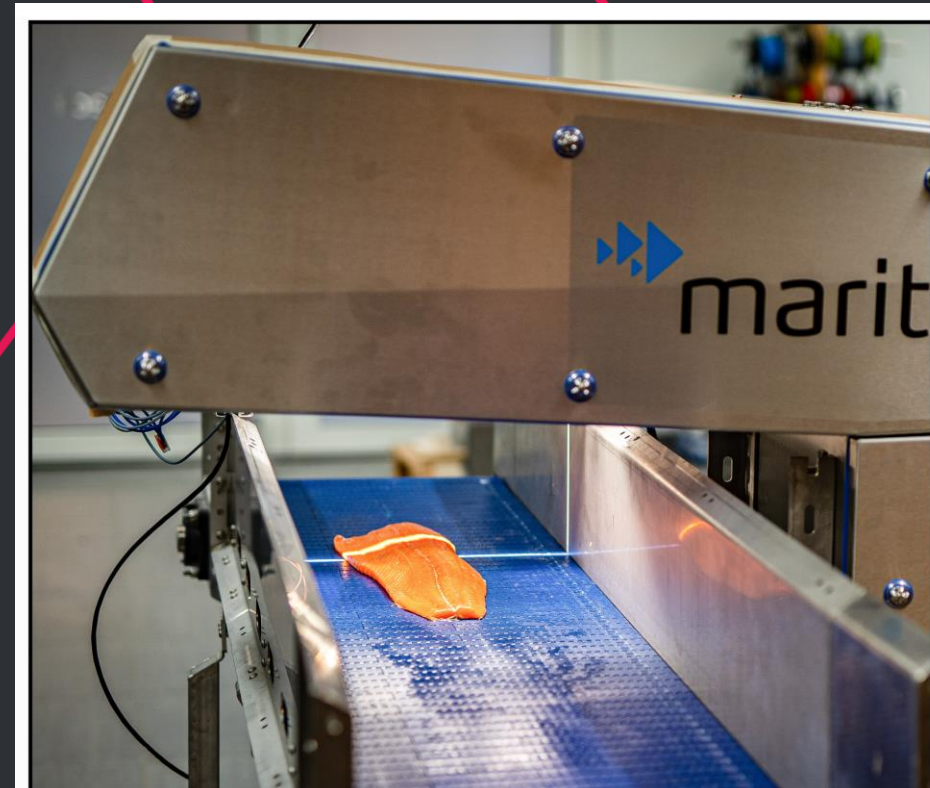


# From Research Reef to Market Catch: A Deep Dive into a Successful Product Launch in the Fish Industry

*Trond Løke - CEO*

*24.04.2024*

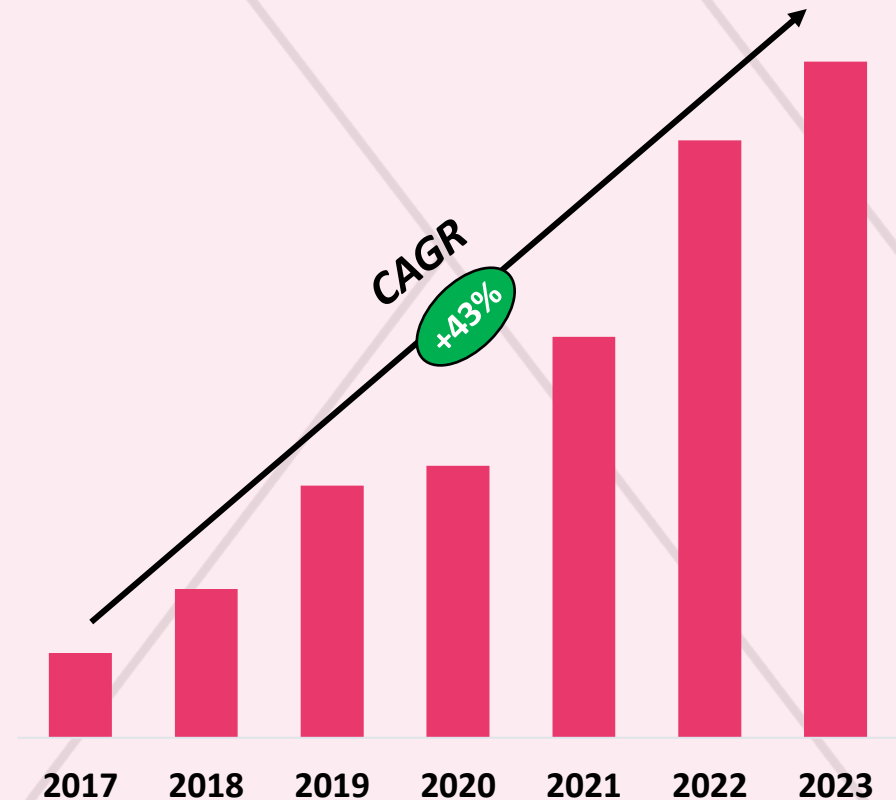


# NEO is a fast-growing tech company with heavy R&D focus

## Company overview

- **Founded in 1985** as a spin-off from Norwegian Defense Research Establishment (FFI)
- Owned by a non-profit foundation with a vision of supporting **art and physics**
- Does **research in electro optics** with the objective to develop **state of the art products** for an international market
- R&D projects should have **high risk profile**.
- Delivers **state-of-the-art hyperspectral cameras** for a wide range of applications through HySpex
- **Headquarters in Oslo** with sales office in the U.S and subsidiary company in Sweden
- Currently **~60 employees**, half of which work in **R&D**
- Been on the **top 50 list of fastest growing tech companies** in Norway several years

## CAGR from commercial activities 2017-2023



# Agenda

- The Technology
- The product and its applications
- History of research on the topic
- The key focus areas in commercializing phase
- KVASS (FHF project)
- Product launch
- Scalability and the future

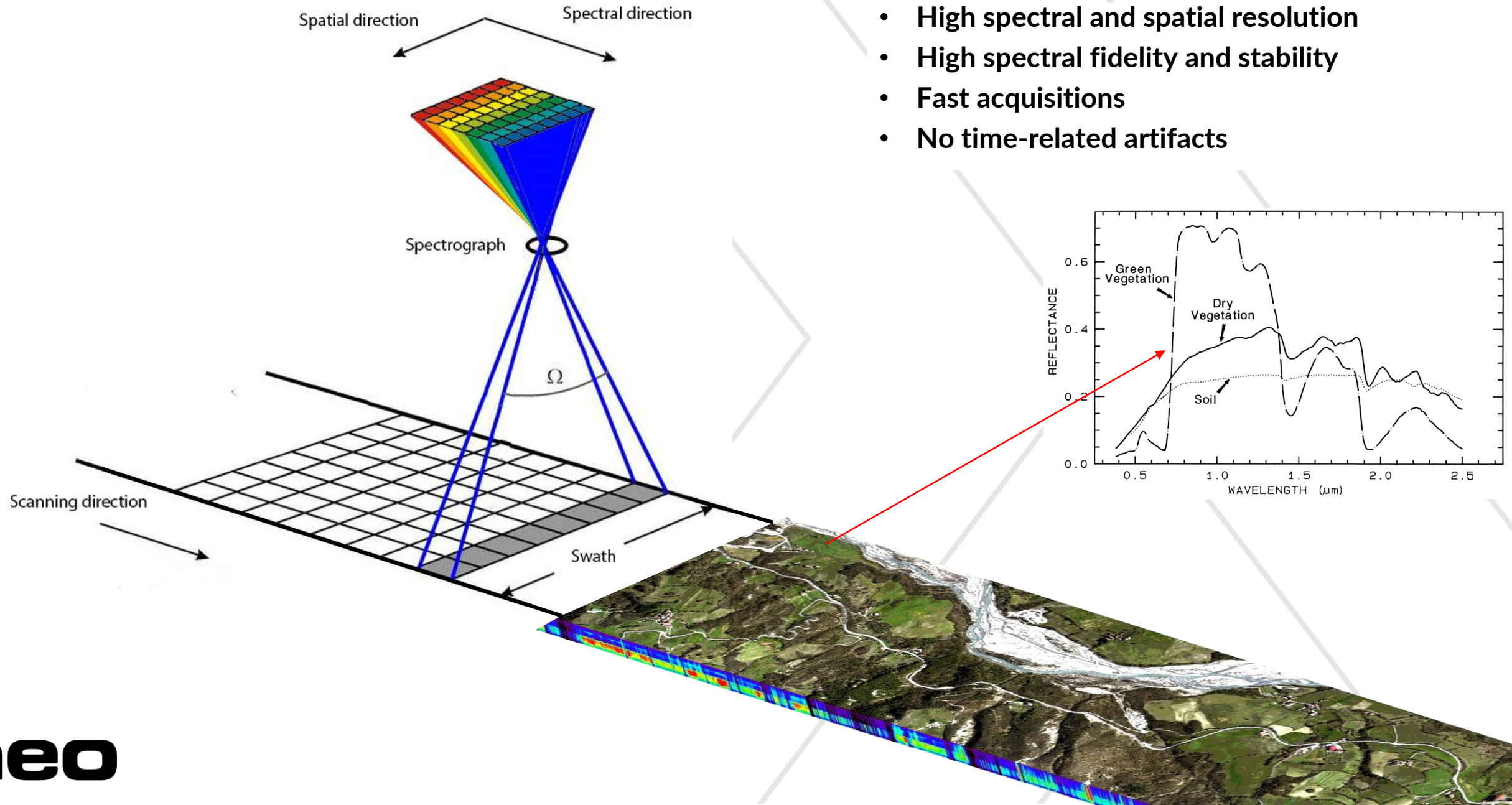


# The technology: Hyperspectral Imaging

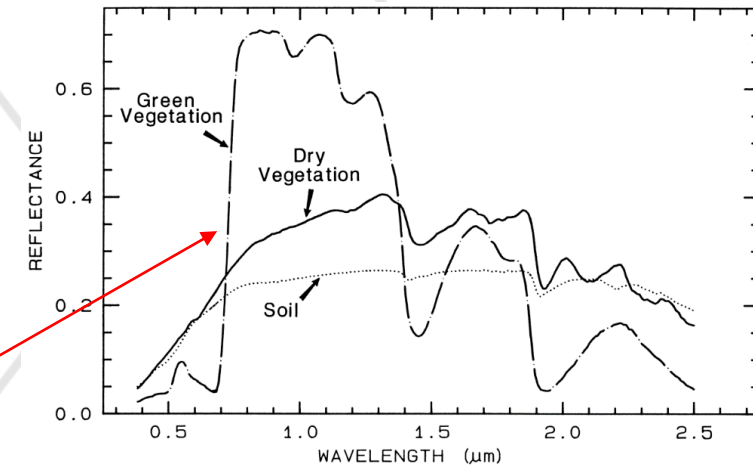




# Pushbroom architecture

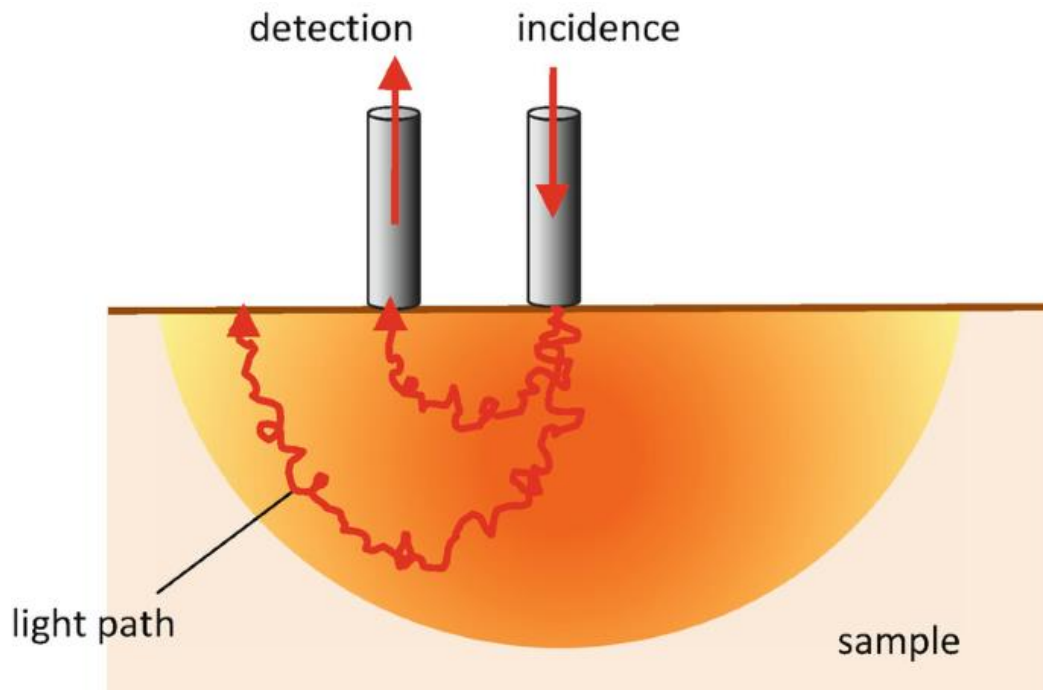


- High spectral and spatial resolution
- High spectral fidelity and stability
- Fast acquisitions
- No time-related artifacts



# Illumination and setup

- Interactance imaging





# The product and its applications

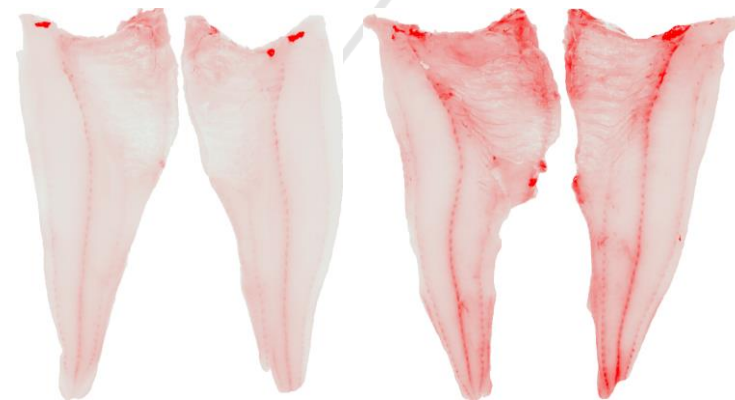
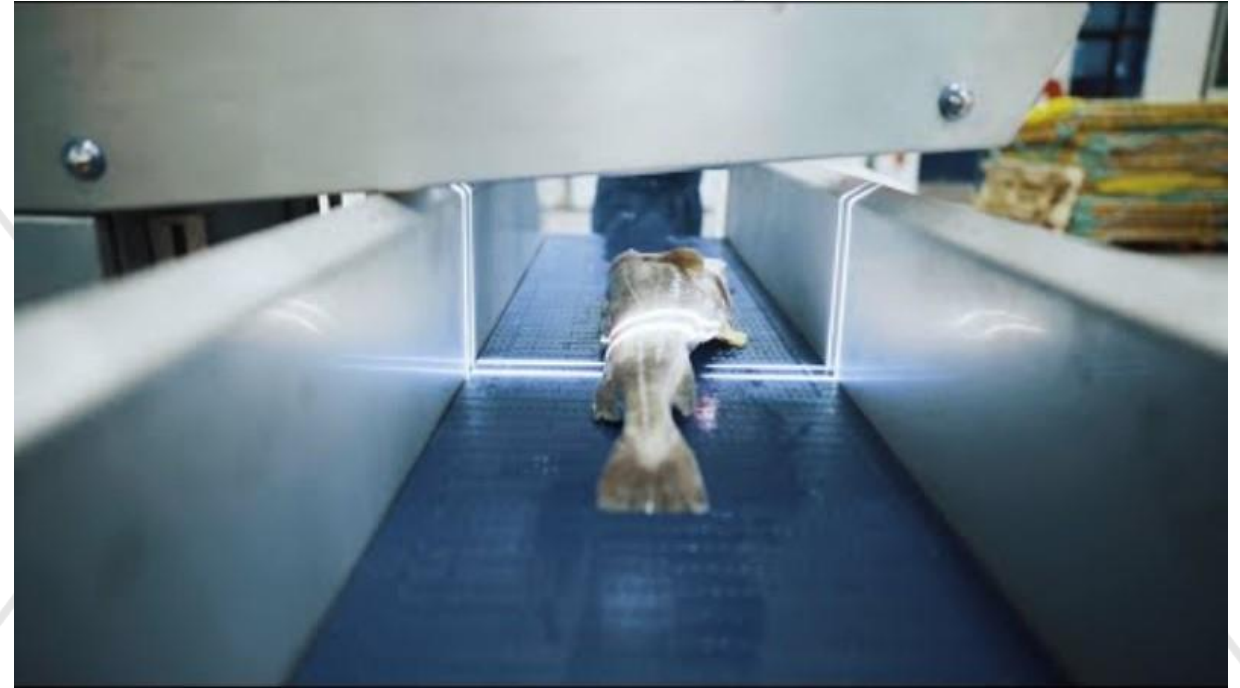
Hyperspectral imaging – White fish

Quality attributes – Implemented:

- Blood spots / blood level
- Nematode detection
- Gaping

Quality attributes – To be studied

- Identification soft tissue
- Remaining shelf life – Spinoff project



# The product and its applications

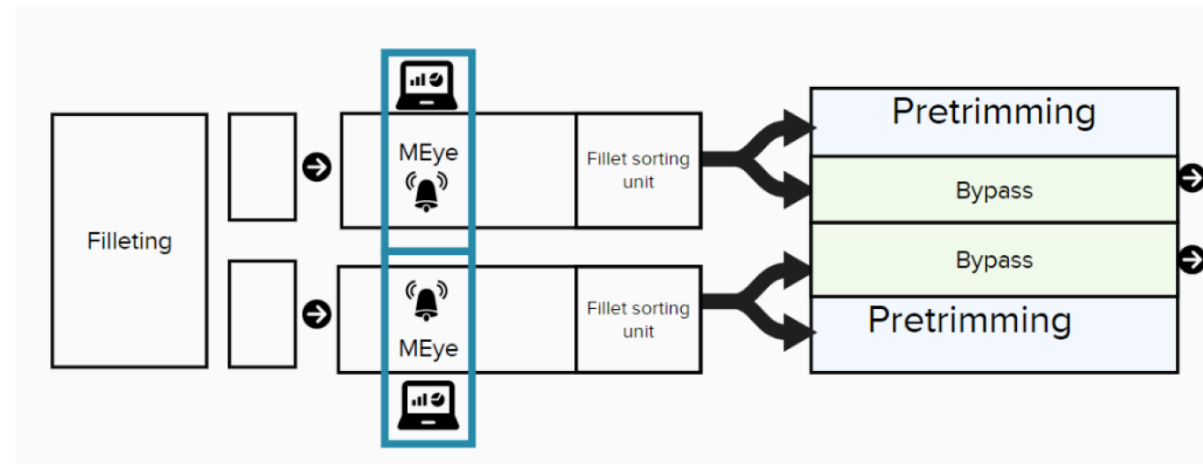
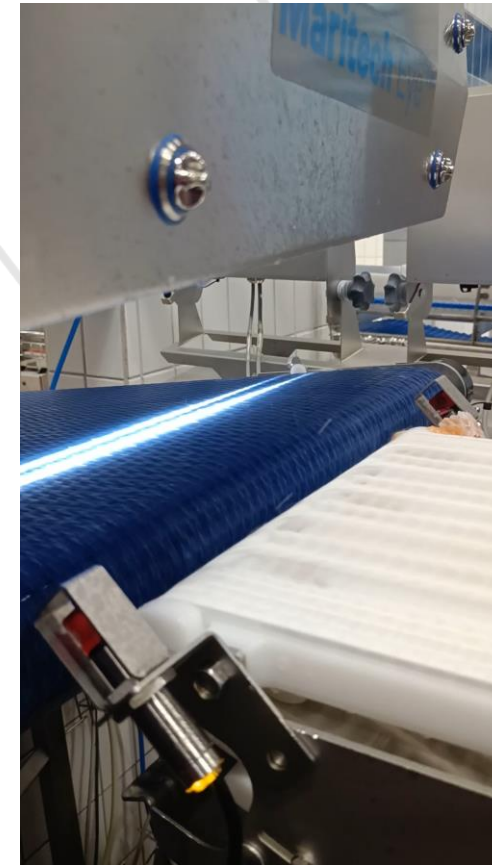
Hyperspectral imaging – Salmon fillets

Quality attributes – Implemented:

- Blood spots
- Melanin
- Color (SalmoFan)
- Fat and fat distribution

Quality attributes – To be studied

- Identification of cartilage
- Texture properties
- Detection of bones?





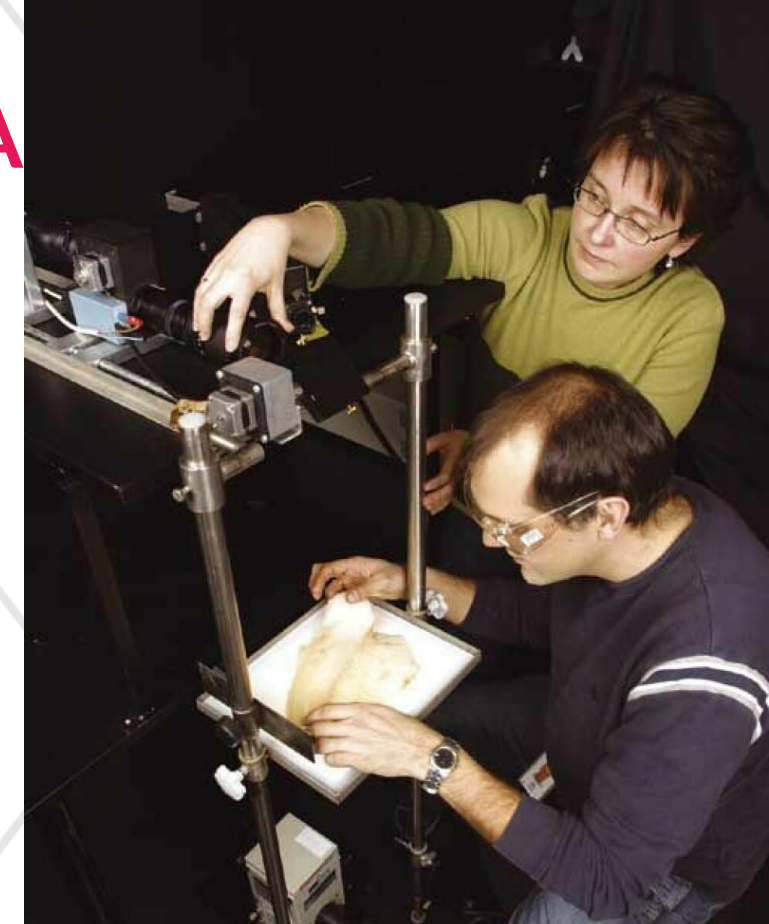
# History of research on the topic by NOFIMA

**2009-2011** – FHF project on hyperspectral imaging with the purpose of detection of blood and melanin spots in salmon fillets

Methodology applied on salmon as a reference method in several projects (Fillet-O, Quality measurement fresh fish, ...)

**2015-2017** – RFF-Nord project and internal Nofima funding's has resulted in a solution for whitefish (fillet's and whole fish). Based on these activities the salmon approach has been improved/changed

**2017-2020** - KVASS (commercialization project)



# The key focus areas in commercializing phase

- Robust and reliable technology: Illumination and hyperspectral camera
- Real-Time software solution
- Robust models
- Cabinets for harsh environments
- User Experience



# Robust Camera

Signal-to-Noise

Calibration

Stability

Uniformity

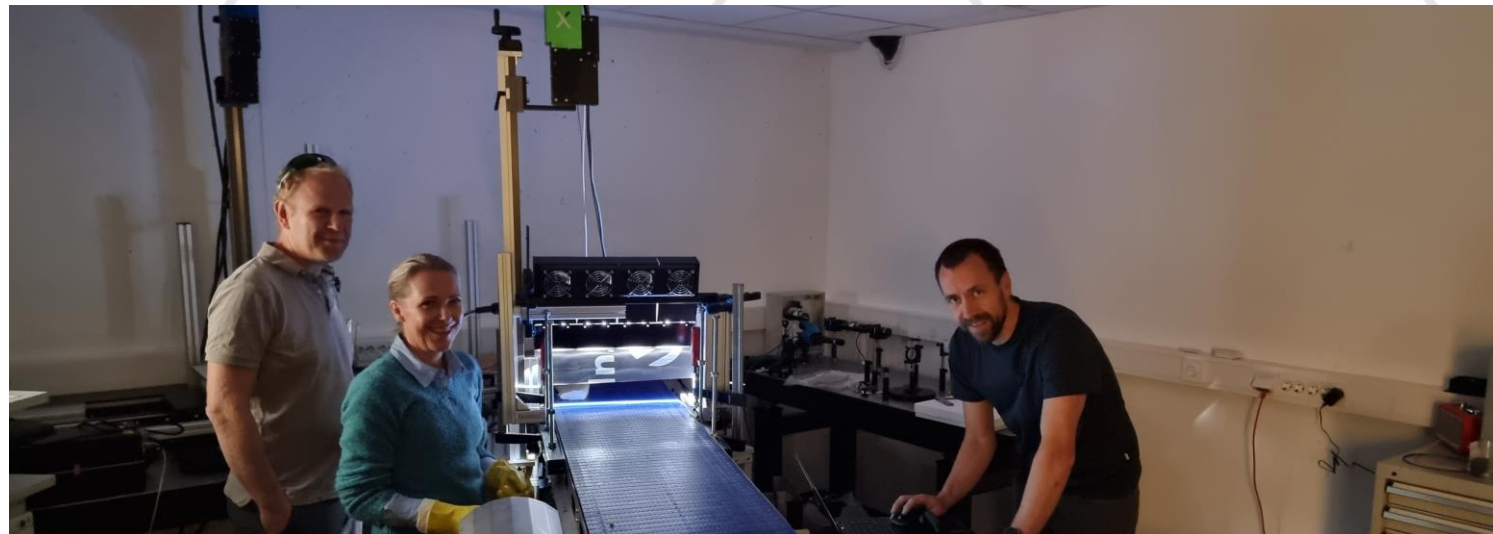
«The four hurdles of imaging spectroscopy»

Joseph W. Boardman



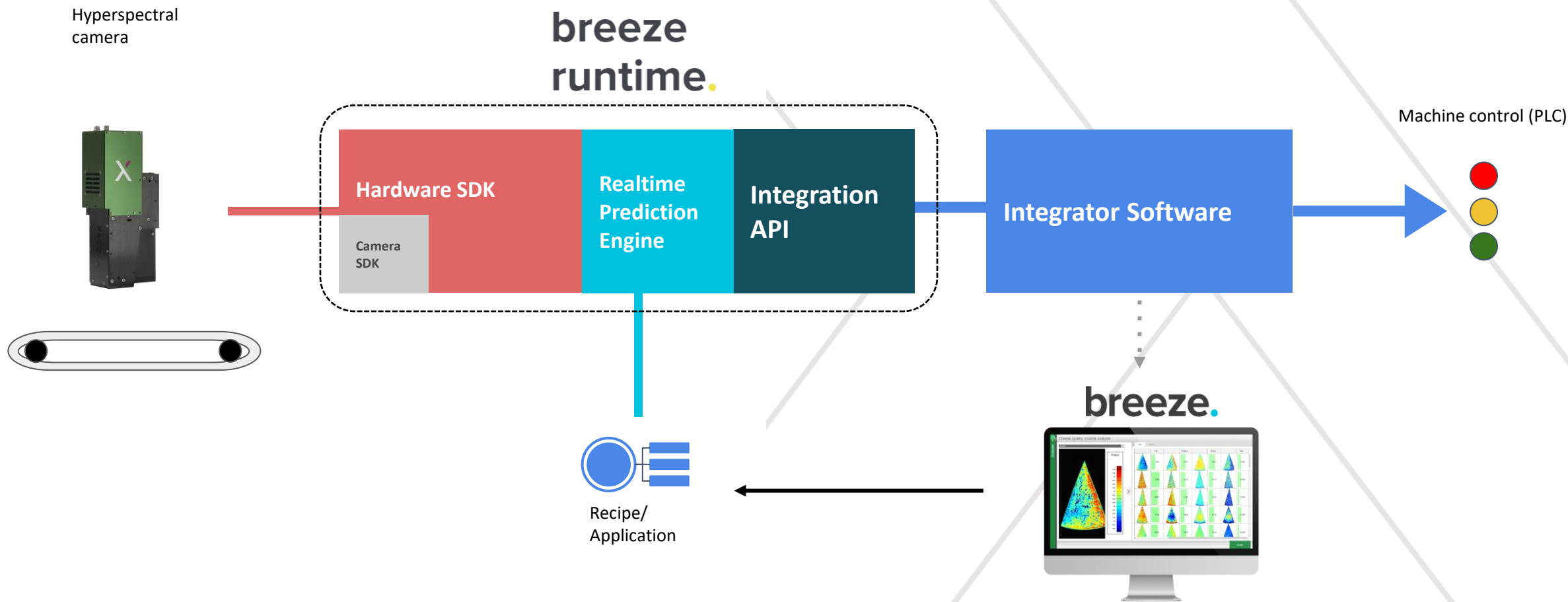
# Robust Illumination

- Stable over time spectrally and spatially
- Stable spectral content in different height from belt and in x and y
- Sharply focused light
- Small amount of straylight in FOV (light coming directly from source)
- White reference calibration



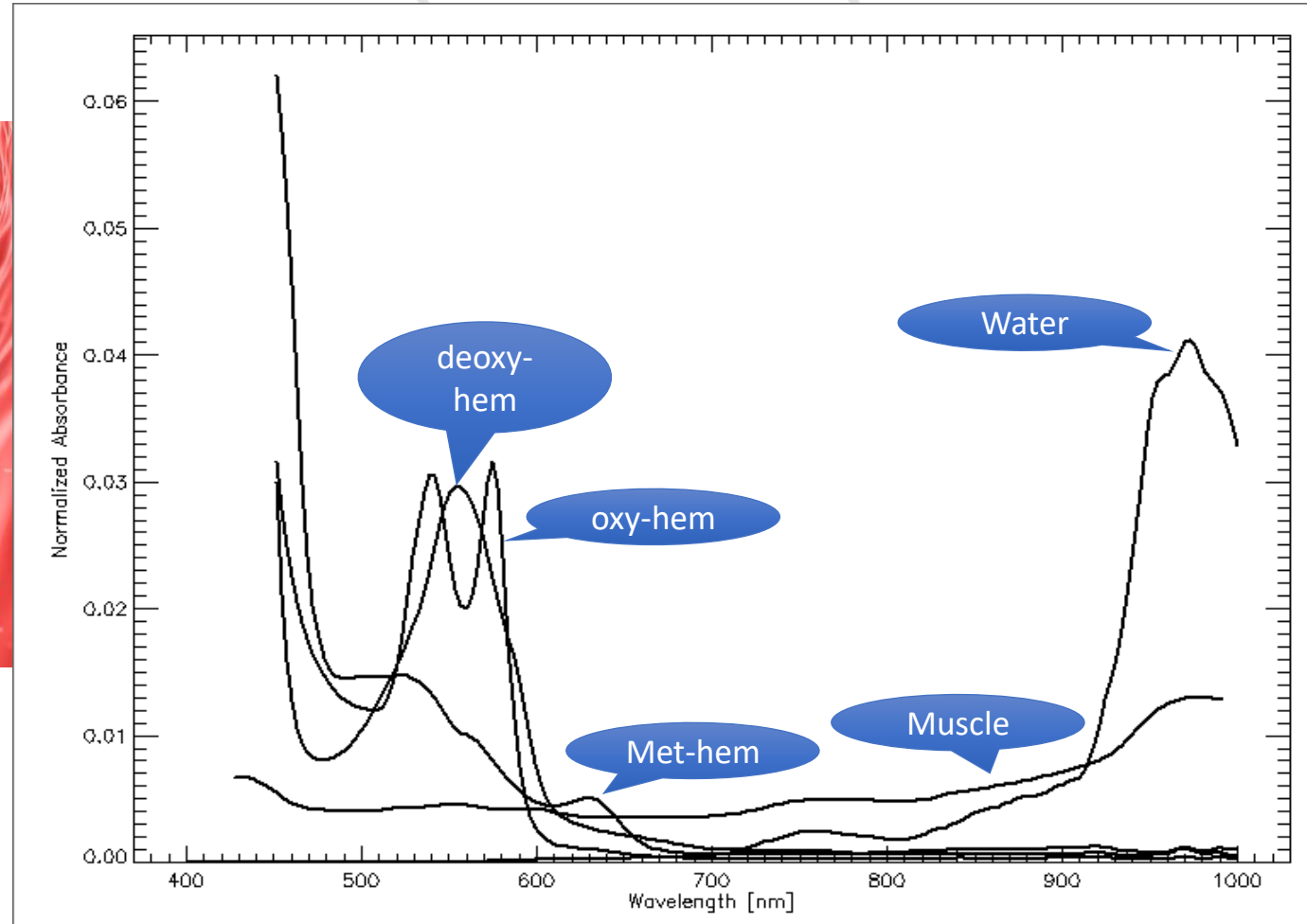
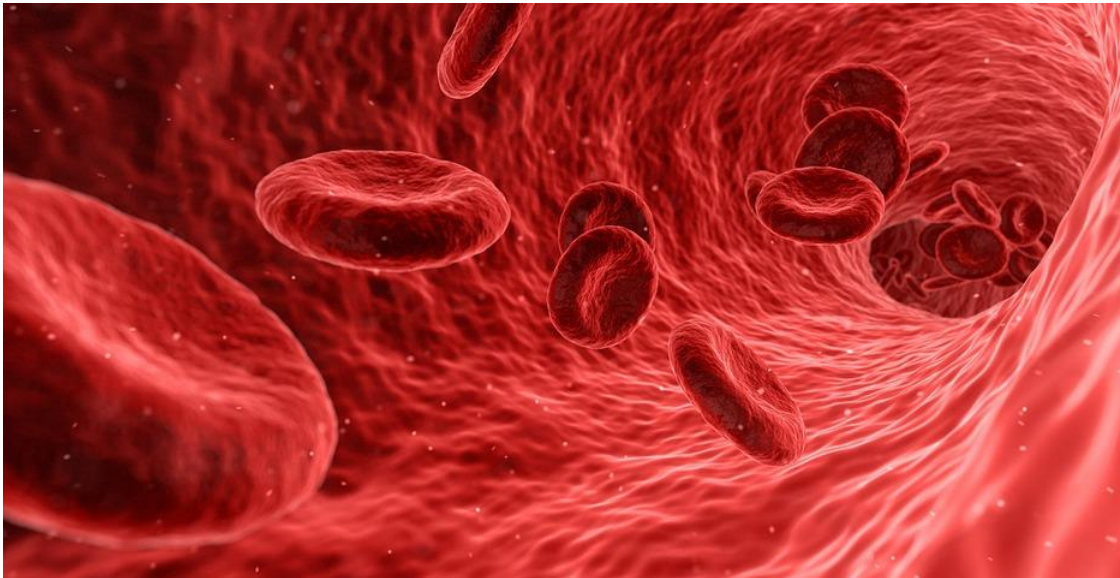


# Breeze runtime solution



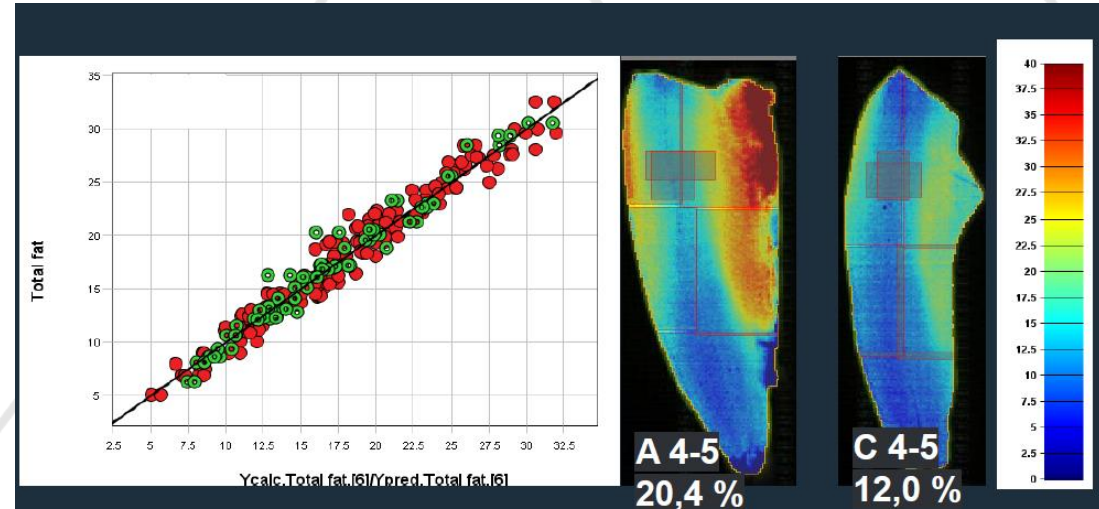
# Constrained Spectral Un-mixing

Algorithm from NOFIMA implemented in Breeze software from Prediktera



# Robust models = Insensitive to unwanted variability

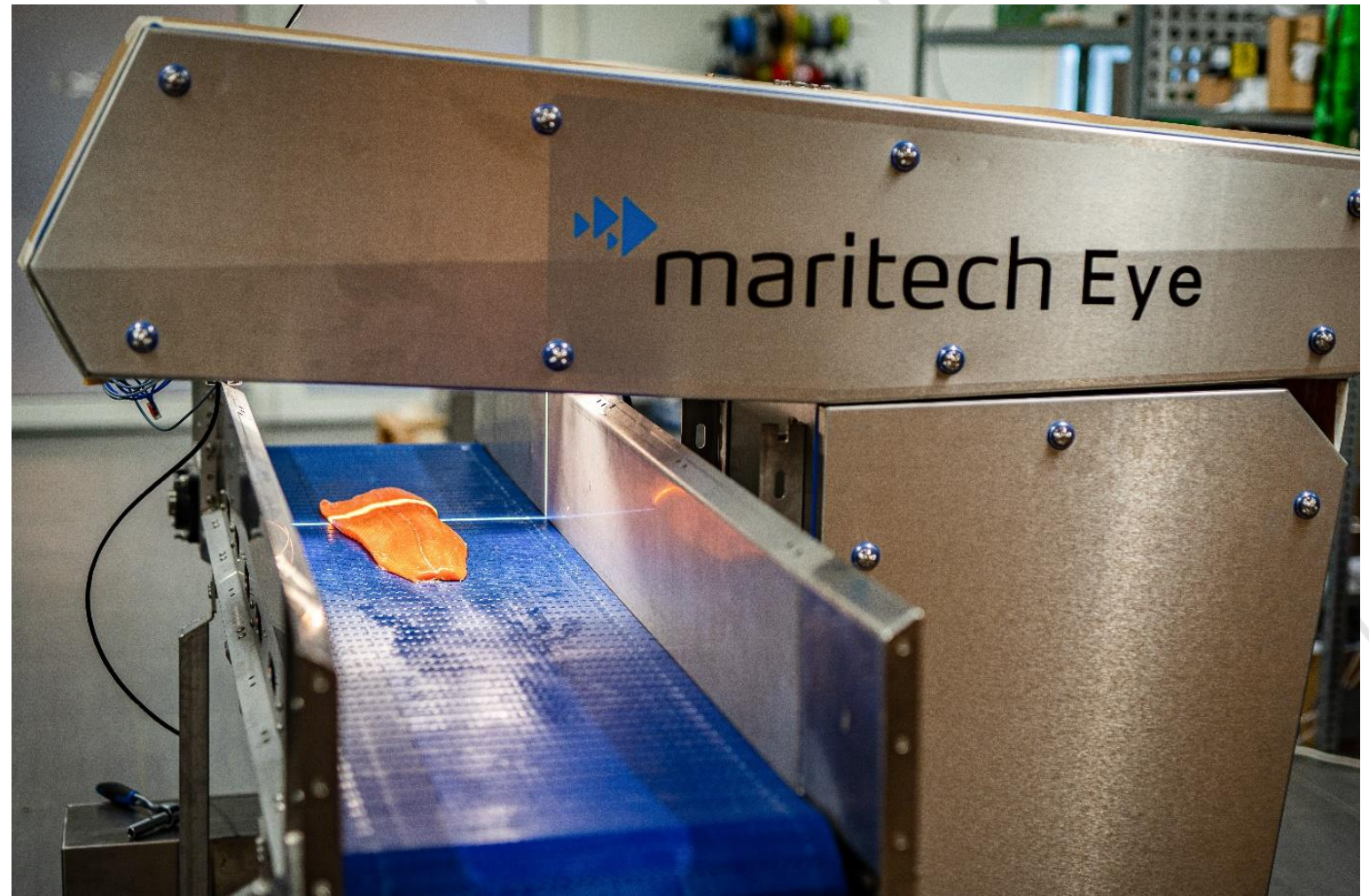
- Interactance imaging combined with “Constrained spectral un-mixing” gives a very precise blood image of the fillets
- Building robust models in Breeze we needed the following
  - A lot of samples with ground truth
  - Relevant variability in the samples.
  - Remove the influence of unwanted parameters, like water
  - Tested on independent samples for validation





# Cabinett

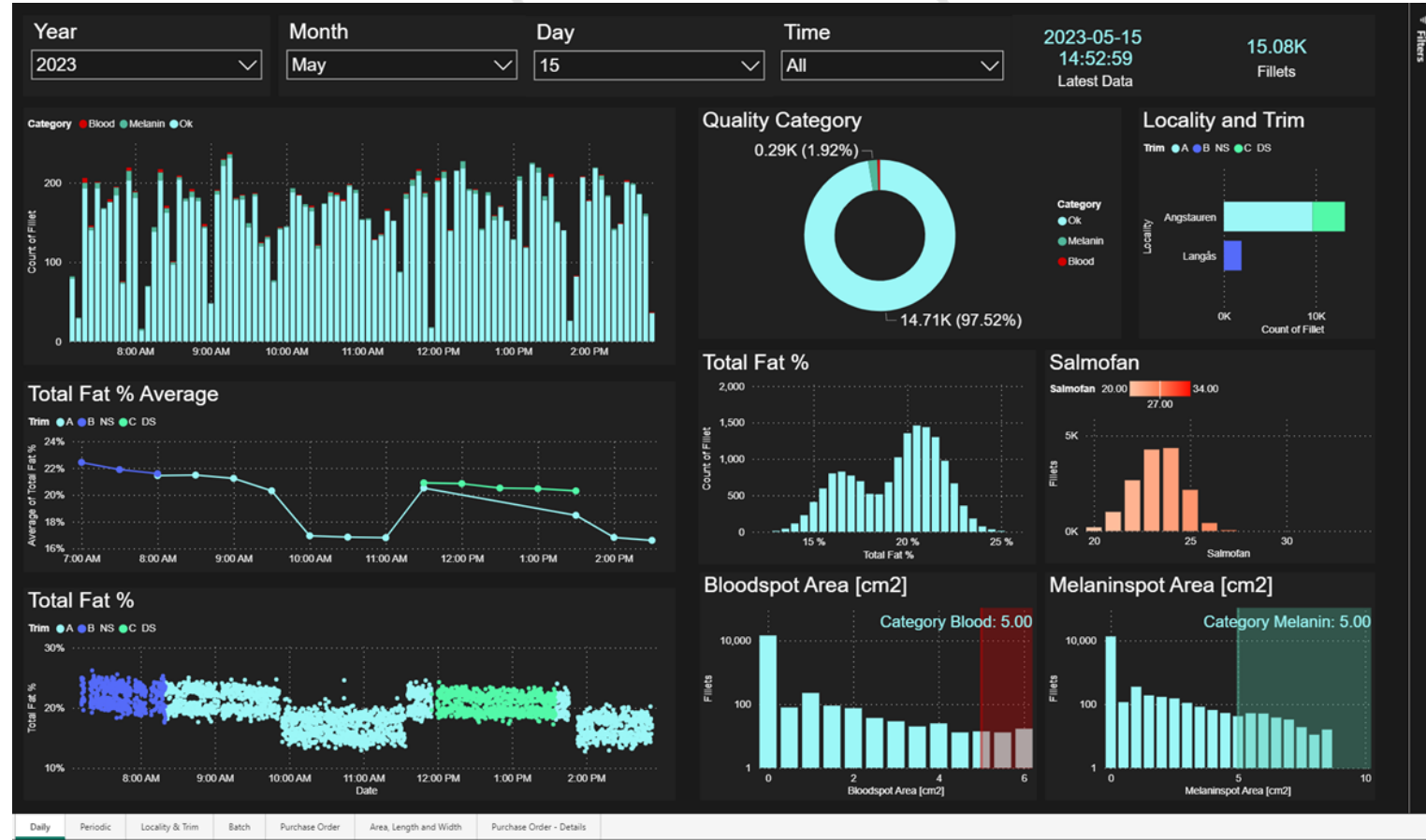
- Water resistant (can be washed with power washer)
- Temperature controlled internally
- Design that did not need alot of space above the belt (adopted for factory boats)
- Optically good glass that is AR coated, and at the same time breaks in a certain way if it breaks.





# User Experience

- Martiech focused on making the GUI user firendly and relevant for the industry.
- Martiech, NEO and NOFIMA focused on making the technology easy to use



# KVASS (2017-2020) FHF

- The focus areas in the commercialization phase was run in a FHF project.
- FHF projects have a big commercialization focus
- Key players in the fish industry was part of the project
- The industry need to make significant investments as there is very little funding for the us!



neo



 maritech





# The product launch: Maritech Eye™



23<sup>rd</sup> of November 2020

# Scalability and the future

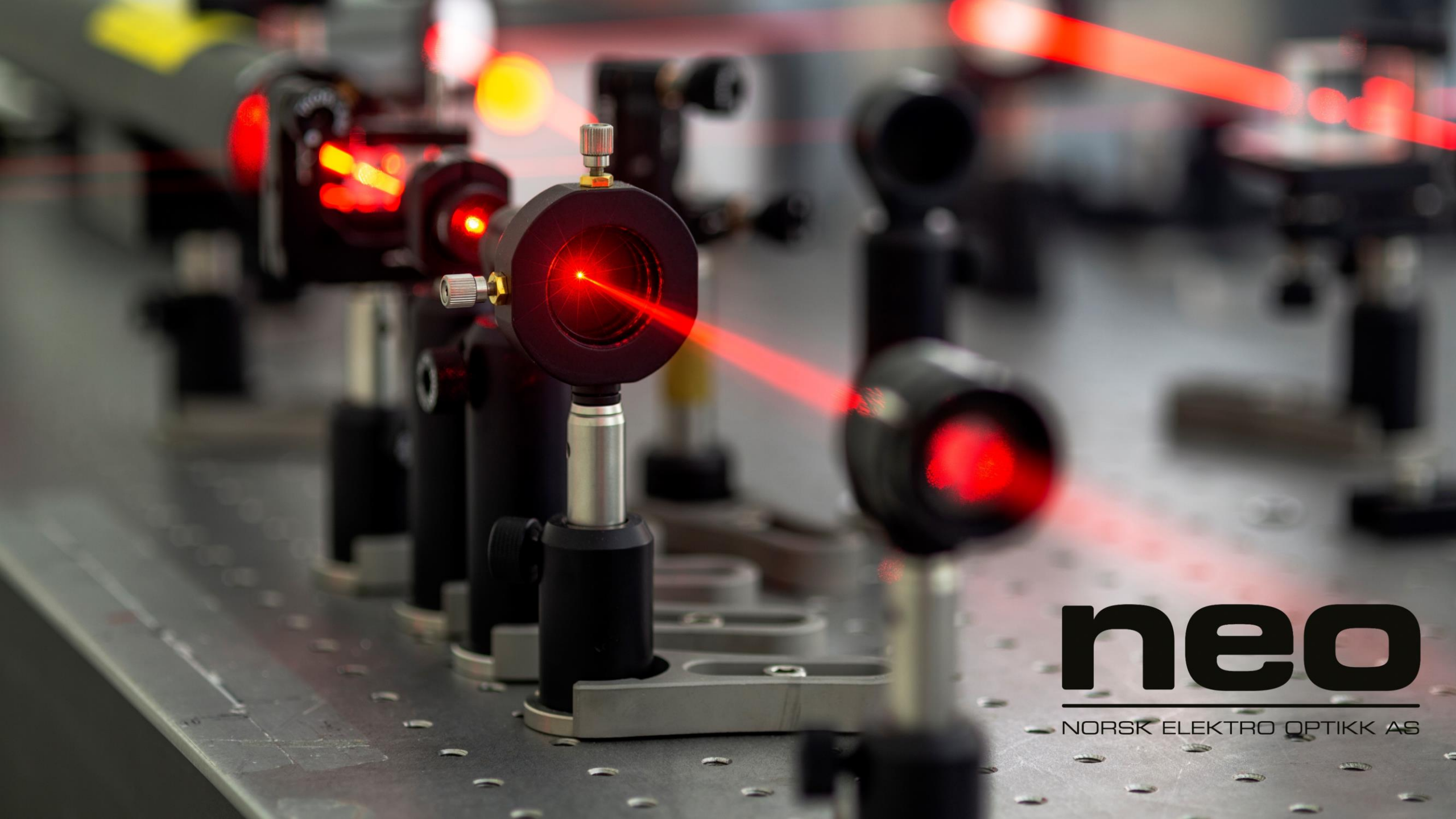
## Scalability

- When you have a hyperspectral system that meets all four hurdles you will be able to make robust models across many systems.
- «Easy» to implement new functionality in the system (models can be uploaded remotely to add functionality)
- Sky is the limit!

## Future

- New applications for same product
- Improved illumination (sharper and less straylight)
- We have also made reflectance versions of this product with SWIR (950-2500nm) cameras for quantifying fatty acids in salmon fillets.





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NORSK ELEKTRO OPTIKK AS