Photonics @ SINTEF

Food & Agriculture

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Technology for a better society

PHOTO: SHUTTERSTOCK

SINTEF is one of the largest independent research institutes in Europe

Revenue

3,4

Billion NOK

Employees

2100

Projects

6800

Clients

3600

International
472 mill NOK

Publications
5100

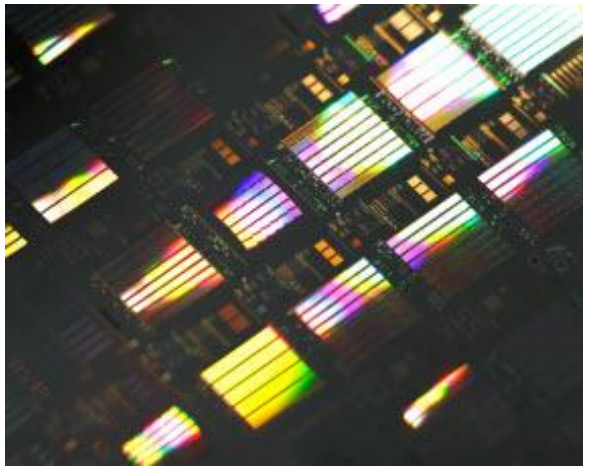
Nationalities
80

Customer satisfaction
4.6 out of 5

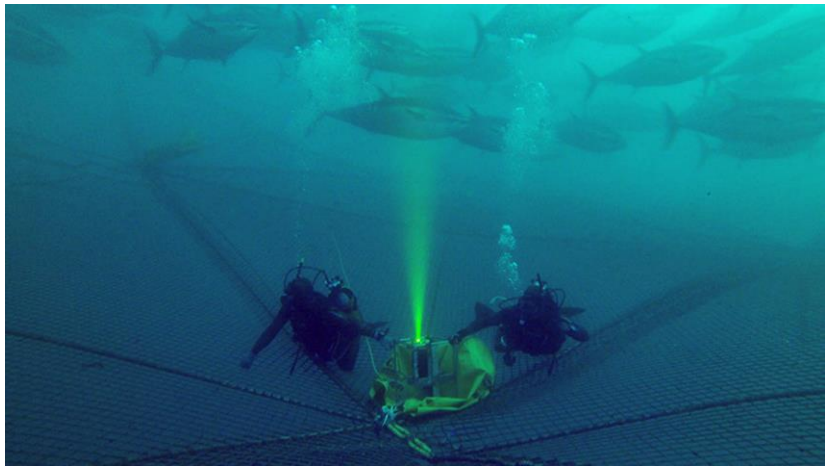
Technology for a better society

Kilde: SINTEFs årsrapport 2020

Photonics @ SINTEF



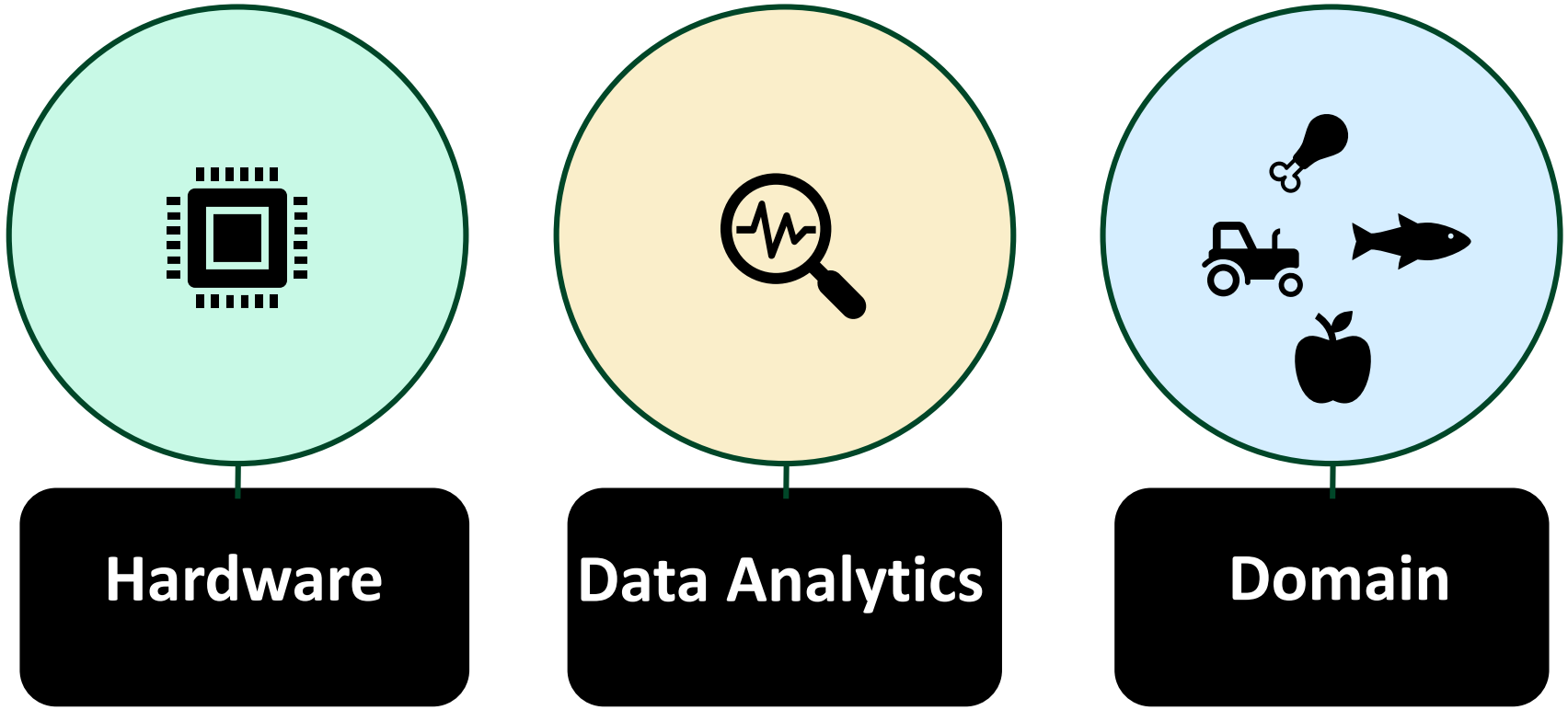
Optical MEMS are systems with structures in the micro- to millimeter range whose purposes are to manipulate light. This includes waveguides, moving micro-mirrors, diffractive gratings , photonic crystals applied to gas sensing or Infrared emitters



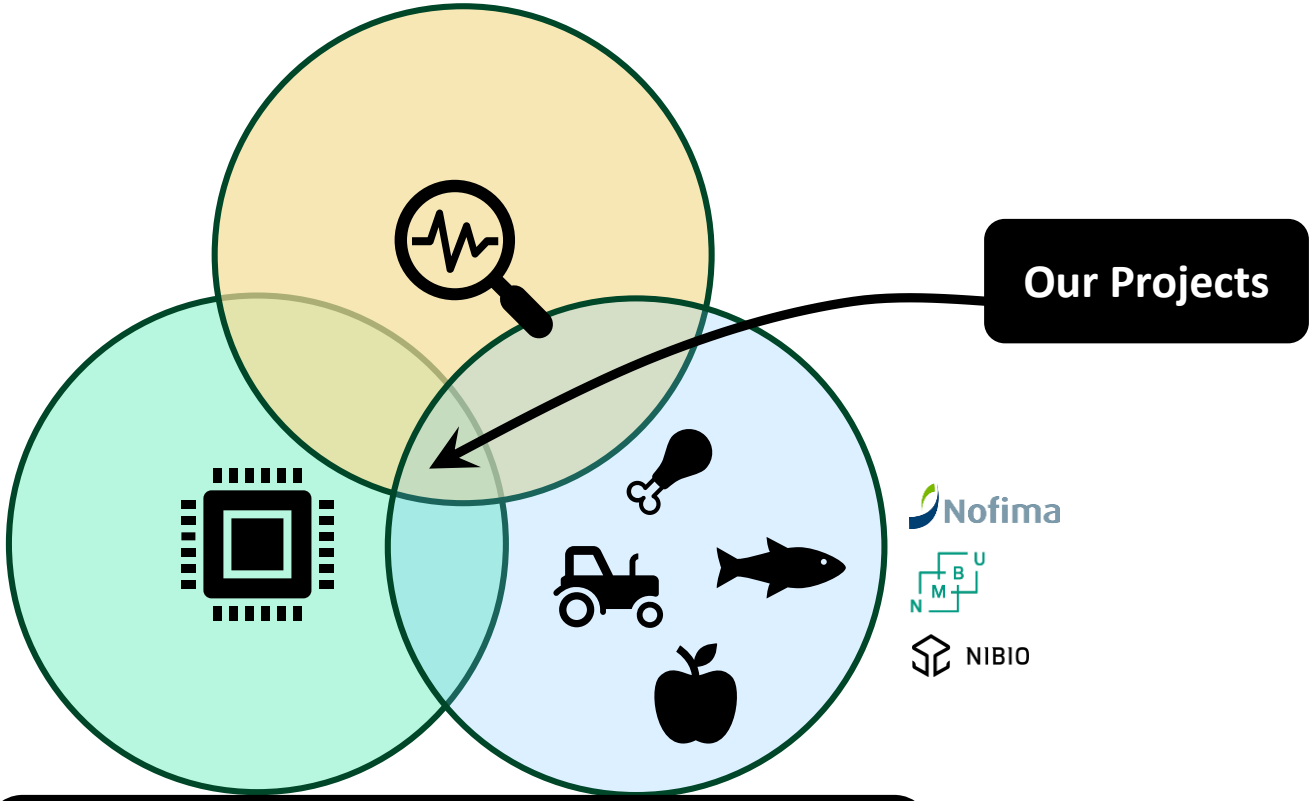
Applied optics
Sensor development for the real world. Optical measurement techniques, optical instrumentation design, detectors, illumination design, electronic design, prototyping, numerical modelling, and data analytics

Computer Vision
Computer Vision includes automatic video analysis, 3D camera technology for accurate measurements and autonomy, as well as deep learning for interpretation of images.

Applied Research



The model for our projects



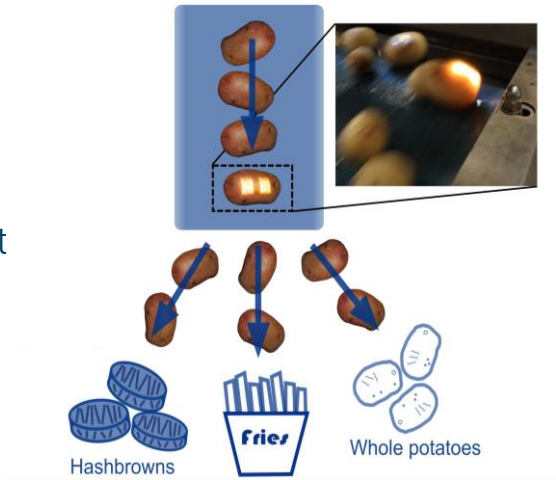
Tschudi J, O'Farrell M, Hestnes Bakke KA. Inline Spectroscopy: From Concept to Function. Applied Spectroscopy. 2018;72(9):1298-1309. doi:10.1177/0003702818788374

Sensors for food quality

- SINTEF expertise:
  - Robust instrumentation and smart sensors systems suitable for use inline, in the field, handheld or on agricultural robots
- What we are measuring:
  - Ripeness
  - Internal and external damage
  - Sugar content
  - Plant diseases
  - Fat and protein
  - Water and dry matter content

FT-IR for hydrolysis (breakdown) of fish waste to consumable proteins – **SFI DigiFoods**

Sub-surface measurement sugar content in strawberries – **IPN Målbær**



High-speed, sub-surface measurement of dry-matter in potatoes **– IPN Smart Sensor**

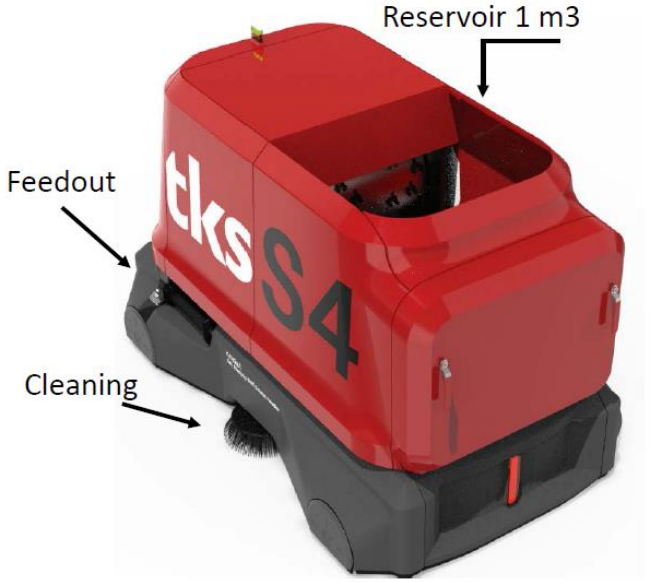
Non-contact measurement of shape (3D) and fat (NIR) for lamb carcass classification **– IPN MeatCrafter**

Sub-surface measurement dry-matter in salted cod – **FHF KlippFisk**

Sensors for Automation in Precision Agriculture

- SINTEF expertise:
  - Holistic design of autonomous systems
  - 3D – structured light, Flash LIDAR, etc.
  - Deep learning on 2D, 3D images
  - Spectral imaging

- What we are working on today:
  - Imaging and processing for quality measurements, detection, remote sensing
  - Imaging and for localisation, navigation and interaction – path planning, obstacle avoidance, manipulation
  - Optimizing missions



Reference list of currently ongoing projects

FHF Klippfisk

Nofima SINTEF

IPN Målbær

Nofima SINTEF NMBU

KSP RoboFarmer

SINTEF NMBU

SFI DigiFoods

Nofima SINTEF NMBU

EU PurPest

NIBIO SINTEF NTNU

FP ENDIT

NIBIO SINTEF NMBU

IPN Filima

SINTEF

IPN Feedcarrier

SINTEF NMBU

- ✓ Klippfisk (FHF) – Nofima, SINTEF, ANFACO (Spain)
  - ✓ Goal: Develop and test a handheld instrument for the measurement of water content in salted cod
- ✓ Målbær (IPN) – Saga Robotics, SINTEF, Nofima, NMBU
  - ✓ Goal: Develop sensors systems for perception of strawberry quality (ripeness, color, health, …), and integrate on Saga's harvesting robot
- ✓ Robofarmer (KSP) – Saga Robotics, Byte motion, Robot Norge, NMBU, SINTEF
  - ✓ Goal: Develop and demonstrate necessary methods for enabling safe operation of autonomous multi-arm robots in outdoor real-world (agricultural) environments
- ✓ DigiFoods (SFI) – SINTEF, Nofima, NMBU + many industrial and international partners (total 27)
  - ✓ Goal: Develop solutions for measurement and digitalization of food quality for optimising value chains in the food industry
- ✓ PurPest (EU) – with 18 partners from 10 European countries, including NTNU, SINTEF, NIBIO
  - ✓ Goal: develop a sensor platform that can detect when plants are being attacked by different pests. This will work by detecting volatile organic compounds (VOCs) emitted by the plants under attack or by the pests themselves.
- ✓ ENDIT – Forskningsprosjekt NIBIO, NMBU, SINTEF
  - ✓ Goal: Develop environmentally friendly, non-chemical way of detecting and preventing fungal infections in greenhouses
- ✓ FILIMA (IPN) – Agrosense, Norsk Landbruksrådgiving, Felleskjøpet R&A
  - ✓ Goal: Develop a holistic field lifecycle management solution including automatic data capture, analytics, & decision support tailored for fodder production
- ✓ FeedCarrier (IPN) – TKS, Orkel, Felleskjøpet, NMBU, SINTEF
  - ✓ Goal: Develop an intelligent and autonomous feed system that enables precise control and optimisation of feeding, leading to more cost-effective operations and improved animal wellbeing.

DigiFoods

SFI Digital Food Quality
Senter for Forskningsdrevet Innovasjon

sfi Centre for Research-based Innovation

The Research Council of Norway

SFI – Digital Food Quality

Main goal: Develop solutions for measuring and digitalising food quality for optimising value chains in the food industry.

- 8 years (2020-2028)
- Total €19M
- Consortium: 27 partners
- 9 PhD students and 3 post docs

DigiFoods

Research Pillars

- Fish
- Meat
- Vegetables
- Dairy
- Bio-processing

Pillar 1
Novel sensor systems and application development

Pillar 2
Robot and sensor integration

Pillar 3
Integrated inline sensing solutions

Pillar 4
Utilization of large-scale quality assessments

✓ Novel sensors and robotics designed for online use

✓ Novel strategies for online success

✓ Novel solutions for process and value chain optimization

DigiFoods

Food companies Sensors &Robotics IT/Data analysis R & D

biomega®

HOFF

LERØY HAVFISK aurora PREMIUM NORWEGIAN SALMON

norilia

Nortura bondens selskap

TINE

HySpex by neo

MARQMETRIX®

ROBOTNORGE

THORVALD

Nanosystems and Technologies GmbH nanoplus

Opto Precision

Camo Analytics An Aspen Technology Company

IBM

idletechs

maritech

Intelecy

Nofima

SINTEF

NMBU Norges miljø- og biovitenskapelige universitet

ulm university universität uulm

UNIVERSITAT POLITÈCNICA DE VALÈNCIA

UNIVERSITY OF LINCOLN

LINCOLN INSTITUTE FOR AGRI-FOOD TECHNOLOGY

Summary

- **What we can bring to projects in food and agriculture**
  - Significant experience in projects within the food and agriculture domain
  - A broad network of industrial partners in food and agriculture.
  - Extensive applied optics, computer vision and data analytics expertise
  - We are used to pushing the performance limits of technology – speed, size, SNR etc., and adapting solutions to needs of the measurement scenario – field of view, measurement frequency, level of autonomy
  - Experience in high TRL prototype development and completing successful field trials
  - A history of commercial successes in industrial optical measurement systems

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https://www.sintef.no/en/sintef-research-areas/sensors/

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