TELEDYNE DALSA
Everywhereyoulook™
Part of the Teledyne Imaging Group

Application Note | Case Study | Technology Primer | White Paper

3D LASER TRIANGULATION

3D vision technology has found its way into many industries today. The technology has found its way into medical, science, automotive, food production and sorting applications, and is found on production floors, in automation, security, and quality control. Developments in modern electronics and artificial intelligence (AI) have enabled systems to become even more powerful, and at a reasonable cost.

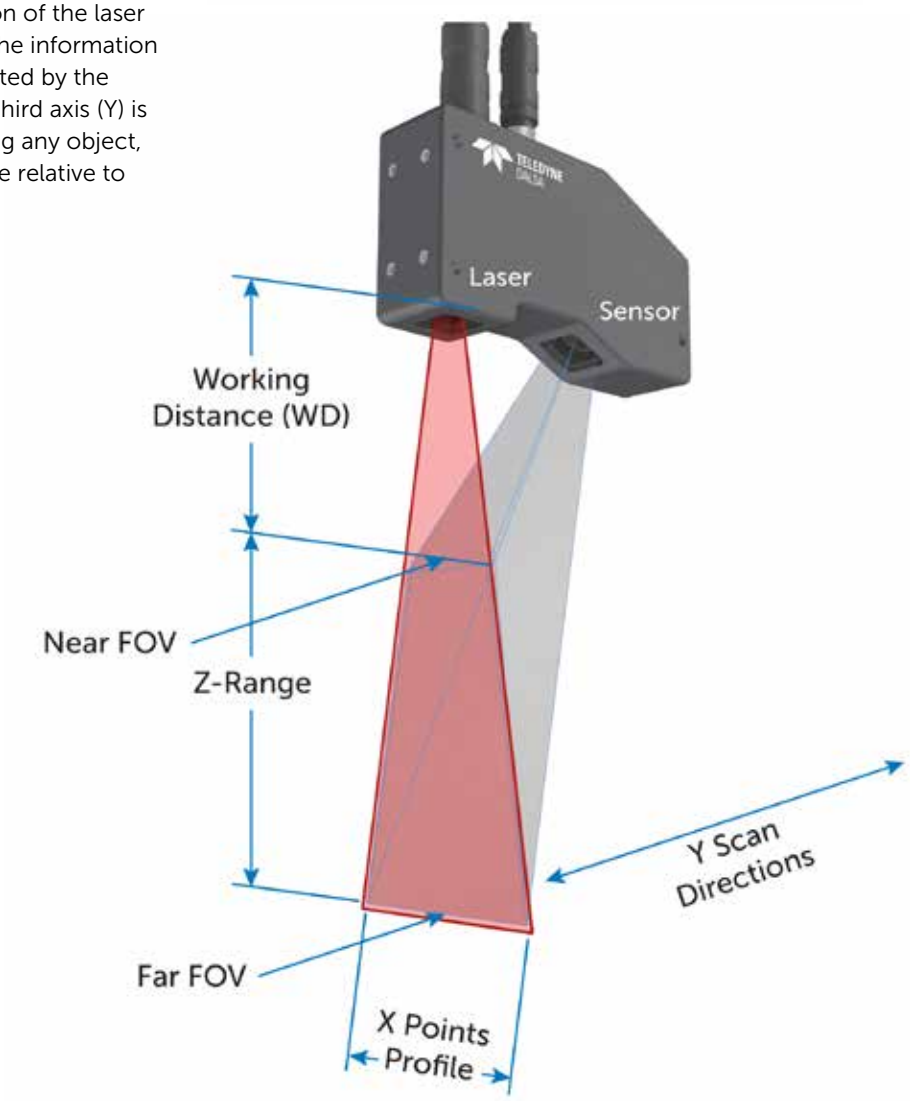
Fifteen years ago, many industries used only 1D (line scan) and 2D (area imaging) to achieve depth information based on software, lighting, and complicated arrangements. At that time 3D systems did not deliver, they cost too much or were unreliable. Measurement results from 3D inspection were often inaccurate and not repeatable.

All this has changed as 3D technologies have become low-cost, very reliable, repeatable, and easy to implement. The trend of using 3D vision systems for inspection started more than a decade ago and is still going strong as the technology is proven in a wide variety of demanding applications. Advancements and improvements in sensor quality and speed, embedded systems, FPGAs, lasers, optics, and smart systems have enabled and enhanced the world of vision by routinely taking advantage of 3D vision. While 2D is still extremely popular, 3D now has its place alongside 2D vision almost everywhere.

This article will discuss a technique known as 3D Laser Triangulation. While laser triangulation has been around for decades, today it offers high resolution, repeatability and accuracy with simple setups at very low cost. The principle of this technology is to project a laser pattern (or stripe) onto an object and observe at an angle the reflected diffusion of the laser from the object. This is laser triangulation. Very often, but not in all cases, a single laser stripe is used to simplify the systems.

Measurement Definitions

The laser stripe is projected on an object and is imaged on an area sensor. After determining the position of the laser stripe on the area sensor, the profiler gives the information for the lateral (X axis) and depth (Z axis) created by the optical triangulation of the laser stripe. The third axis (Y) is obtained by scanning the object. By scanning any object, we obtain a volumetric image (X,Y,Z) in space relative to the camera or profiler.



 Continued on page 3

Let's Look at the Benefits of Laser Triangulation in More Detail.

» **Low cost.** Laser triangulation 3D systems remain relatively low cost because laser profilers use commercial parts that are off-the-shelf. The overall system is also simple to use and implement. The improvements in recent years of CMOS imagers have made this technology very strong, reliable, and fast. In addition, the processing speed and power of FPGAs have helped greatly to lower barriers to integration.

» **Easy to use.** Laser triangulation profilers are usually very easy to use and setup. No special arrangements such as lighting are required.

» **Fast and robust.** With the advancements of high speed CMOS sensors combined with FPGA and powerful embedded systems, speed and reliability are more easily attained.

» **Wide range of resolutions, from meters to micrometers.** A wide range of optical arrangements is possible with this technology without having to change the processing architecture. Simply changing the mechanical and optical design to obtain diverse resolutions can scale from several meters down to 5 microns. Under 5 microns is also possible but increases the risk of getting the proper accuracy.

» **Accuracy and repeatability.** With proper calibration and good optics, mechanical and electronics design, accuracy and repeatable measurements are obtained easily relative to the overall cost.

» **Easy to integrate.** Because profilers are becoming more reliable and this technology is now very mature, users are not afraid to use it and willing to choose it as a preferred technology.

» **Easy to expand.** With clever architecture, many processing blocks can be added to increase the power of the systems. AI is a clear example of added processing intelligence. Pixel processing and smart sensors are others.

» **Can tolerate vibrations.** By scanning, small vibrations can actually help to reduce the overall noise created by the speckle of the laser.

And Just a Few Considerations to be Mindful of in 3D Laser Profiling

» **Occlusions.** Because laser triangulation needs to look at angles, occlusions are often a problem. Occlusions are shadows created by the positioning angle of the profiler caused by the geometric triangulation. One solution is to use one or two lasers and two cameras.

» **Laser speckle.** Inherent noise generated by the laser reduces the resolution of systems.

» **Sensor performance.** In this type of technology, the sensor may limit the speed and overall performance of the system.

» **Scene or object to inspect needs to be scanned** to obtain a volumetric image of any object.

Written by Raymond Boridy, Product Manager at Teledyne DALSA.

Originally published in Novus Light.
https://www.novuslight.com/pros-and-cons-of-popular-3d-technologies_N8910.html

www.teledynedalsa.com

Americas
Boston, USA
+1 978-670-2002
sales.americas@teledynedalsa.com

Europe
Krailling (Munich), Germany
+49 89-89545730
sales.europe@teledynedalsa.com

Asia Pacific
Tokyo, Japan
+81 3-5960-6353
sales.asia@teledynedalsa.com

Shanghai, China
+86 21-3368-0027
sales.asia@teledynedalsa.com

TELEDYNE DALSA
Everywhereyoulook™
Part of the Teledyne Imaging Group