Central European Cooperation in Smart Specialisation on the Application of ICT and
Advanced Manufacturing Solutions in the Food Supply Chain workshop

Machine Vision Technologies for Food Quality Analysis and Control

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Fraunhofer IOSB

The Fraunhofer Society

Europe’s largest organization for applied research

- 69 institutes and research units in Germany
- 24,500 staff
- Founded in 1949 in Munich
- More than 24,500 employees
- Annual budget is about € 2.1 billion, partially public founded
- Representative offices, research units, and subsidiaries worldwide
- **Fraunhofer IOSB: Institute of Optronics, System Technologies and Image Exploitation**

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Fraunhofer Food Chain Management Alliance

Pooling the expertise of nine Fraunhofer institutes

- **Mission:** Developing innovative approaches in **food security**, **microelectronics** and **logistics** that can be easily integrated into the **whole food supply chain**, ensuring the highest possible added value
- **Competencies**
  - Food Science
  - Packaging Technology
  - Logistics
  - Radio Frequency Identification (RFID)
  - **Optical Analysis and Machine Vision**
  - Sensors und Micro System Technology
  - Biochip Technology and Lab-On-Chip
  - Networks & Consulting Services

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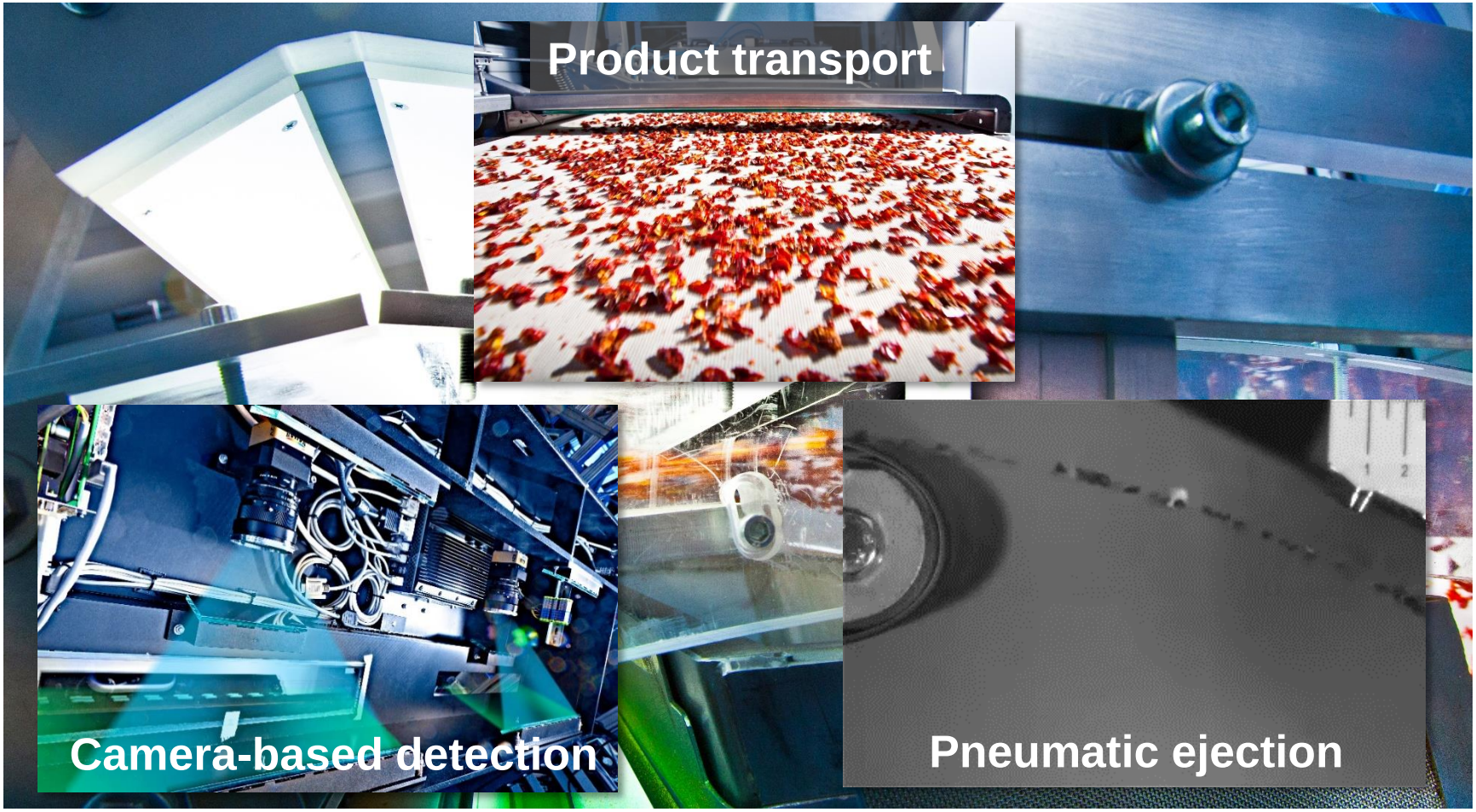
Machine vision for food inspection

Example optical sorting: inspection by colour and shape



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Hyperspectral Imaging across the EM spectrum

Capturing physicochemical material and food properties

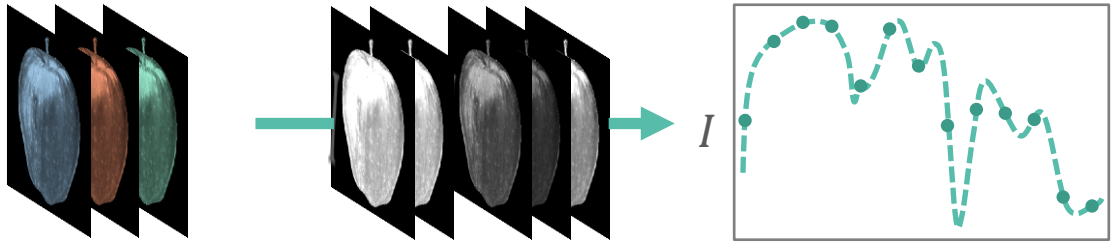
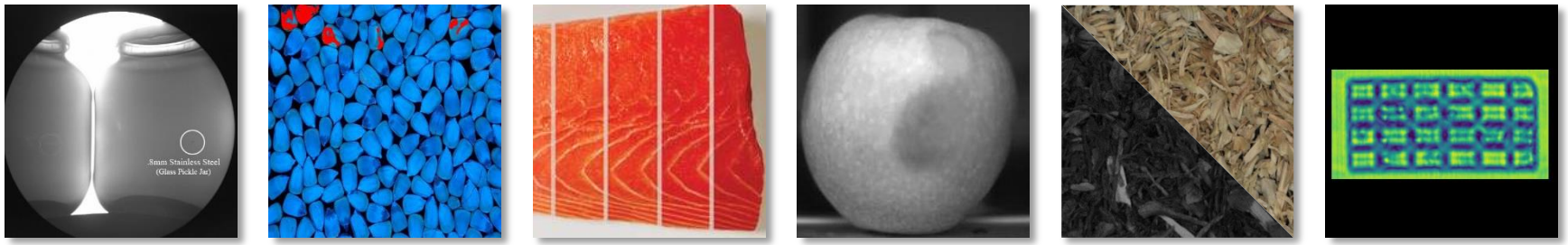


Image processing + Chemometrics + ML

X-ray | **UV** | **VIS** | **NIR** | **SWIR** | **THz**



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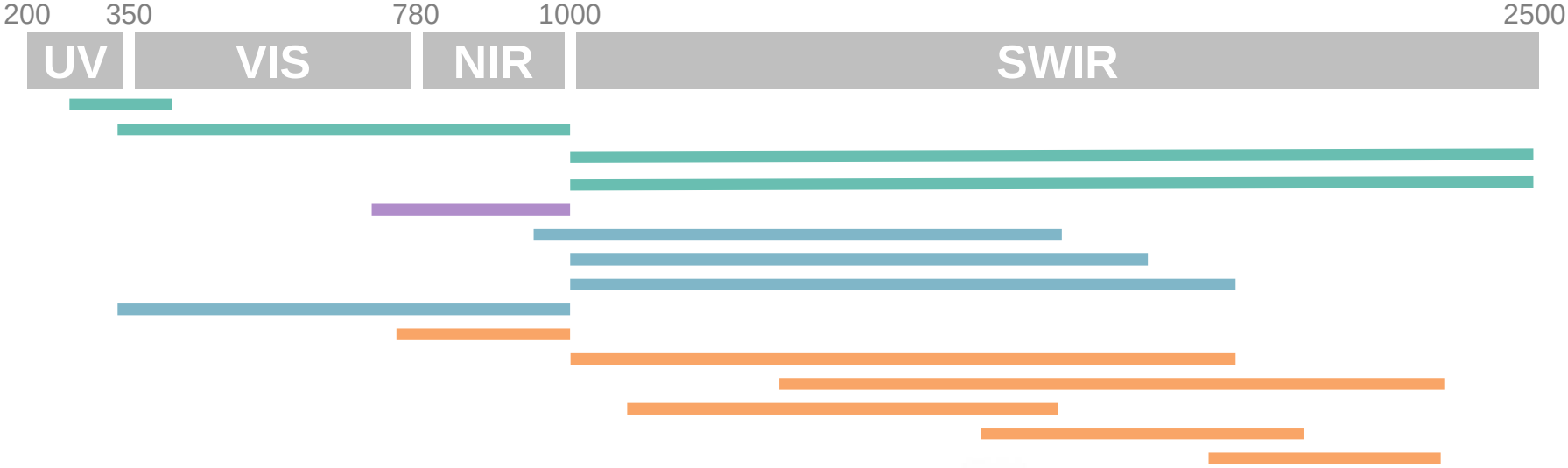
Fraunhofer hyperspectral imaging laboratory

Task-oriented evaluation of imaging and sensor technologies



hyperspectral imaging systems (pushbroom)

snapshoot HSI

non-imaging spectrometers

spectral sensors

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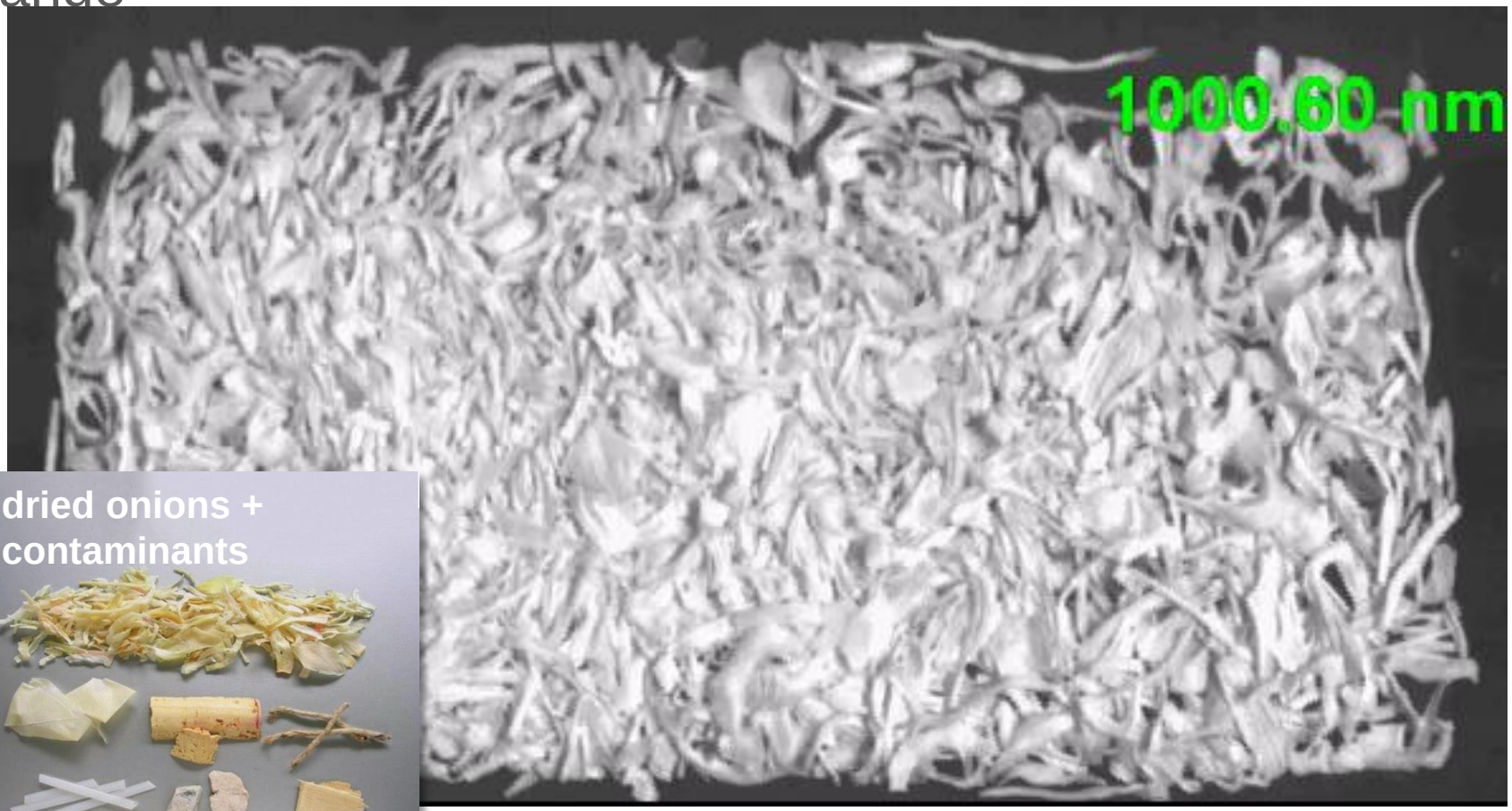
Project: Foreign body detection in dried foods

Hyperspectral imaging in the short-wave infrared (SWIR) range



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Project: Optical grape sorting for better wine

Ripeness of grape berries is measured in the near-infrared (NIR)

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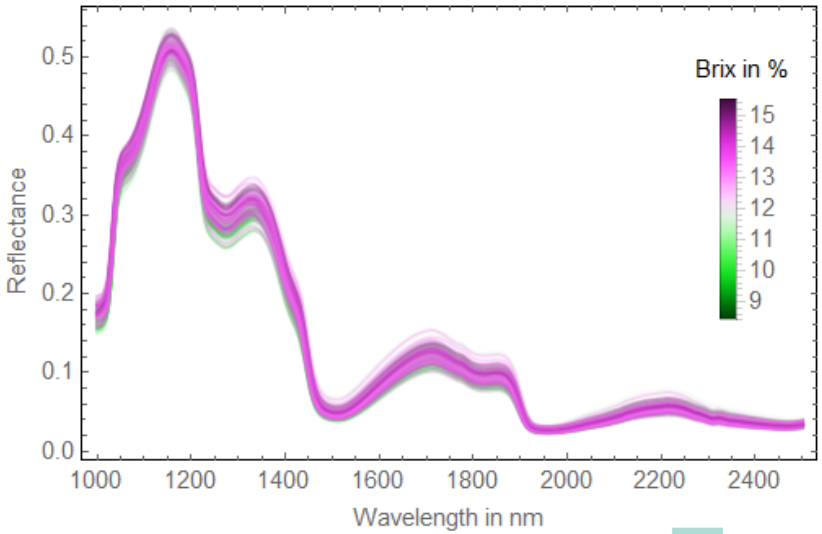
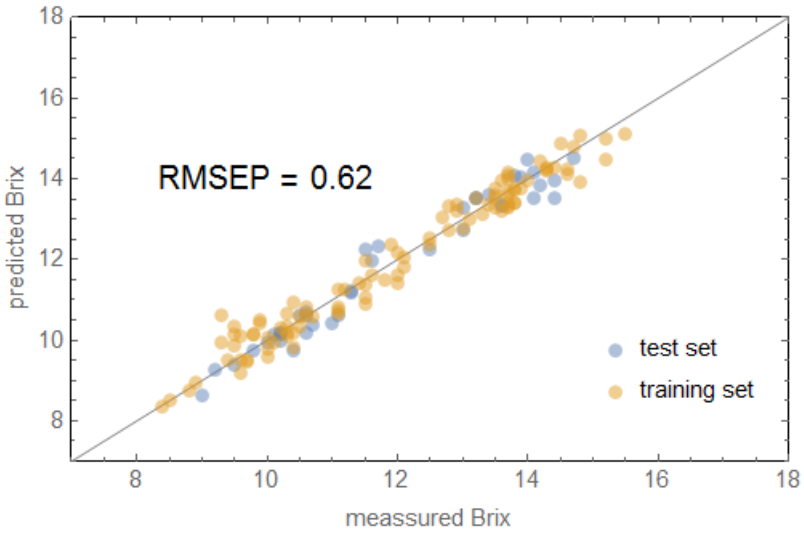
Project: Hyperspectral image inspection of apples

Assessment of internal and external fruit quality parameters



Chemometric calibration for Brix prediction



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Current trend: Miniaturization of spectrometers

Low-cost spectral sensors enable new applications and solutions

1980 → 1990 → 2000 → 2010

Costs

Required user expertise

Measurement accuracy (???)

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Spectral sensors enable mobile food analysis

Foodscanner increase food transparency for consumers

- Consumers may check for
  - food quality (ripeness, spoilage, etc.)
  - food safety (contamination, adulteration, etc.)
  - food authenticity (counterfeiting, origin, etc.)
  - nutritional information (carbs, fat, protein, etc.)

Source: Consumer Physics

Source: NeoSpectra

Spectroscopy-based foodscanners

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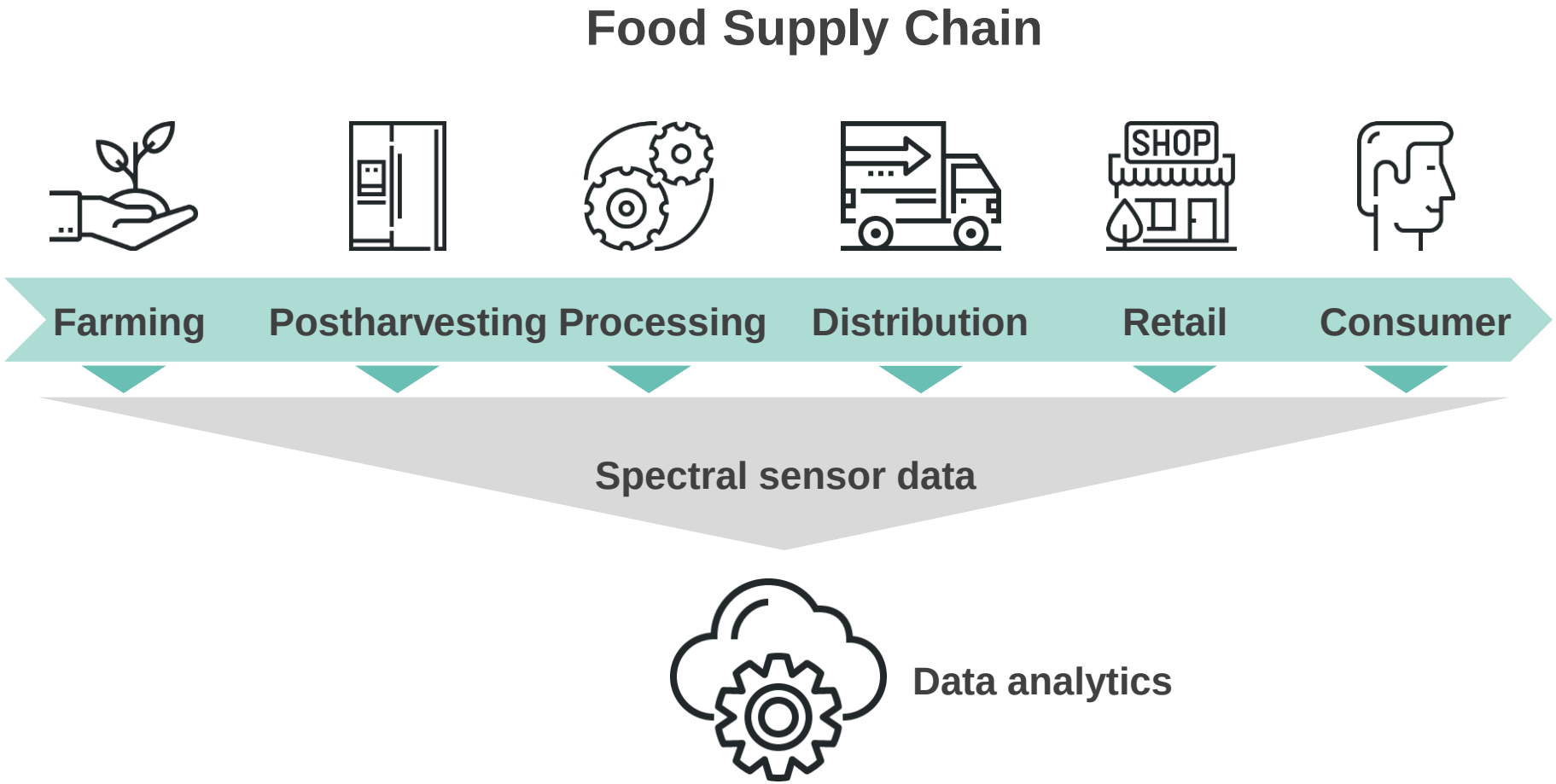
Spectral sensors enable the “Internet of Food”

Real-time chemical information is provided from farm to fork



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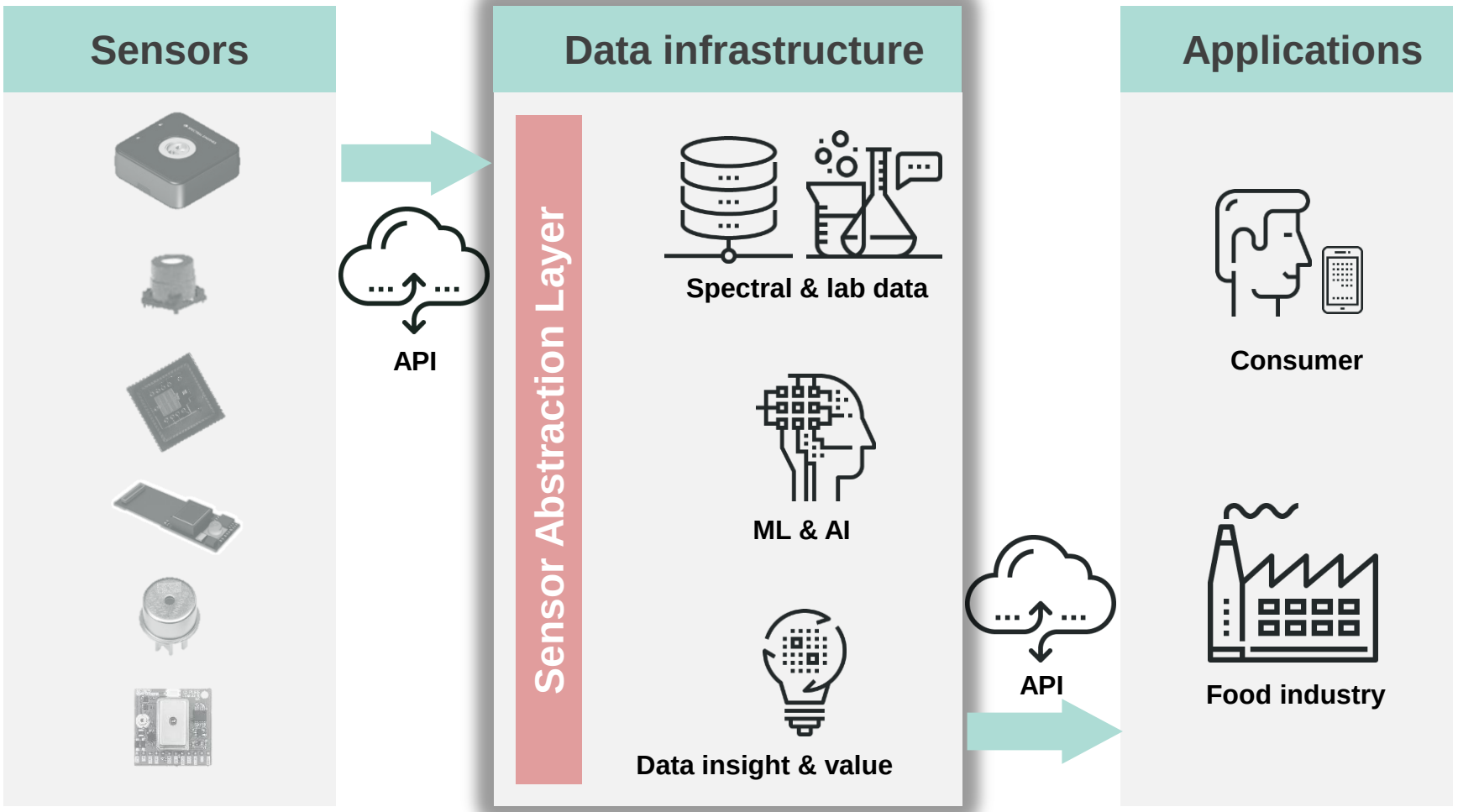
Building a spectral data analytics infrastructure

Chemometric modelling needs to be sensor independent



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Areas of possible collaborations

Joint research projects and contract research

- Machine vision for food quality control, e.g., sensor-based sorting
- Hyperspectral imaging in food production and agriculture
- (Mobile) NIR spectroscopy for food analysis
- Application of spectral sensor technologies in food supply chain
- Designing and building sensor-independent spectral data infrastructures
- Chemometric and machine learning for spectral data analysis