Smart vision and optical solutions for the food and beverage industry
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1. Who we are
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About Opto Engineering

simple works better
About Opto Engineering

WHO WE ARE

Opto Engineering designs and manufactures optical and illumination systems for the machine vision industry since 2002. We specialize in OPTICAL IMAGING TECHNOLOGIES. Our focus is to build and provide every single component needed to solve imaging applications.
Global presence

Opto Engineering HQ
Mantova
ITALY

Opto Engineering GmbH
Munchen
GERMANY

Opto Engineering USA
Houston
USA

Opto Engineering CHINA
Shanghai
CHINA

Opto Engineering South East Asia
Taipei
TAIWAN
Our driving principles

Innovation
To set new standards in machine vision.

Simplicity
To ensure the smoothest integration between optical imaging components and mechanics.

Quality
To deliver every product with a certified quality.

Service
To further improve our connection with the local markets thanks to our major locations in Germany, Italy, North America, China and Taiwan.
TRADITIONAL VISION SYSTEMS

Operate with well defined single-variable pass-fail criteria

The goal of the system is to
- check the dimensions on a screw
- reject the component if one of the dimensions is out of tolerance
FOOD INSPECTION

CHALLENGES

- The acceptance criterion is often a complex combination of many parameters
- The severity of the defect is a subjective combination of multiple variables
- Products feature a high degree of variability in shape and/or color
- One single line is used for multiple products
- There is need to simply and rapidly modify the acceptance criteria in order to
  - inspect new products
  - follow changes in production requirements
Smart vision system for food inspection
Smart vision system for food inspection

Smart vision system based on NEURAL NETS
FOOD INSPECTION

**Smart vision system for food inspection**

**Neural networks**

software algorithms that mimic the human brain

- They learn from examples (as humans do) → easy to use (no complicated settings)
  - They are adaptive → easily tailored to inspect new products
ALBERT is a vision system for SHAPE and COLOR inspection, based on artificial intelligence techniques.

Learns from examples as humans do.
ALBERT

Inspects complex products with high variability as simply as a human operator would.
Smart vision system for food inspection

ALBERT

Self-learning
Learns the features of your products directly from the production line without complicated settings.
NO NEED to present the good parts only.
Smart vision system for food inspection

ALBERT

**Self-learning**
Learns the features of your products *directly from the production line* without complicated settings.
NO NEED to present the good parts only.

**Simple and Intelligent**
Inspects in a more strict or tolerant way by simply moving a slider according to different production requirements.
Smart vision system for food inspection

ALBERT

Self-learning
Learns the features of your products directly from the production line without complicated settings.
NO NEED to present the good parts only.

Simple and Intelligent
Inspects in a more strict or tolerant way by simply moving a slider according to different production requirements.

Suitable to identify complex defects
Understands the quality of products even with complex features and high variability.
Self-learning
Learns the features of your products directly from the production line without complicated settings.
NO NEED to present the good parts only.

Simple and Intelligent
Inspects in a more strict or tolerant way by simply moving a slider according to different production requirements.

Suitable to identify complex defects
Understands the quality of products even with complex features and high variability.

IP65 Rated
Ideal for the food industry.
Smart vision system for food inspection

ALBERT

SPECS

- LED status BAR
  - LEARN PHASE = YELLOW
  - CHECK PHASE = GREEN (OK PART) RED (NOK PART)
  - SET SEVERITY LEVEL = BLUE

- LED diffuse strobe illuminator, white
- 8 mm f1.4 f16 lens
- Increase / decrease SEVERITY LEVEL
- POWER
- STOP CHECK
- START CHECK
- Press together LEARN PHASE

Booth 1F44 Hall 1
Smart vision system for food inspection

APPLICATIONS

→ PRODUCTS FEATURING NATURAL VARIATIONS IN THEIR INGREDIENTS
→ PRODUCTS FEATURING A HIGH DEGREE OF VARIABILITY IN SHAPE AND/OR COLOR WHERE TRADITIONAL VISION SYSTEMS SUFFER (e.g. FOOD)
→ PRODUCTS THAT ARE NOW INSPECTED BY HUMAN OPERATORS (OBSERVATION)
→ ONE SINGLE LINE FOR MULTIPLE PRODUCTS
→ NOT OVERLAPPED PRODUCTS
Smart vision system for food inspection

APPLICATIONS EXAMPLES

TOASTED BREAD

OK

TYPE OF DEFECTS
Smart vision system for food inspection

APPLICATIONS EXAMPLES

TOASTED BREAD

OK

TYPE OF DEFECTS

1. 110011
2. 010011
3. 010011
4. 100111
5. 110011
6. 110011
7. 110011

Booth 1F44 Hall 1
## APPLICATIONS EXAMPLES

### COOKIES

<table>
<thead>
<tr>
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<th>TYPE OF DEFECTS</th>
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<tr>
<td>![OK Cookie Image]</td>
<td>![Defect 1]</td>
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<td>![Defect 2]</td>
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The images above illustrate various types of defects found in cookies, demonstrating the application of the ALBERT system in quality control.
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Optics – basic lens types

ENTOCENTRIC

TELECENTRIC

PERICENTRIC
ENTOCENTRIC (FIXED FOCAL)
Optics – basic lens types

TELECENTRIC

Required for dimensional measurement imaging applications
Optics – basic lens types

PERICENTRIC or 360° VIEW OPTICS

Convergent rays
Entrance pupil

Pericentric: entrance pupil in front of lens
### 360° view optics & application cases

#### Traditional approach:
- use of 4-5 cameras with FFL lenses
- Flexibility to be adapted to different sample formats and sizes
- Complex software work, synchronization and alignment of cameras is pricey and time-consuming

#### 360° view optics:
- complete inspection with 1 camera
- Unique solution
- Inspection from the TOP (compact solution)
- Use of 1 camera instead of 4-5 cameras
- No need for specific sample orientation, the defect is always visible
- Less components = less possibility that something gets broken and has to be repaired
- Accurate centering is needed
- Less resolution vs 4-5 cameras
360° imaging of small objects
Parts down to 7.5 mm in diameter can be imaged

Extra wide lateral viewing angle
Object sides viewing angle approaches 45°

Compactness
The lens can be easily held and integrated in any system

Perfect chromatic correction
For RGB camera applications and color inspection
Product: PCCD012 CATADIOPTRIC LENS

Application: Examining the threads of a PET bottle neck preform

Detection of:
- Incomplete thread
- Defective thread
- Oval Shape
- Mouth defects
Product: PCCD012 CATADIOPTRIC LENS

Application: Examining the integrity of caps retaining rings

Detection of:
- Integrity of retaining ring
- Oval Shape
- Color
Product: PCCD012 CATADIOPTRIC LENS

Application: CHECK FOR CORRECT SEALING OF VIALS (FLIP OFF CAP)

SA10 automatic inspection machine for vials

Detection of:
- Stopper absence
- Defective Crimp
- Dents
- Flip Off Deformation
- Wrong Color
- Cap Scratches and Deformation

- Production of 6.000 p/H - Totally electronic
- Products are loaded in the machine through baskets.
- Separated in "good" and "reject"

Image courtesy CMP Pharma
360° view optics & application cases

Product: PCHI023 hole Inspection optics

Perfect focusing of holed objects
Both the walls and the bottom of a cavity are imaged in high resolution

Cavity inspection from the outside
No need to put an optical probe into the hole

Very high field depth
Objects featuring different shapes and dimensions can be imaged by the same lens

Wide viewing angle
Sample surfaces are acquired by the lens under a convenient perspective to clearly display their features
360° view optics & application cases

Product: PCHI023 Hole Inspection optics

Application: Check of aluminium tubes for latex seal integrity

SET UP

IMAGES

NOT OK

OK

latex seal

Image courtesy ZIND ENGINEERING
360° view optics & application cases

Product: PCHI023 Hole Inspection optics + ringlight

Application: Icecream cups code reading
image and read code inside the wall of the jar for its identification

SET UP

IMAGES

Image courtesy AMVS Netherlands
**360° view optics & application cases**

**Product:**

PCHI023 Hole Inspection optics + LTLAB2-W high power strobe ringlight

**Application:** caps inspection

---

**SET UP**

- Camera:
  - Exposure time = 50 μs
  - Sensor = 1600x1200 4.4 μm

**IMAGES**

- Optics: PCHI012
- Lights: LTLAB2-W
- Strobe controller: LTDV1CH-17V

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**360° view optics & application cases**

**Product:**

PCHI023 Hole Inspection optics + LTLAB2-W high power strobe ringlight

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**SET UP**

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**IMAGES**

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- PCHI012

**Lights:**
- LTLAB2-W

**Strobe controller:**
- LTDV1CH-17V
360° view optics & application cases

Product:
PCHI023 Hole Inspection optics + LTLAB2-W high power strobe ringlight

Application: caps inspection

Camera:
Exposure time = 50 μs
Sensor = 1600x1200 4.4 μm

SET UP

Images

Optics:
PCHI012

Lights:
LTLAB2-W

Strobe controller:
LTDV1CH-17V
TIP: The importance of strobe lights

Beverage industry typical conditions

- Inspection of fast moving parts
- Cameras set at short exposure times
- Optics set at high F/N

Whenever the image is too dark, ways to obtain a processable image are:

- Increase camera gain → which leads to higher noise level
- Lower the lens F/N → which leads to higher aberrations (e.g. coma / spherical aberration) and decrease in depth of field

Both of these ways will however lead to an image where fewer details can be distinguished.
TIP: The importance of strobe lights

Beverage industry typical conditions

- Inspection of fast moving parts
- Cameras set at short exposure times
- Optics set at high F/N

Whenever possible we suggest to:

1. Set the lenses at higher F/N → increase in Depth of Field al lower aberrations
2. Increase the amount of light using strobe lights

**STANDARD DOME LIGHT**

- **SETTINGS**

  - Optics:
    - Model = Computar M3514-MP2
    - Aperture = F/8
  - Camera:
    - Exposure time = 400 μs
  - Sensor = ICX445
  - LED Lighting:
    - T on = 1 ms

<table>
<thead>
<tr>
<th>I = 1 Amp</th>
<th>I = 17 Amp</th>
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<tr>
<td>STANDARD DOME LIGHT</td>
<td>OE DOME LIGHT</td>
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Product: PC pericentric optics

Product:

**Just one camera**
No need for multiple cameras placed around and over the object.

**Fast image analysis**
No image matching software is needed as the picture is not segmented.

**Single point of view**
No perspective effects typical of multi-image systems.

**Smooth on-line integration**
Inspected parts pass unobstructed in the free space below the lens.
360° view optics & application cases

Product: PC12030HP

Application: label OCR regardless the position of the label

Image courtesy AMVS Netherlands
Product: PC12030HP

Application: closures inspection
Product: PCPW012

Just one camera
No need for multiple cameras placed around and over the object

Wide viewing angle
45° object sides view makes otherwise hidden features visible

Complete surface inspection
Both inner and outer object surfaces can be imaged in one shot

Very high resolution
Even the tiniest defects can be detected.
Product: PCPW012

Application: cap inspection with one single camera
Product: PCPW012

Application: FLIP OFF cap inspection with one single camera
Telecentric optics & application cases

Product: Telecentric lens TC23036 + telecentric illuminator LTCLHP036-G

- BI telecentricity
- Nearly zero distortion
- Excellent resolution
- Simple and robust design (fixed aperture)
- Detailed test report with measured optical parameters
- Matching telecentric illuminator
Product: Telecentric lens TC23036 + telecentric illuminator LTCLHP036-G

- **High speed** production lines
  The high throughput allows for shorter exposure times

- **Silouetting** and for detecting edges and defects
  Elimination of blurred edges caused by diffuse reflections

- **Increased distance** between object and illumination source

- **Precision measurements**
  where accuracy, repeatability, and throughput are key factors

- **Complete light coupling**
  very high signal-to-noise ratio

- **Border effects removal**
  collimated rays are typically much less reflected

- **Field depth and telecentricity improvement**
  Collimated illumination geometry increases a telecentric lens natural field depth
Telecentric optics & application cases

Product: Telecentric lens TC23036 + telecentric illuminator LTCLHP036-G

Application: Glass vials measurement

Type of measurements:
- Finish / collar/ cone profile
- Diameter of the neck / cone
- Planarity of the mouth
- Axiality of the neck
- Shoulder angles
- Total length

Diffused lighting
Telecentric lighting

Clear object contours can be seen under telecentric lighting, making accurate measurements of the object possible.
Come visit us!

Booth 1F44 Hall 1

Thank you

www.opto-engineering.com
contact@opto-engineering.com