PRESS RELEASE

New 3D sensor scans transparent objects

Jena (Germany)

A new measurement method for 3D shape acquisition has been developed by researchers at the Fraunhofer Institute for Applied Optics and Precision Engineering IOF. With their "MWIR 3D sensor", they can scan objects three-dimensionally, regardless of whether they are made of transparent plastic or glass. Even objects with shiny metallic or jet-black surfaces can be detected without any difficulties. Combining different materials is also no problem for the new 3D infrared sensor. In the field of 3D sensor technology, this degree of flexibility in the properties of the object is a first. Applications are conceivable in areas such as quality control in production and robotics. The system will be presented for the first time at this year's international trade fair "Control-Virtual".

Until now, if you wanted to measure reflective, transparent or black surfaces accurately with conventional 3D scanners, you first had to treat the surface for this purpose. This means that the objects were temporarily coated with varnish for the measurement. After the scan, this usually had to be removed again at great effort.

Glass and transparent objects become visible to machines

The latest invention by Fraunhofer IOF will make this impractical and time-consuming treatment of the object superfluous in the future. Due to the size of the measuring field as well as the resolution and speed, the method is also suitable for quality control in production processes or for applications in automation.

This is possible because researchers at the Fraunhofer Institute in Jena, Germany have succeeded in making thermal radiation usable for 3D measurement. The researchers therefore refer to this method as "3D sensing in the thermal infrared range". At the heart of the system is a high-energy CO2 laser with which the objects are irradiated.

Using special lenses for high power densities, the laser beam is expanded into a line that vertically illuminates the entire object. For a high-resolution measurement result, this line is moved over the object in a specially coordinated sequence. The energy of the laser light is absorbed by the measured object and partially re-emitted.

Editorial Notes
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Combination of thermography and triangulation

Two thermal imaging cameras analyze the thermal signature left by the narrow and intense infrared line on the object from two different perspectives. Afterwards, a software developed in-house calculates spatial pixels from the information of the two viewing angles and merges them into the exact dimensions of the measured object.

The thermal energy introduced for the 3D analysis is so low that the object is not damaged. The temperature difference between heated and non-heated surfaces is typically less than 3 °C. For this reason, the method is also suitable for sensitive materials.

"By switching from a full-surface thermal pattern to a narrow thermal strip, we have succeeded in advancing the technology in such a way that we can meet the requirements placed on a 3D sensor in industrial use," emphasizes Martin Landmann, a researcher of the "Imaging and Sensing" department at Fraunhofer IOF. Together with his team and a group of researchers of the innovation alliance "3Dsensation", he has been working on the system since 2017.

"With adaptive mirror optics, we have succeeded in focusing the power of the laser on a much smaller surface, thus providing the necessary contrast for the thermal imaging cameras much faster. Only this made it possible to achieve an accuracy of less than 10 µm for the 3D coordinates with a field of view width of 160 mm," he explains.

Conceivable applications in robotics

Following the successful scientific demonstration of the new measurement method, the researchers are now working intensively to make the measurement principle ready for the market: "For us, it is now a matter of transferring the system from the laboratory to practical use," explains Landmann. He already has concrete areas of application in mind: "The parameters of our system allow us to optimize it for different application scenarios. If we reduce the resolution to below 50 µm, we can record a stereoscopic data set in under a second and are thus fast enough for applications in robotics."

At Fraunhofer IOF, researchers are currently developing various systems based on the MWIR 3D measurement method. In addition to optimizing the method for various measurement scenarios and applying it in industrial plants, the team led by Martin Landmann and group leader Dr. Stefan Heist is working on a system for use in robotics. This system focuses on transforming the laboratory setup into a prototype that is as compact and robust as possible. In this way, robots can be enabled to recognize and grasp transparent objects.

First MWIR 3D system "Glass360Dgree" presented at "Control-Virtual"

The first application-oriented system to use this MWIR 3D measurement principle is "Glass360Dgree". The system is specifically designed for inspecting glass bodies in optics manufacturing and will also be used by research partners in the further course of testing how the measurement method can be integrated into a wide variety of robotic processes. The Fraunhofer IOF researchers will present "Glass360Dgree" to the public for the first time at "Control-Virtual", the international trade fair for quality assurance, starting May 3.

Trade journal “inVISION” honors new sensor as “Top Innovation 2021”

The new 3D measurement method in the thermal infrared region was recently selected as “Top Innovation 2021” by the magazine “inVISION” - a trade journal for the topics of image processing, embedded vision and measurement technology. “We are very pleased about the inVISION award,” says group leader Dr. Stefan Heist. “This is a wonderful confirmation of our intensive work over the past years and a great motivation to keep enhancing our 3D thermal system.”

Video demonstration and scientific publication

You can see a video demonstration of the measurement system on YouTube. The researchers also published their fundamental scientific developments on the MWIR 3D method at "The European Physical Journal Conferences 2020".

About Fraunhofer IOF

Light is a versatile tool. Due to its diverse applications as well as excellent properties as an electromagnetic wave and as a light particle, it is a key technology for future challenges of the modern world.

With this in mind, the Fraunhofer Institute for Applied Optics and Precision Engineering IOF, based in Jena, Germany, conducts research on the development of light as a means of solving a wide variety of problems and application scenarios. The work of the institute, founded in 1992, focuses on applied research in light generation, light guidance, and light measurement.

The interdisciplinary pooling of the institute's own expertise in the fields of optics and precision engineering allows Fraunhofer IOF and its cooperating partner organizations to develop complex and unique photonic components and systems. Together with researchers from basic research and industry, innovative solutions are created that represent a technological advantage in science and industry and open up new fields of application for photonics.

Press Photos

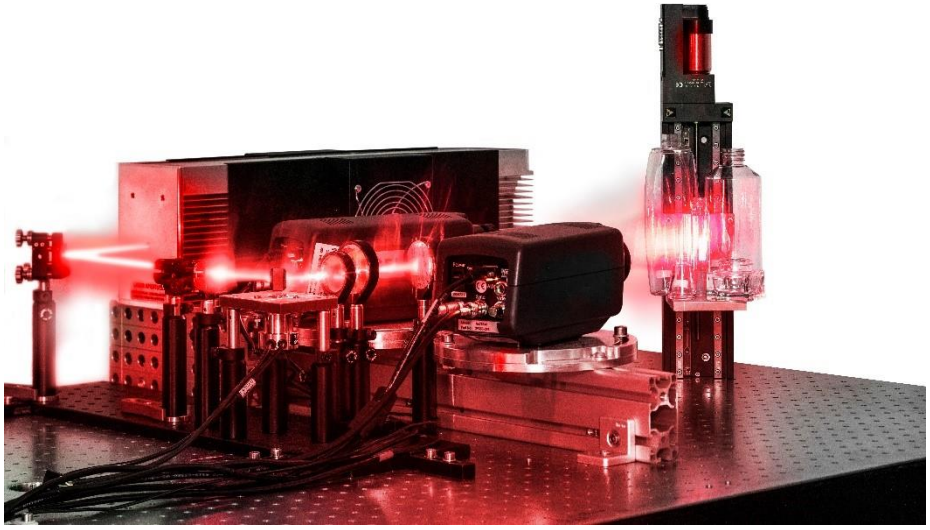

Fig. 1: Laboratory setup for demonstrating the MWIR 3D measurement principle (Copyright: Fraunhofer IOF).

Fig. 2: "Glass360Dgree": First MWIR 3D system for the inspection of glass bodies in optics manufacturing (Copyright: Fraunhofer IOF)

Fig. 3 / Fig. 4: "Glass360Dgree": First MWIR 3D system for inspecting glass bodies in optics manufacturing (Copyright: Fraunhofer IOF)

Fig. 5: The system uses thermal radiation for 3D detection of transparent objects (Copyright: Fraunhofer IOF)

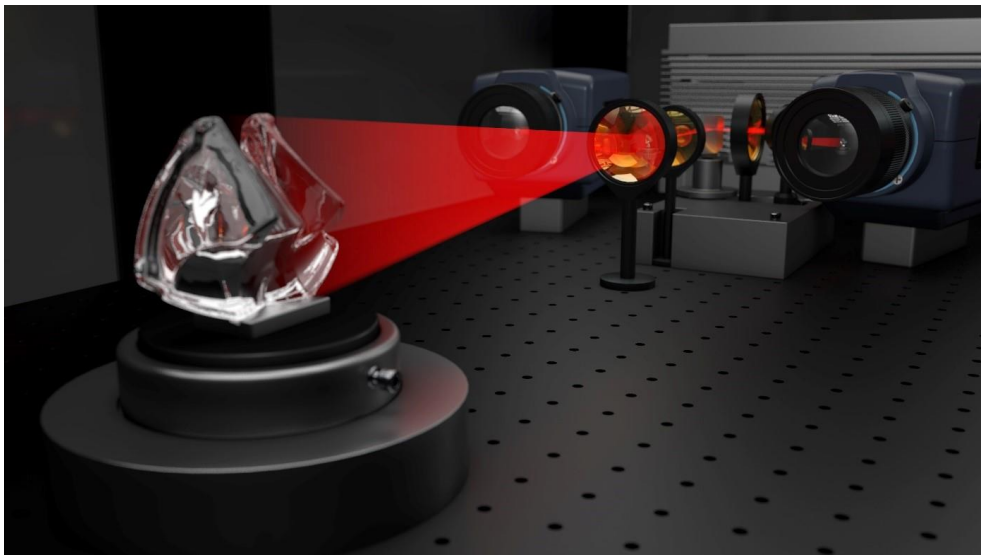

Fig. 6: "Glass360Dgree": Visualization of the 3D scanning process (Copyright: Fraunhofer IOF)

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