



Smart Food Production Machinery The Impact of Optical Systems

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BÜHLER

Our relevance

8 billion people
worldwide

2 billion

people each day enjoy food
produced on Bühler equipment

1 billion

people travel in vehicles partly
produced with Bühler machinery



6:30 a.m.

7:15 a.m.

10:00 a.m.

3:00 p.m.

7:00 p.m.

Bühler is part of the everyday life of billions of people

7:00 a.m.

7:30 a.m.

12:00 p.m.

6:00 p.m.

8:00 p.m.





01

Solutions and products

Smart Food Production Machinery - The Impact of Optical Systems

Pro and contra



- Contactless
- Wear-free
- Visual impression, close to human experience
- 3D information
- more opportunities (IR, NIR etc.)
- Machine can be closed
hygienic design / process visualization in control room



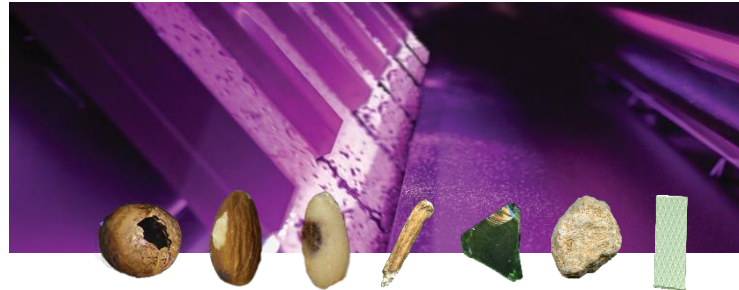
- Distance to the object
- Free view to the object
- Resolution, Reflections
- Visible range
 - Illumination → heat source
 - incidence of extraneous light
 - depth of focus
- Danger of lens contamination
→ cleaning
- Glass not usable in food process
→ lens
- Safety issues
→ laser class
- Reliability
→ algorithm

Smart Food Production Machinery - The Impact of Optical Systems Applications



Photonics

- Sensors & Cameras
 - **Optical filters** transform light information
- Ophthalmic
 - **Coatings** change transmission - absorption or improve usability
- Glass coating
 - Coatings for energy reduction
- Metallization
 - High reflection



Food safety and quality

- Sorting
 - Rice, wheat, grain, pulses, nuts, coffee, frozen fruits & vegetables ...
- Typical defects
 - Foreign materials such as shells, stones ...
 - Chips & scratch, broken, out form
 - Color defects
 - Insect damage & pinholes
 - Black spot, inedible, rotten grains
 - Moisture, protein, ash, starch, gluten
 - Mycotoxins, ergot, fusarium
 - Allergens



Smart process control

- Color
 - Process adaption according to product color
- NIR
 - Process control according to product chemical
- Pattern and topology
 - Process adaption according to pattern recognition or topology changes



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Spectral Vision

- Full color camera
- InGasAS to remove foreign material
- Xenon IR lighting

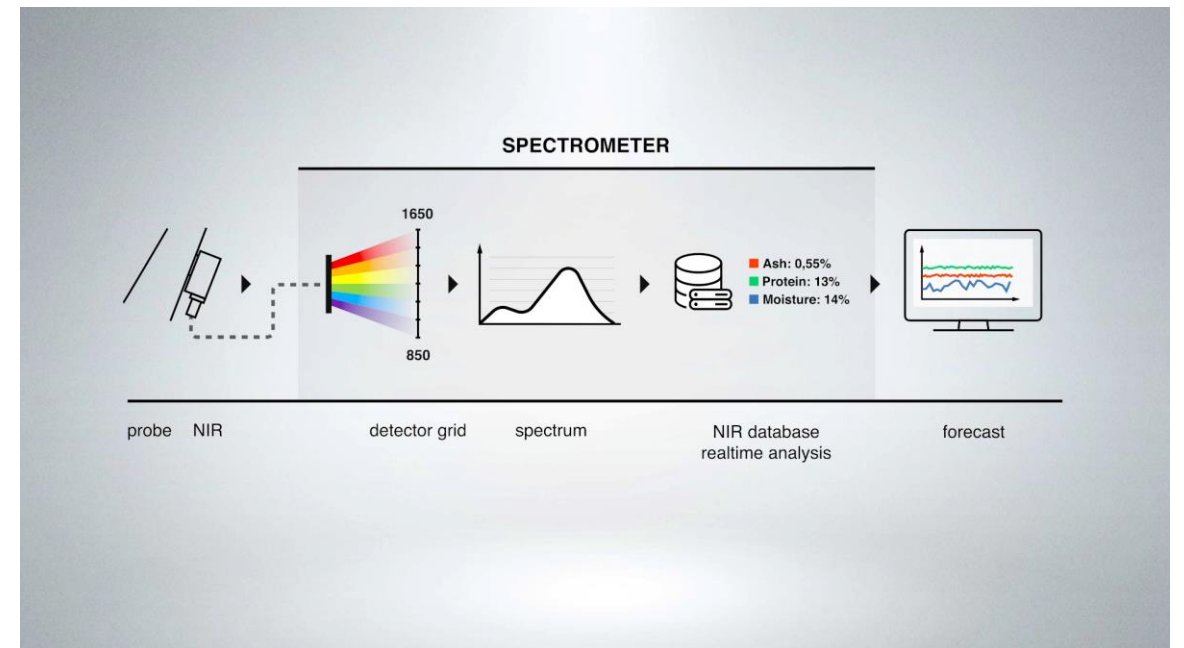




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Inline spectrometer process control

- The NIR probe detects the chemical composition
- The CAM probe detects color and specks



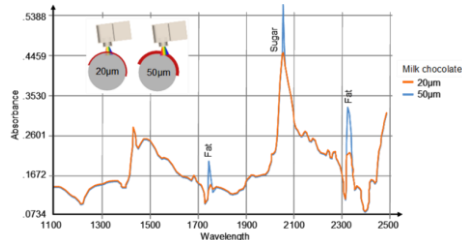
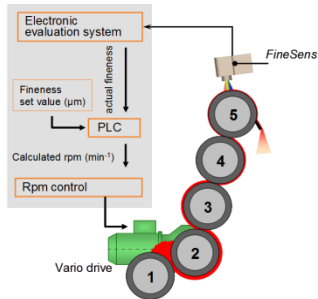
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Process control



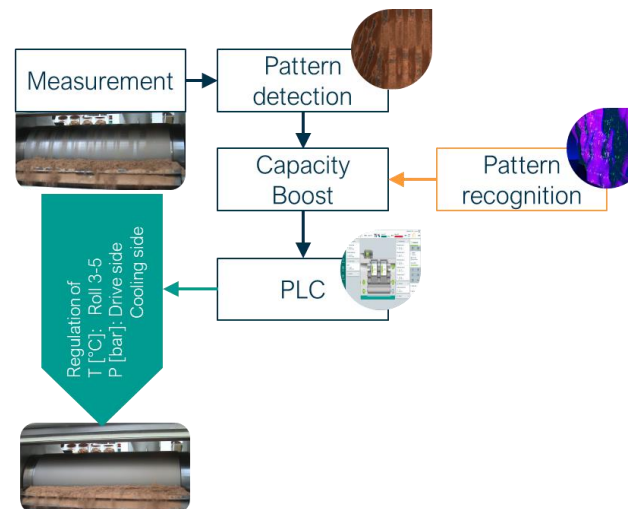
Online particle size measurement

- Chocolate film is radiated with light
- Product contents absorb NIR radiation
- Peak height correlates with volume of substance based on calibration substance



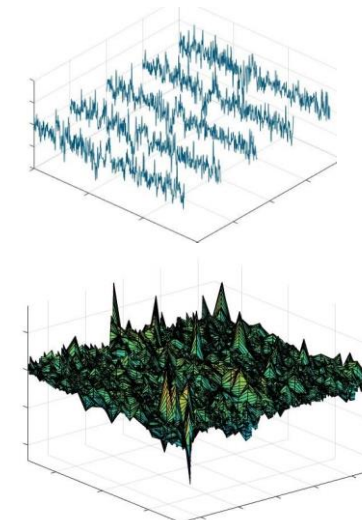
Product film optimization

- Image processing - pattern detection
- Area camera system



Plasticity control

- Laser triangulation measurement
- Perform a topographic profile





02

Tomorrow

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Photonics - Drivers for tomorrow's life



Digitalization in our daily life.

- Extended reality
- SMART glasses
- Wearables
- SMART home
- Bio sensing
- Spectral sensing



New opportunities in car optics due to autonomous driving technology.

- LiDAR
- Driver monitoring
- Car-2-x (Car communication)
- Smart lighting system & projection



Smart Phones and 5G Connectivity

Digitalization of life

Big Data

Autonomous Driving Technology

Sustainability

More demand for optical filters and lenses for smart phones and 5G base stations.

- Cameras
- Sensors
- 5G Connectivity



Increased data processing.

- 2020-2025
- Optical communication
 - Photonic integrated circuits (PIC)
- 2025-2030
- Quantum Communication
 - Quantum Computing



Growing awareness for sustainable products.

- Low-E glass
- Chrome replacement

Smart Food Production Machinery - The Impact of Optical Systems

Sorting

- Enlargement to other ingredients
- Food safety – visualization of bacteria ...
- Lower resolution will be compensated by AI
- ...

Process control

- Lab – measuring methods moves to inline solutions as particle size measurements ...
- Color, moisture ... measures in difficult environments like hot temperatures (roasting)
- Vision systems working with little light
- ...





INNOVATIONS FOR A BETTER WORLD