



LMI TECHNOLOGIES

FactorySmart® Inspection

# BETTER MACHINE VISION: THE BENEFITS OF COMBINING 2D & 3D

HOW TO MAXIMIZE PRODUCTIVITY AND PROFITABILITY  
WITH AUTOMATED 2D & 3D INSPECTION SOLUTIONS

# INTRODUCTION

When combined, 2D and 3D technologies form a robust inspection system that produces a complete digital reproduction of real-world objects — including high-precision 2D intensity images and rich 3D point cloud shape data.

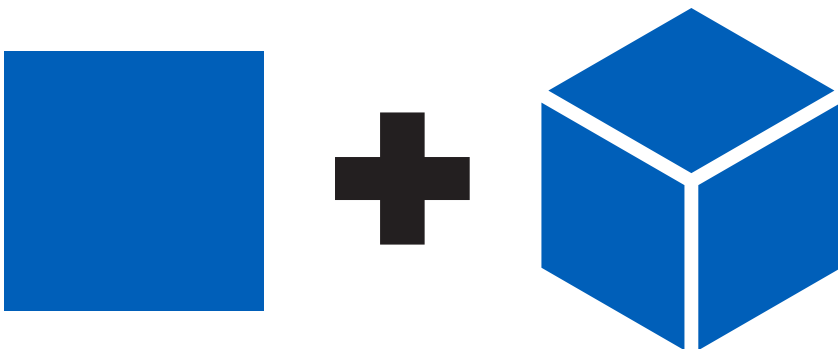
## **2D: The Trusted Scanning and Inspection Technology**

2D is the more established of the two technologies and over the past 30 years has proven highly effective in a wide range of industrial and commercial quality control and product verification applications.

## **Combining 2D and 3D Technology**

3D builds on the proven capabilities of 2D by adding a secondary layer of data describing shape, which is essential to designing highly robust measurement systems.

By looking at 3D as an additive process to 2D rather than an either/or equation, businesses can gain the advantages of 3D without sacrificing the benefits of 2D.



# 2D

## A MACHINE VISION CORE CAPABILITY

### 2D MACHINE VISION IS USED FOR...

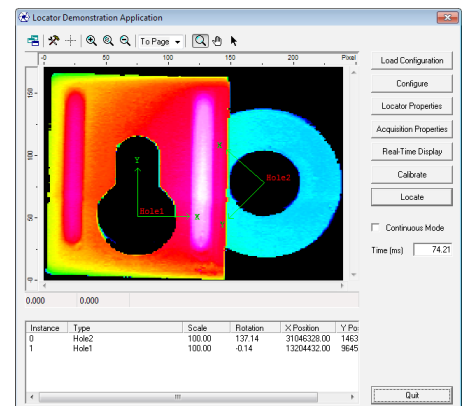
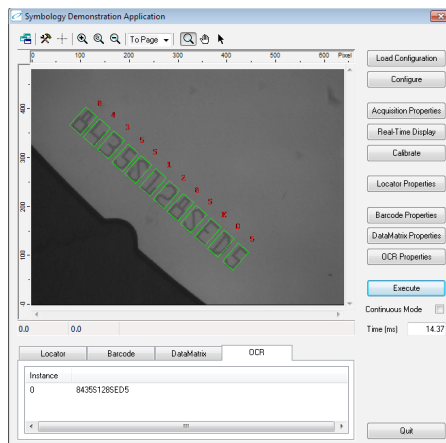
- Barcode and character reading
- Label inspection and verification
- Basic positional verification
- Feature presence and dimensional verification
- Surface defect detection

#### Contrast Driven Feature Processing

2D technology delivers results based on features relating to contrast in a grayscale or color image. 2D is suited to applications for absence/presence detection, discrete object analysis, pattern alignment, barcode and optical character recognition (OCR), and a variety of geometric analysis based on edge detection for fitting lines, arcs, circles and their relationships (distances, angles, intersections, etc).

#### Pattern Matching: A Key To Handling Part Variation

2D technology is largely driven by contour-based pattern matching to identify part location, scale and orientation. Technicians can use 2D to identify a part and create downstream inspection tools that dynamically adapt to the part's position, angle, and size for robust measurement. Today's pattern matching handles occlusions, clutter, distortion, contrast reversal, overlapping parts, and uneven lighting.



# 3D

# FOR ENHANCED MACHINE VISION FUNCTIONALITY

## Richer Data Acquisition

3D measurement produces shape information that 2D systems do not. As a result, features related to shape can be measured such as object flatness, surface angle and volume.

## Measurement Stability

All components in 3D systems are rigidly mounted on a single opto-mechanical assembly to ensure repeatability, with focal lengths locked in place relative to emitter and imager planes, and temperature compensation included for correcting any movement in the scan target.

## Precision and Repeatability

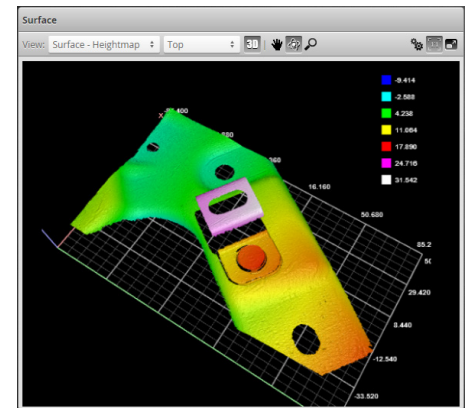
With the depth measurement information provided by 3D machine vision, errors due to object location (distance from the sensor) are automatically compensated for, meaning objects can move anywhere within the sensor's field of view and still yield accurate results. This simplifies object fixturing requirements and reduces both system design and maintenance costs.

## Data Synchronization

A further benefit of 3D machine vision is the ability to stitch together point clouds from multiple scanners. For example a large object such as a truck frame can be scanned with multiple scanners. Complex shapes can be digitized by stitching point cloud data from multiple, strategically placed scanners into a common coordinate system for CAD analysis.

## Precision Robotic Guidance

Industrial robots work in a three dimensional world. A blind robot is limited to performing repetitive and structured tasks. 3D machine vision allows a robot to sense variations in its physical environment and adapt accordingly, increasing flexibility, utility and speed in essential applications such as pick-and-place.



## WHY 3D MACHINE VISION?

- **Contrast invariant, ideal for inspecting low contrast objects**
- **Volumetric measurement provides shape and position related parameters**
- **Insensitive to minor lighting variation or ambient light**
- **Higher repeatability due to integrated optics, lighting, and calibration**

# 2D+3D

## INTEGRATION IN-THE-FIELD

### INDUSTRY EXAMPLE

## Rubber & Tire

### APPLICATION

## DOT-Code Identification

Combining traditional 2D area-based inspection with the geometry information in 3D height maps offers a more comprehensive solution resulting in full 3D measurement.

### THE CHALLENGE: Reading Characters on the Tire Sidewall

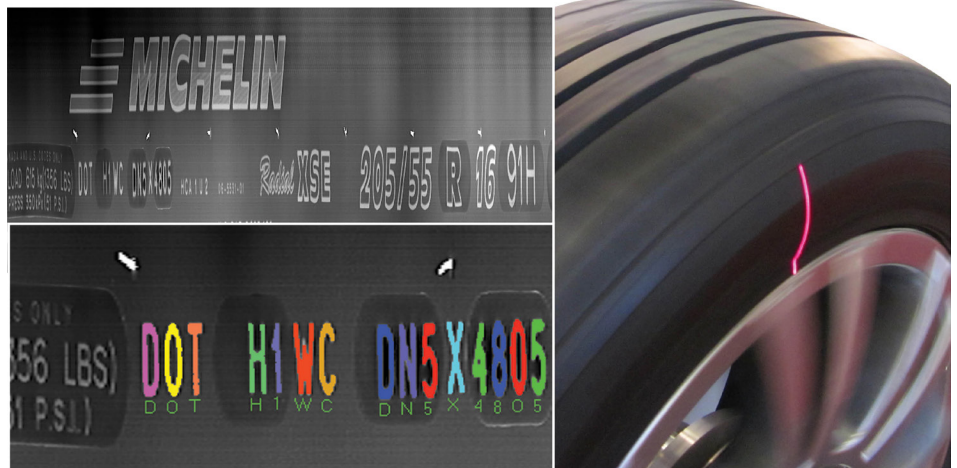
Tire sidewalls contain extensive alphanumeric information in the form of raised or embossed characters. Characters include tire identification codes for sorting, and DOT-codes for tracking the vehicle at the time of assembly.

Reading alphanumeric characters requires a combination of 3D and 2D inspection because neither can complete the task on its own. The raised or embossed DOT-Code characters on the sidewall are “black-on-black”, with effectively zero contrast. This prevents 2D machine vision from capturing the outline or edges of the characters.

### Combining 2D and 3D Machine Vision Capability

To solve the zero contrast problem, 3D depth measurement capability is able to generate point cloud data of embossed characters and render them as a height-map. The height-map data is then sent to third-party software for optical character recognition (OCR) based on extensive 2D vision libraries.

*A prime example of both 2D and 3D technologies working together to create a more robust inspection system.*



**INTERESTED IN LEARNING MORE  
ABOUT COMBINED 2D & 3D MACHINE VISION?**

**LET'S TALK POSSIBILITIES.**



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## ABOUT LMI TECHNOLOGIES

### ADVANCING 3D MEASUREMENT WITH SMART SENSOR TECHNOLOGY

At LMI Technologies we work to advance 3D measurement with smart sensor technology. Our award-winning, FactorySmart® sensors improve the quality and efficiency of factory production by providing fast, accurate, reliable inspection solutions that leverage smart 3D technologies. Unlike contact based measurement or 2D vision, our products remove complexity and dramatically reduce implementation cost.

To learn more about how LMI's inspection solutions can benefit your business, we invite you to contact us at [contact@lmi3d.com](mailto:contact@lmi3d.com) or visit us at [www.lmi3d.com](http://www.lmi3d.com) to explore the possibilities of smart 3D technology.

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