Fine scratch detection and monitoring of coating properties for high-quality film production

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Speaker Info

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Introduction ISRA Vision
The global market and technology leader in **MACHINE VISION**

30 years of experience in **Industrial Automation** and **Surface Inspection**

- Established: 1985
- Legal form: AG, public company
- Sales (14/15): 112,2 mill. €
- Equity: 144 mill. €
THE GLOBAL MARKET LEADER

Surface Inspection

Special Paper  Paper  Metals
Coating  Composite  Nonwovens  Film
Glass  Print  Solar
STRATEGICAL STRENGTH OF ISRA

Cameras
- Latest technology
- Fastest line rates
- Highest sensitivity

Illumination
- Ultra bright
- Smart light technology
- Harsh environment

Computing power
- Highest data throughput
- High-level classification
- User friendly interface

Beyond Inspection
- From data to decisions

All competence in one Hand!
ISRA Surface Inspection - The road to zero defect production
Conventional defect types
Typical images of Classical defect types

- Carbon (black specs)
- Clear gel / bubble
- Amber colored inclusion
- Black carbon inclusion
- Wrinkle
- Gel string
- Insect
- Die line / streak
- Smear
- Holes
New Challenges
Advanced fully automated optical inline inspection systems

Next-generation of Automated Optical film Inspection

DEFECTS and OPTICAL PROPERTIES

- Micro scratch detection and classification
- Haze and gloss monitoring
- Uniformity monitoring of critical properties
- Cosmetic defect detection:
  - Gels
  - Bubbles
  - Scratches
  - Dents
  - White spots
  - Contamination
  - Holes
  - Wrinkles
  - Missing coating / adhesive
Scratches - Data from Korad³D - White-Light Interferometry

**Parameters**  | Unit | Step 1 | Step 2  
---|---|---|---  
Maximum height | μm | 1.25 | 1.74
Introduction to Cross-Dark-Field Scratch detection
Introduction to Cross-Dark-Field Scratch detection
Multi-Mode principle

- Special high frequency switching LED illumination in CROSS DIRECTION
  - One single illumination generates bright field, and CROSS DARK FIELD views
  - Highest contrast generation by image superposition
Cross-Dark-Field: Detection examples with 33µm resolution

Data from Inspection System

Scratch 3.2µm

Data from Microscope

Scratch 4.2µm
Cross-Dark-Field: Detection examples with 33µm resolution

Data from Inspection System

Scratch 2,7µm

Data from Microscope

Scratch 3,2µm
Control of Optical Properties - COP
Control of Optical Properties - COP

![Graph showing control of optical properties](image)
Material properties related to transmission / absorption

- How to increase the sensitivity
- How to deal with long term drift etc.

Use up to 3 different Filter ($2^X \times 2^Y / X,Y = 0, 1, 2, \ldots 9$) plus background subtraction.

Camera signal

SWP II

512x512
512 - 32
32x32
32 - 4
4x4

$H_1$, $L_1$
$H_2$, $L_2$
$H_3$

2D-filtering (Example)
Difference filtering (Example)
Detection thresholds
(High / Low thresholds)

Uniformity / Homogeneity Detection

Defect Detection

Uniformity classification with evaluation thresholds
Gloss / Haze - Direct and Diffuse Reflection/Transmission
Inline **Monitoring** of optical material properties:

- The worldwide unique inline **Monitoring** of:
  - Haze analogue to standard ASTM D-1003
  - Transparency
  - Gloss
  - Reflectivity
  - and others

Image processing to convert camera data into Haze Monitoring

Material property: Haze 29%

Special LED switching technology
Summary and Outlook

- Cross-Dark-Field - Multi-Mode web inspection can detect faint scratches with sizes that are by far (1/10) smaller than the optical resolution of the inspection system.

- Control of Optical Properties – COP is a unique technology to monitor values and uniformity of optical parameter that define the features and functionality of the product.

- Cross-Dark-Field - Multi-Mode and COP are key technologies for quality control and process optimization for Production of Coatings and Films

- Now available: New technologies to monitor and increase the quality of coated films.
Inspection you can rely on …

Thank you for your attention