare a part to its CAD drawing beyond the optical file of view. With traditional optical comparators, the overlay is fixed on the screen and doesn't move when the stage carrying the part moves. With the Digital Optical Comparator, the overlay "tracks the part". This means that if you have a part that is larger than the field of view, you can move the stage to see another portion of the part and the overlay will follow the stage. The CAD drawing moves with the part!

Summary

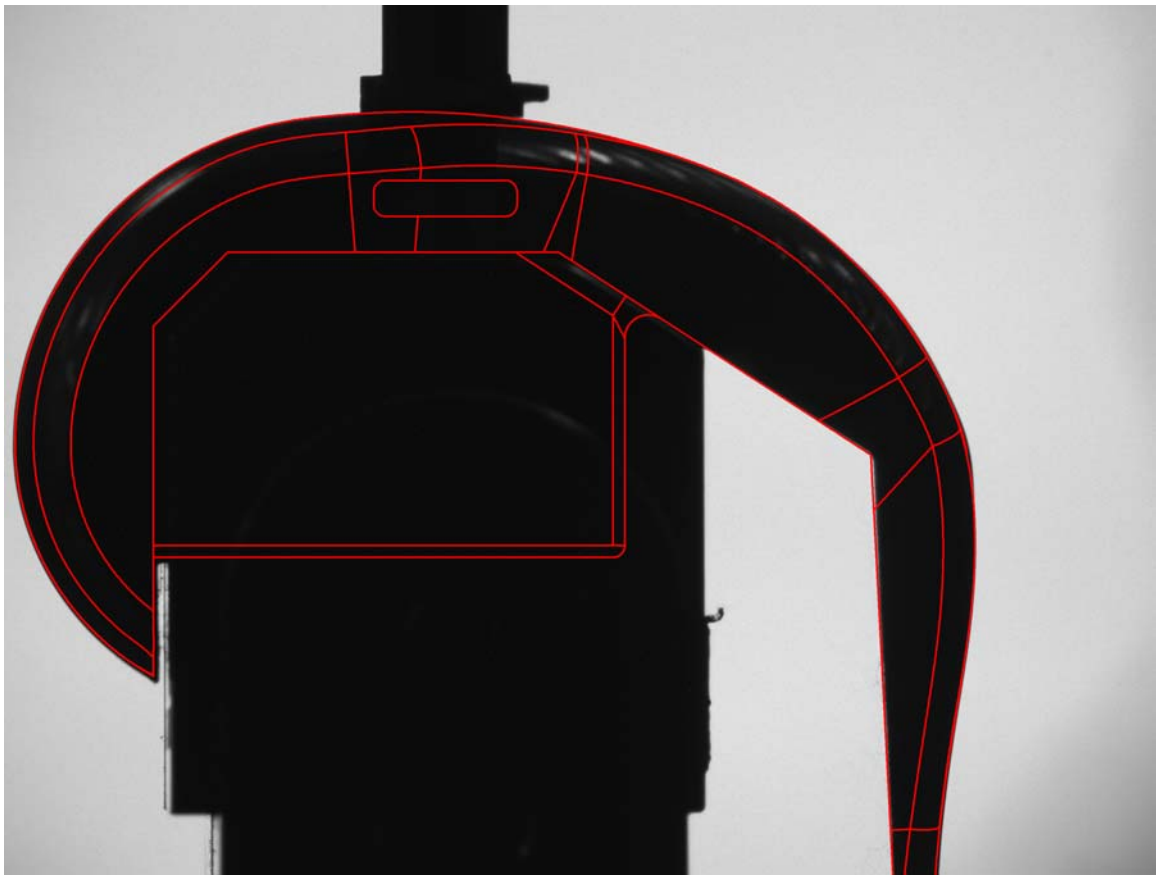
These systems are completely software-driven making it possible to automate all of the operations. As a result, you can operate this new system using only a barcode reader and a joystick. This results in significant productivity gains. Users typically report a doubling of their productivity with this instrument, i.e. they can get twice as much work done with a single machine.

The Digital Optical Comparator's digital image can also be saved to disk, either with or without the CAD data overlay and with or without annotations, along with measurements, annotations and other data. This is extremely useful for documentation and collecting device history in the medical industry.

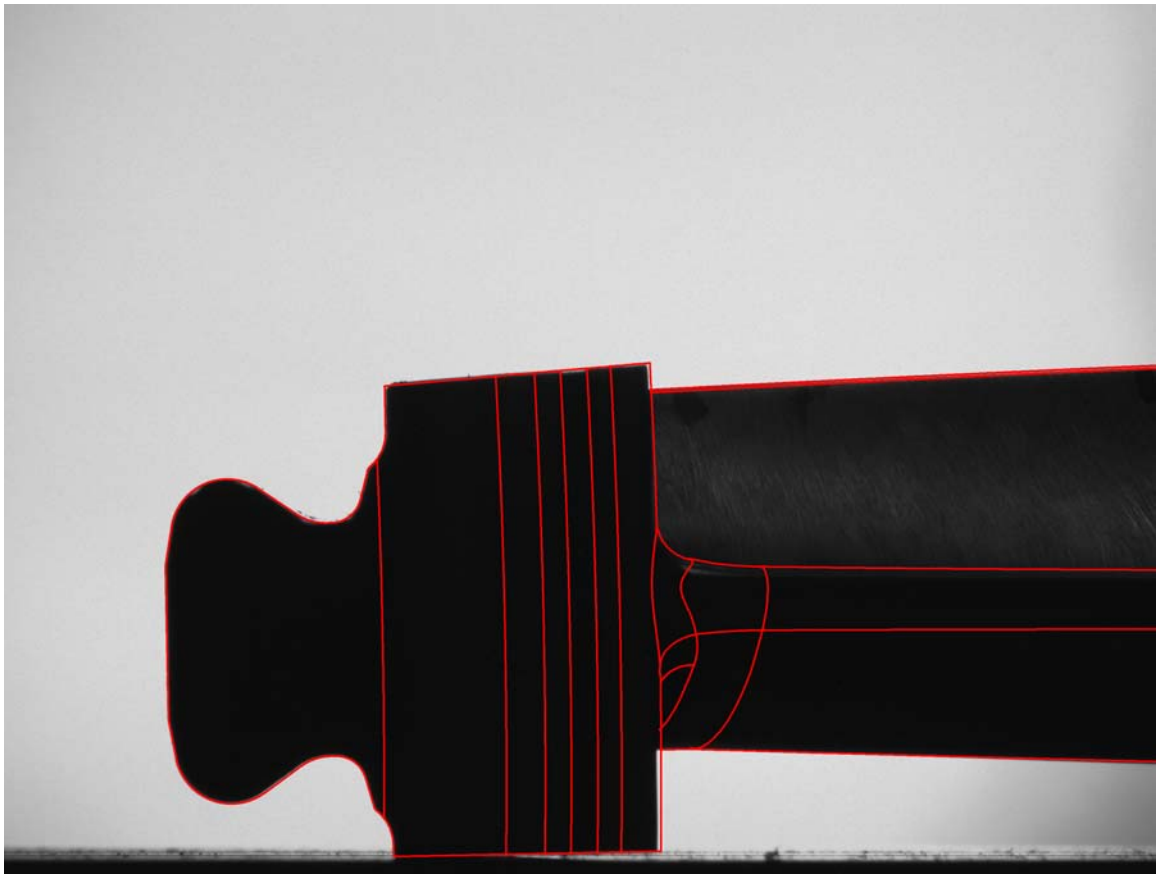
The new VisionGauge® Digital Optical Comparator is a very easy-to-use system that is perfectly suited for both the shop floor and the metrology lab. It is available in both horizontal and vertical configurations, single and multi-mag configurations, with industry-standard 5X, 10X, 20X, 50X and 100X magnifications. This new instrument brings optical comparators into the 21st century. It uses advanced technology to offer a better solution to the classic manufacturing problem of ensuring that parts match up with their CAD drawing.

Overall view of the VisionGauge® Digital Optical Comparator.
In this picture, we can see the collimated LED back illumination module (on the left),
the stage and column (towards the middle of the picture)
and the quad monitor display (top).

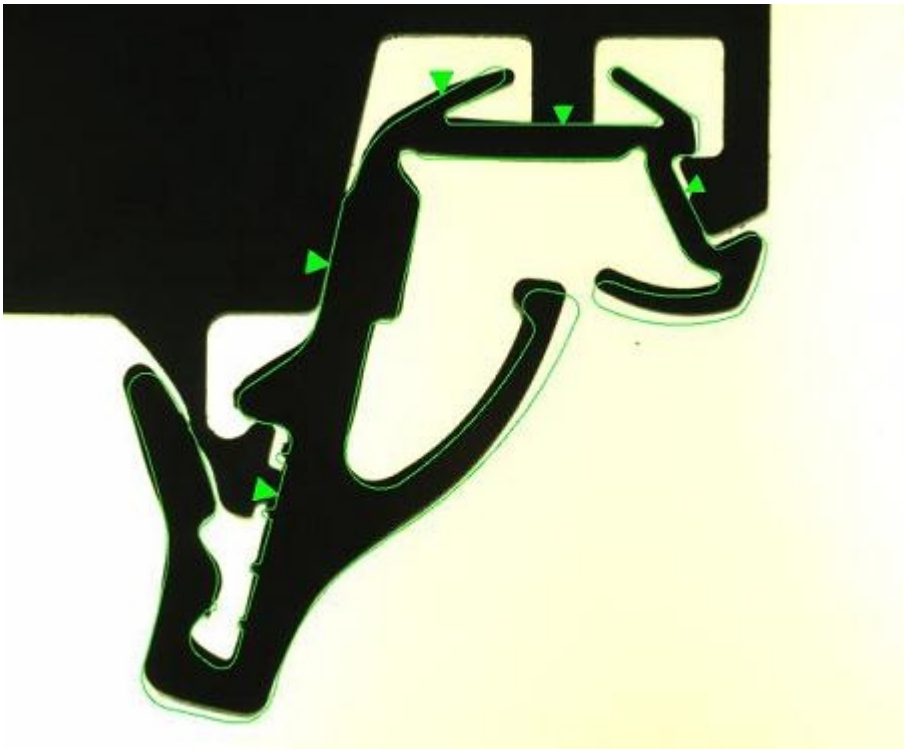
The VisionGauge® Digital Optical Comparator is also available in Vertical Configuration.



The overlay of the part's CAD drawing onto the live video image of the part.
In this case, the part is a knee implant in the orthopedics industry.



A "fir tree" compared against its CAD data from the aerospace industry.



A typical application for this new instrument in the automotive industry

Image of a part (an orthopedic hip implant) using traditional transmitted (i.e. back) illumination. This produces the maximum edge / profile sharpness.

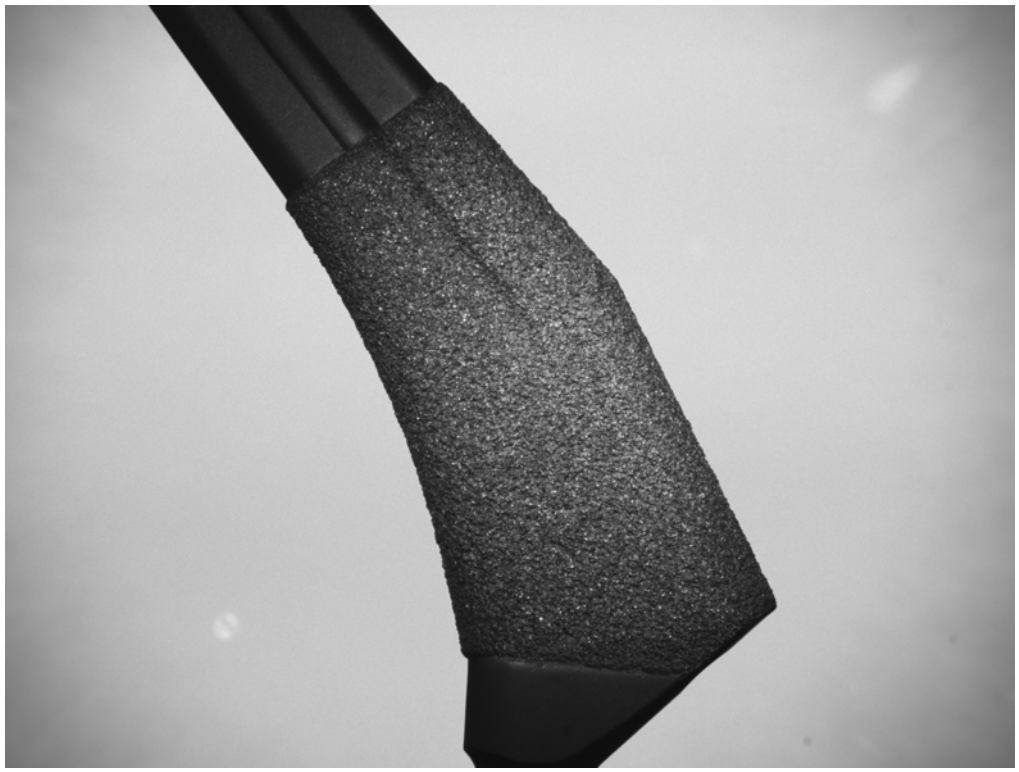


Image of the same part using both transmitted (i.e. back) and reflected (i.e. front) illumination. In this case we can also inspect the surface of the part.