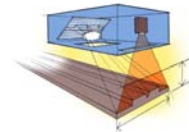




Profile Sensor Technology for Automatic DOT Code Recognition

Bytewise Measurement Systems USA
1150 Brookstone Centre Parkway
Columbus, Georgia 31904

Dennis Reynolds
330.633.2253 Akron Office
706.593.3091 Mobile
dreynolds@bytewise.com



December 15, 2004

Automatic DOT Code Recognition Using Bytewise High Speed Profile Sensor Technology December 15, 2004

Introduction

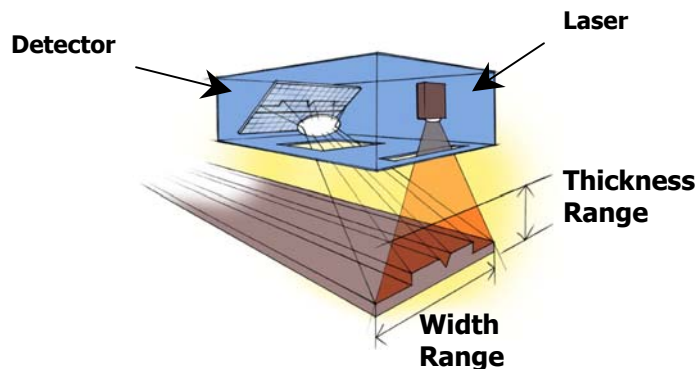
The Bytewise MIDS (Mold Identification System) uses a high-speed (2,000 Hz) sheet-of-light laser triangulation sensor manufactured by Bytewise to acquire dimensional data that characterizes the sidewall topographical geometry. When applied to the bead area the sensor digitizes the area that contains the DOT Code, Mold Code, E-Mark Code, or other molded-in feature. MIDS has applications in:

1. Automatic Tire Sorting – in the Tire Plant between curing and final finish
2. Phase Angle Recognition – as provided to support DOT Code laser-engraving
3. ***DOT Code recognition for DOT/VIN matching at Tire/Wheel Assembly***
4. Automatic recognition for verifying laser engraved codes in Tire Manufacturing

The first two systems above have shipped in December and will be production tested during January. DOT recognition is an extension of the first two systems and requires special configuration for each customer.

Profile Sensor

Profile sensors are manufactured by Bytewise. The Profile Sensor utilizes a laser light source to project a laser light line across the surface of the profile. The laser light line reflects from the surface, through a lens, and onto a high-resolution 2-dimensional digital detector. These detectors and light sources are assembled into complete sensor assemblies.



Bytewise Profile Sensor

Frequency – 2,000 Hz
Width Range – 40mm
Thickness Range – 40mm
Standoff Distance – 40 to 80mm



Automatic DOT Code Recognition Using ByteWise High Speed Profile Sensor Technology December 15, 2004

Laser triangulation provides for true geometrical measurement of the area of interest. This is far different from traditional front-lit machine vision technology:

- MIDS works from a data set of three-dimensional (xyz) geometrical coordinates (numbers) whereas machine vision works from a data set of two-dimensional gray-scale images.
- The profile sensor is calibrated in three dimensions via a method traceable to NIST Standards.
- The laser triangulation method can compensate for varying angles between the face of the sensor and the slope of the tire in the measurement area.
- Laser triangulation is not influenced by variations in surface color, texture, and background lighting.

ID Code Recognition Software

ID Code Recognition software is comprised of several elements:

- Sensor data acquisition
- Calibration transform
- ID Code or molded feature isolation and extraction
- OCR transform
- ID Code validation
- ID output

Note that the DOT Code recognition software is a customized application that requires configuration and training for the various families of tires expected at each location.

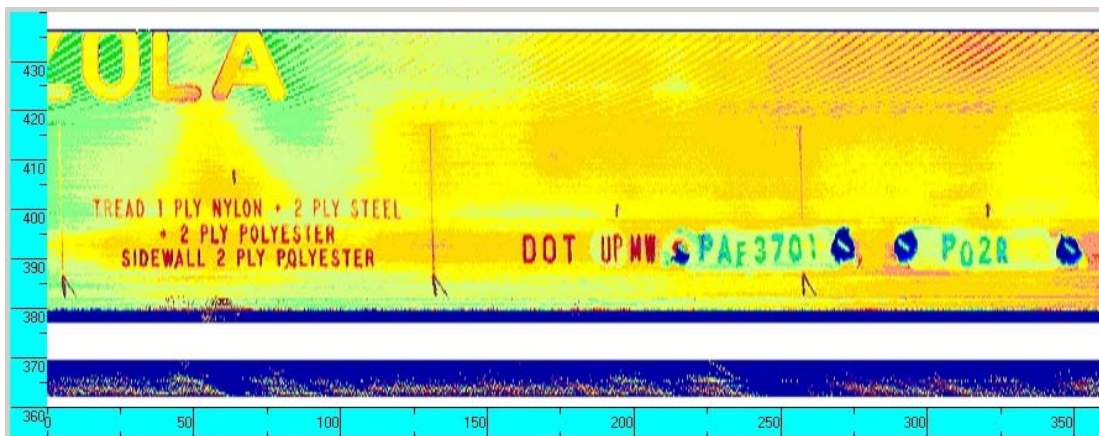
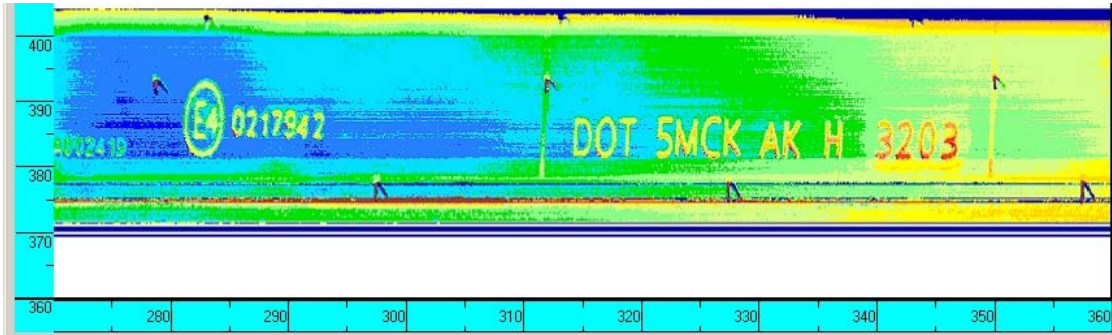
Scope of Supply

The ByteWise System consists of the following:

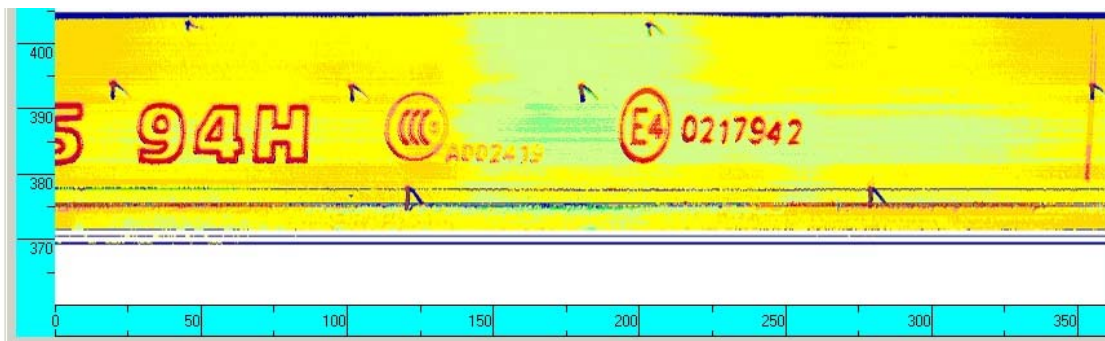
- One High Speed SL Sensor
 - 2,000 profiles/second
 - 40mm radial measurement range
- Cables
- Measurement Server PC (Pentium IV with 2.1+ GHz processor)
- Laser Power Supply
- One MIDS (Mold Identification System) Software License
- Tire handling and sensor positioning system

**Automatic DOT Code Recognition
Using Bytewise High Speed Profile Sensor Technology
December 15, 2004**

DOT Code Scans in Color Topographical Visualization

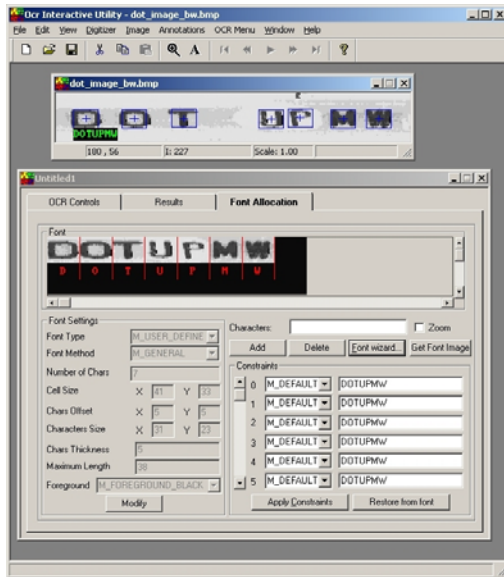


E-Mark Scan in Color Topographical Visualization

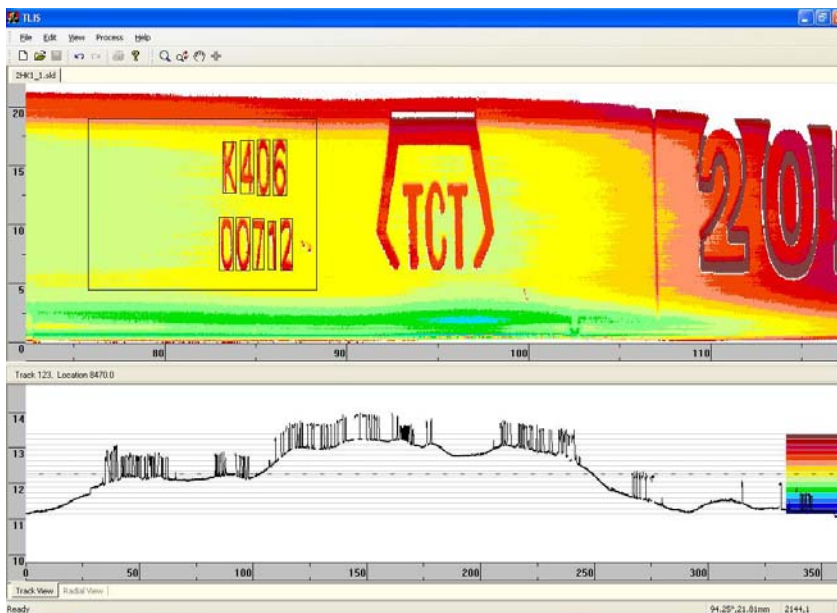


**Automatic DOT Code Recognition
Using Bytewise High Speed Profile Sensor Technology
December 15, 2004**

DOT OCR Transform



Isolation of the Mold Code Location - Color Topography and Single Track Waveform



**Automatic DOT Code Recognition
Using Bytewise High Speed Profile Sensor Technology
December 15, 2004**

Tire Handling and Sensor Positioning System

Bytewise offers a general-purpose tire handling station that centers the tire and sweeps the sensor circumferentially to acquire one scan of surface data, as shown below.

