

Rask og ikke-destruktiv sortering av krabber

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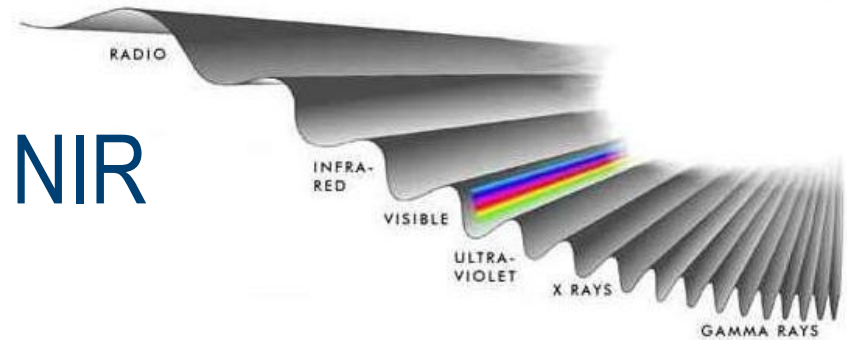


Oversikt

- Mål: Utvikle metode for rask og ikke-destrktiv måling av matfylde i krabber
 - Industriell sortering
 - System for sortering ombord
- Aktive partnere: Møreforskning, TI, QVision, Hitramat and NofimaMat
- Utgangspunkt: Instrument basert på nærinfrarød (NIR) spektroskopi spectroscopy
- Instrument installert hos Hitramat i 2007, koblet til automatisk grader
- Mange målinger er gjort for å kalibrere systemet



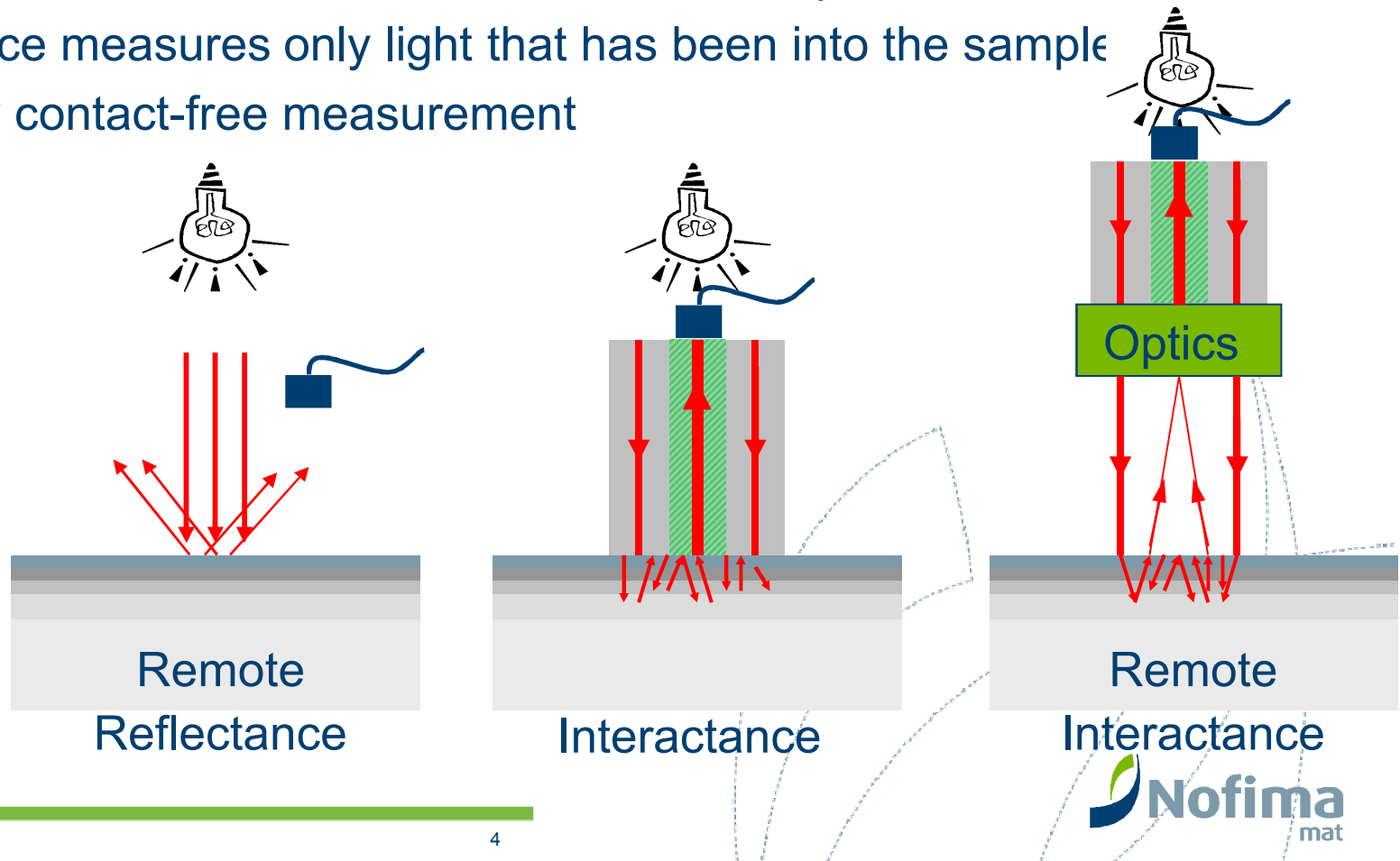
Near-infrared spectroscopy - NIR



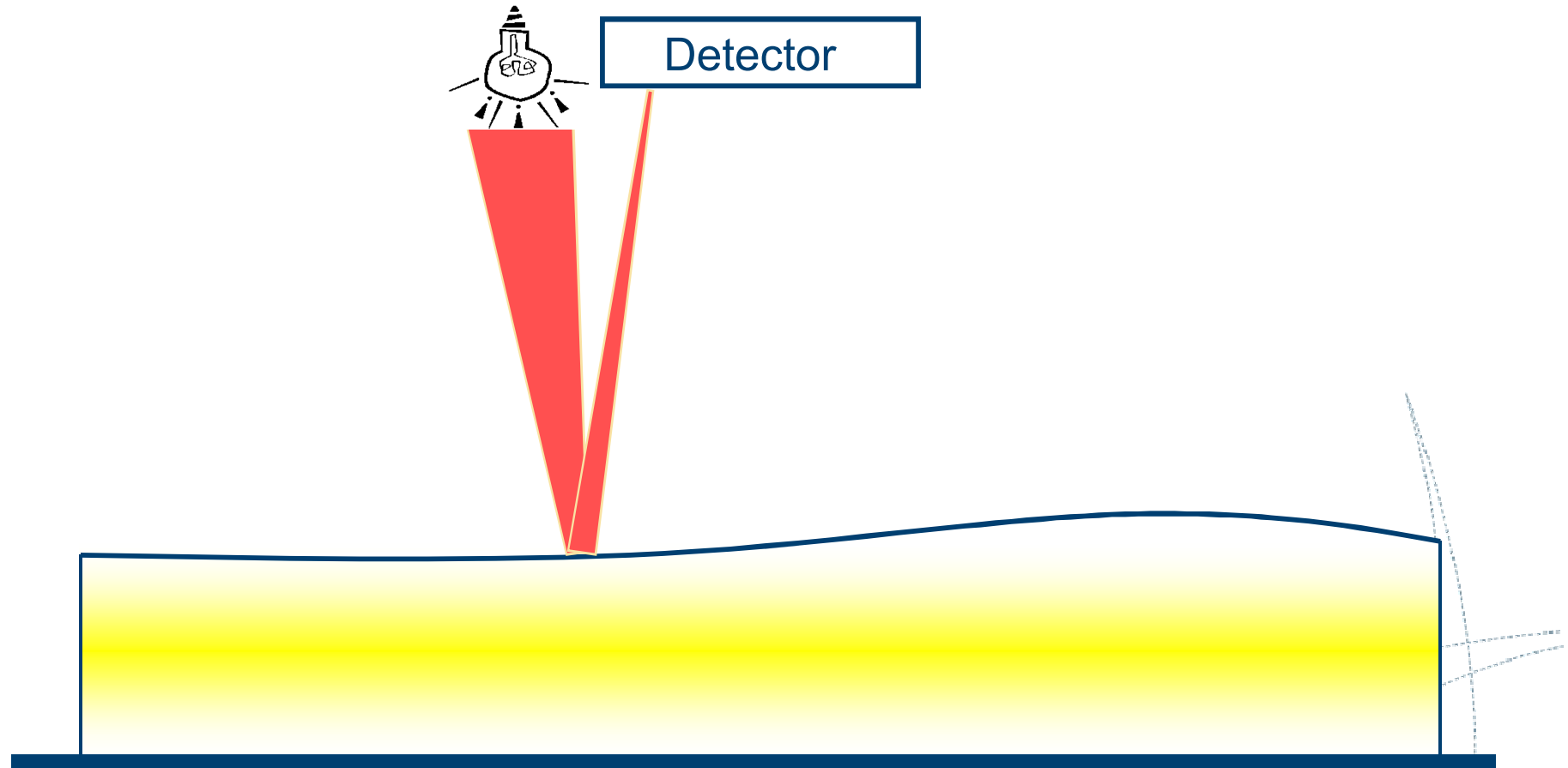
- Spectral range 800-2500 nm
 - near-NIR: 800-1100 nm, high penetration depth
- Enables measurement of the main components in foods:
 - fat, water, protein, sugars, salt, etc.....
- Many different on/at-line systems for foods exist
 - Protein in grains
 - Sugar in fruits (apples, oranges, etc.), where measurements are done through the skin/peel.
 - On-line determination of fat, water, protein in ground meat
 - On-line determination of water in potatoe chips
 - On-line determination of fat in salmon fillets
 - Fat, water and protein in animal feed

NIR optical sampling

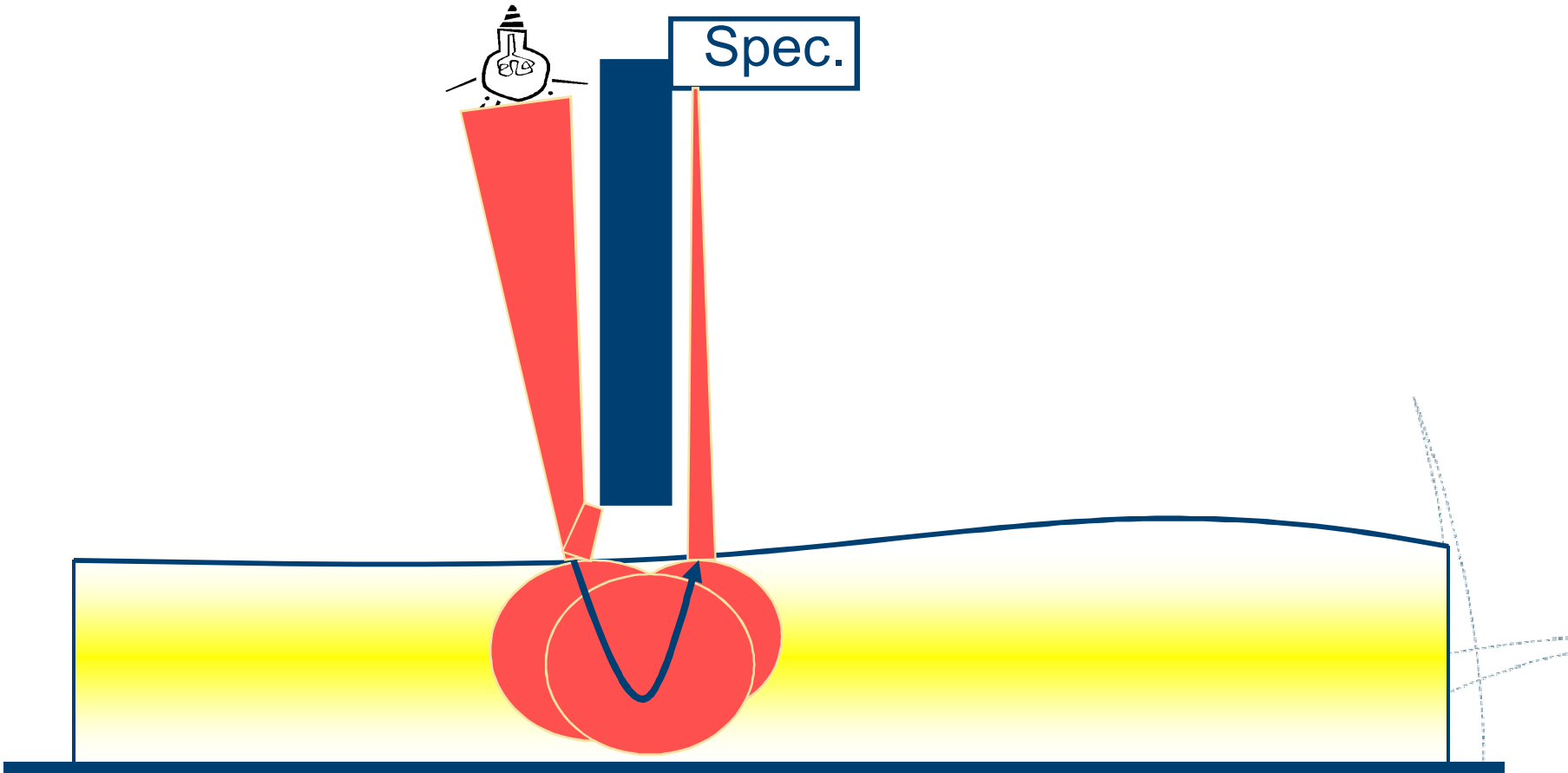
- Transmission is difficult in on-line setting
- Reflection does not reflect the interior of the sample
- Interactance measures only light that has been into the sample
- Preferably contact-free measurement



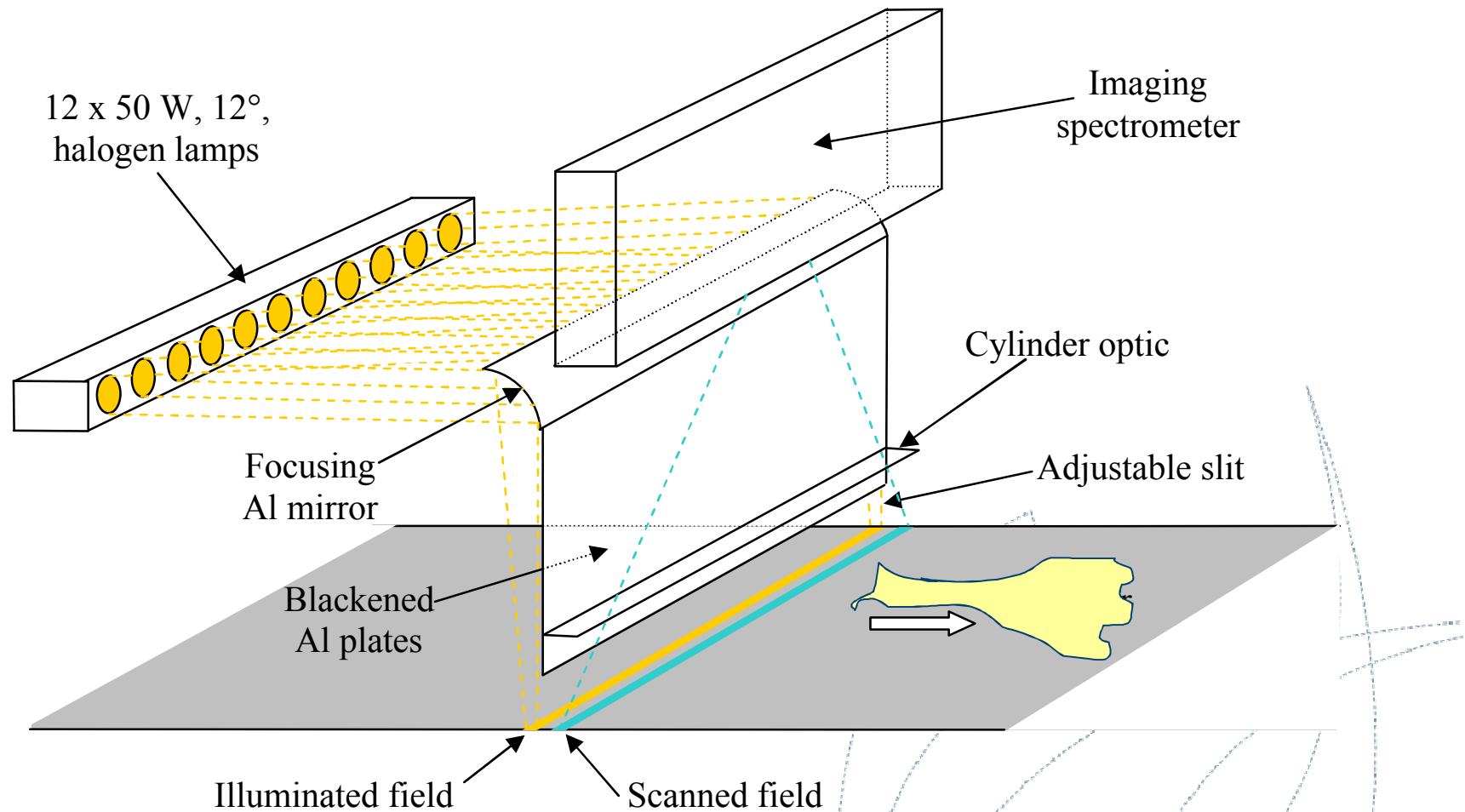
Reflection: Measures the surface



Interactance: Forces light into the product



Instrumental solution (patented): Scanning interactance measurement



Installasjon i praksis

- Sorterer på vanninnhold
- Produsenten får riktig pris
- Unngår reklamasjoner

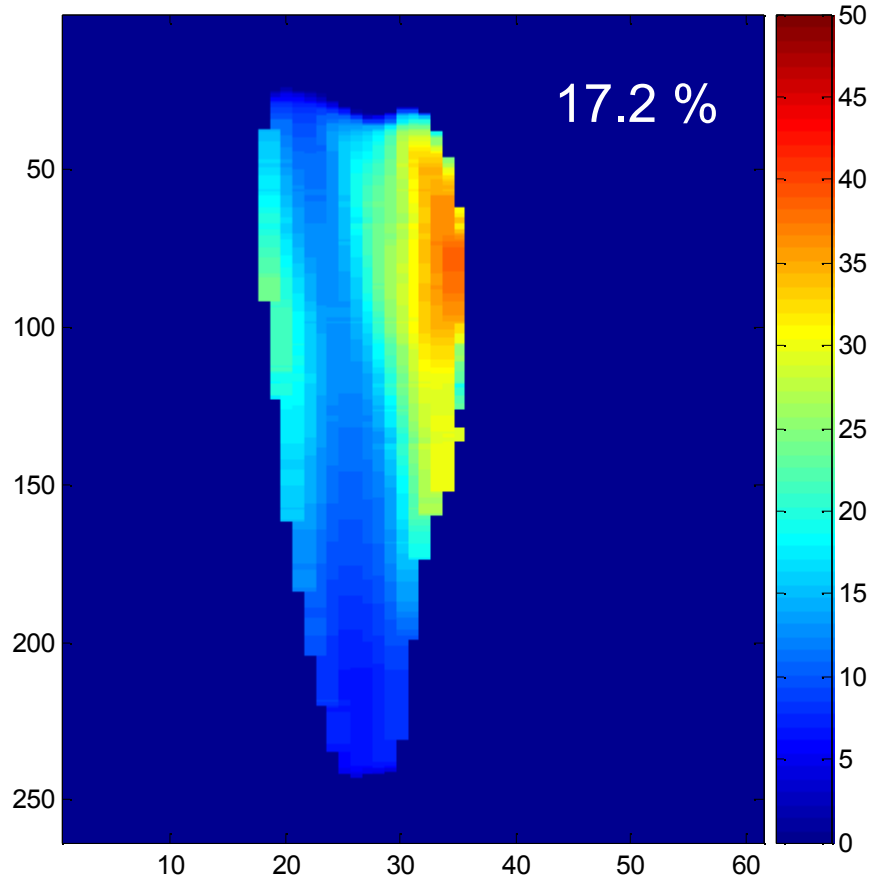


Commercial implementation: fat in salmon fillets

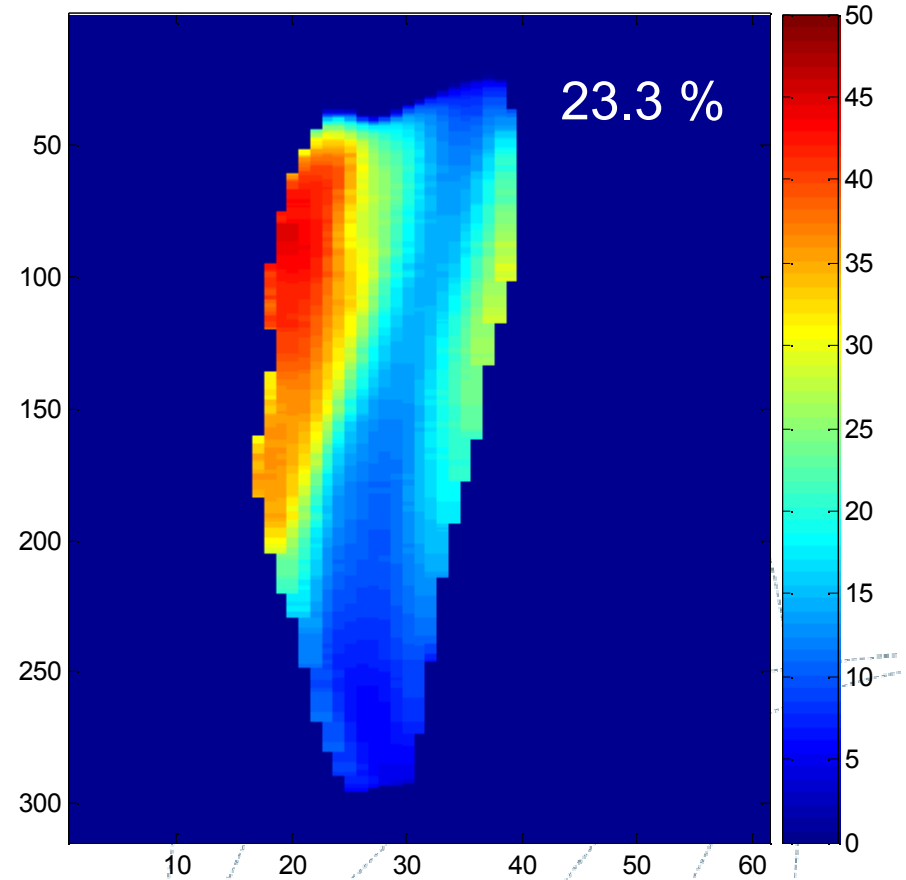


Chemical images: Fat content in each pixel

Fisk: 16 FettFisk: 17.2034% Share: 20.2078

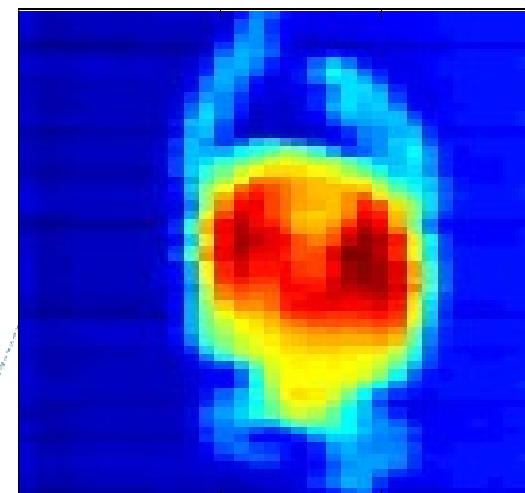
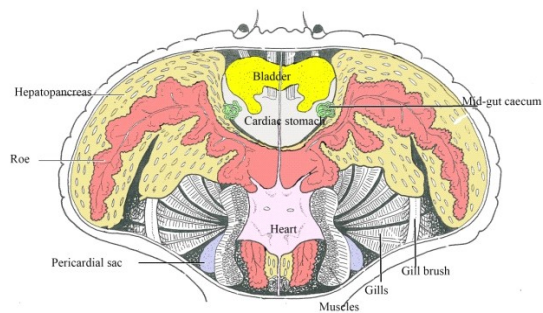


Fisk: 20 FettFisk: 19.8969% Share: 23.6285



How and what do we measure?

- Crabs are scanned on-line on a conveyor with the shell up and exposed to the scanner
- The crab is measured from above
- Mainly the upper 15 mm is probed
- Multispectral NIR images are captured
- 15 NIR channels in each image



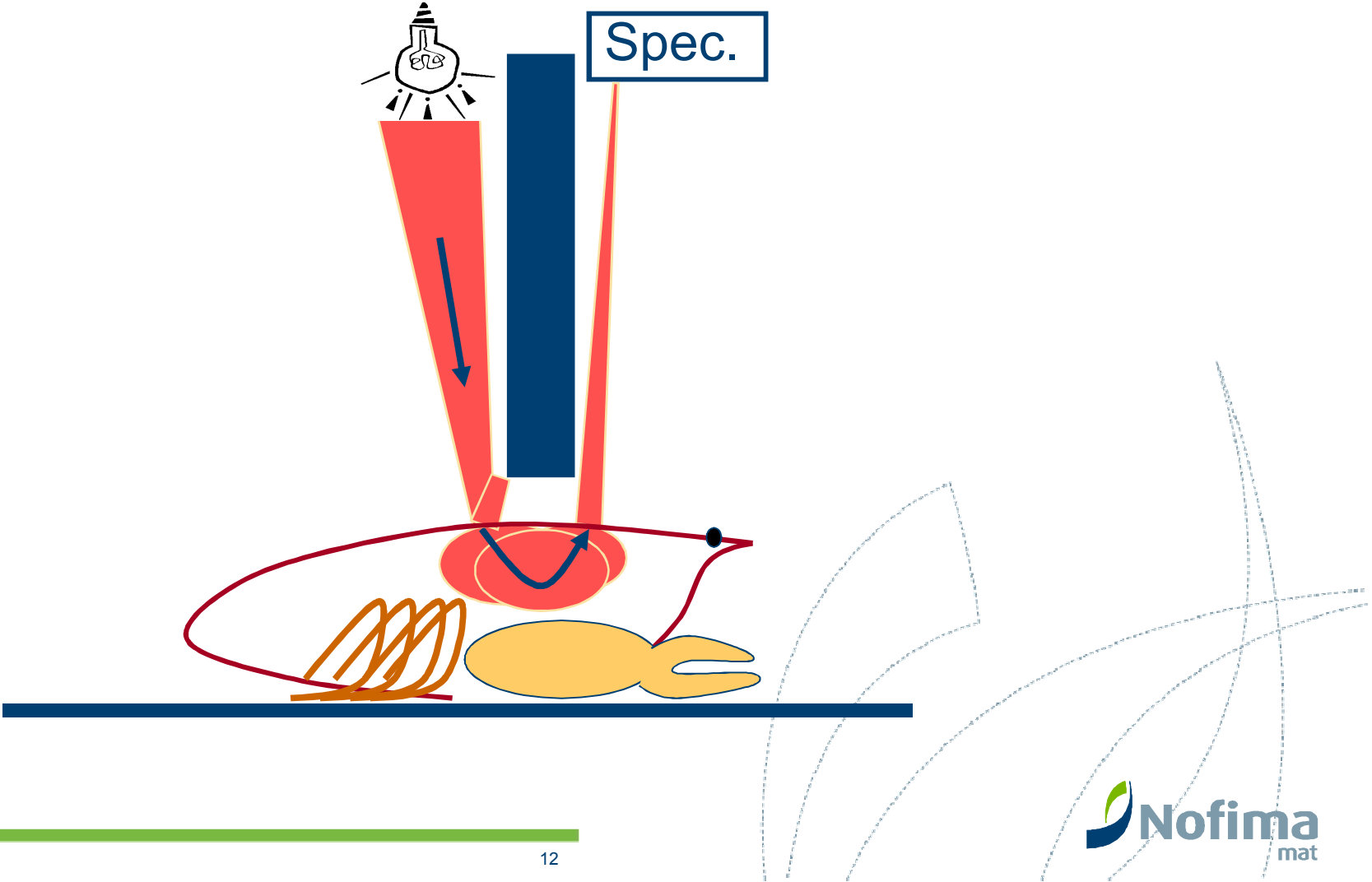
A

19.05.2010

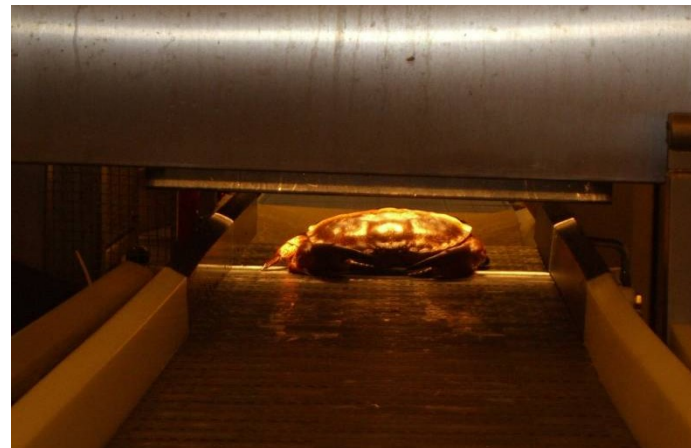
B

11

Interactance: Forces light into the crab



Qmonitor scanner at HitraMat



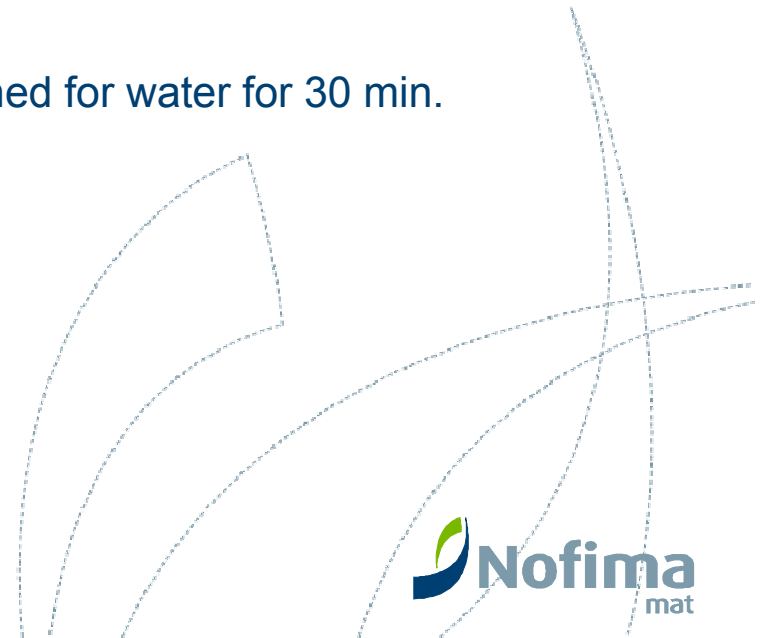
Fire krabbesorteringer:

1. Topp kvalitet
 - Mye rogn og lever
 - Kokes hel, til Frankrike
 2. Bra konsum kvalitet,
 - bra matfylde
 - Kokes hel, til Norge
 3. Lite matfylde
 - Skall åpnes, innmat tas ut og kokes for seg
 - Setter sammen skjell, klør til eget produkt
 4. Tom krabbe
 - Klørne tas, resten kastes
- Problem: Vanskelig å se forskjell!

Measurement of food content



- As a measure for the amount of food, we have calculated a Measured Quality Index (MQI)
- Important: Before weighing, the carapace was drained for water for 30 min.
- The instrument is then calibrated against MQI
- If no meat, then the crab is full of water



Determination of food content in crabs: The meat index

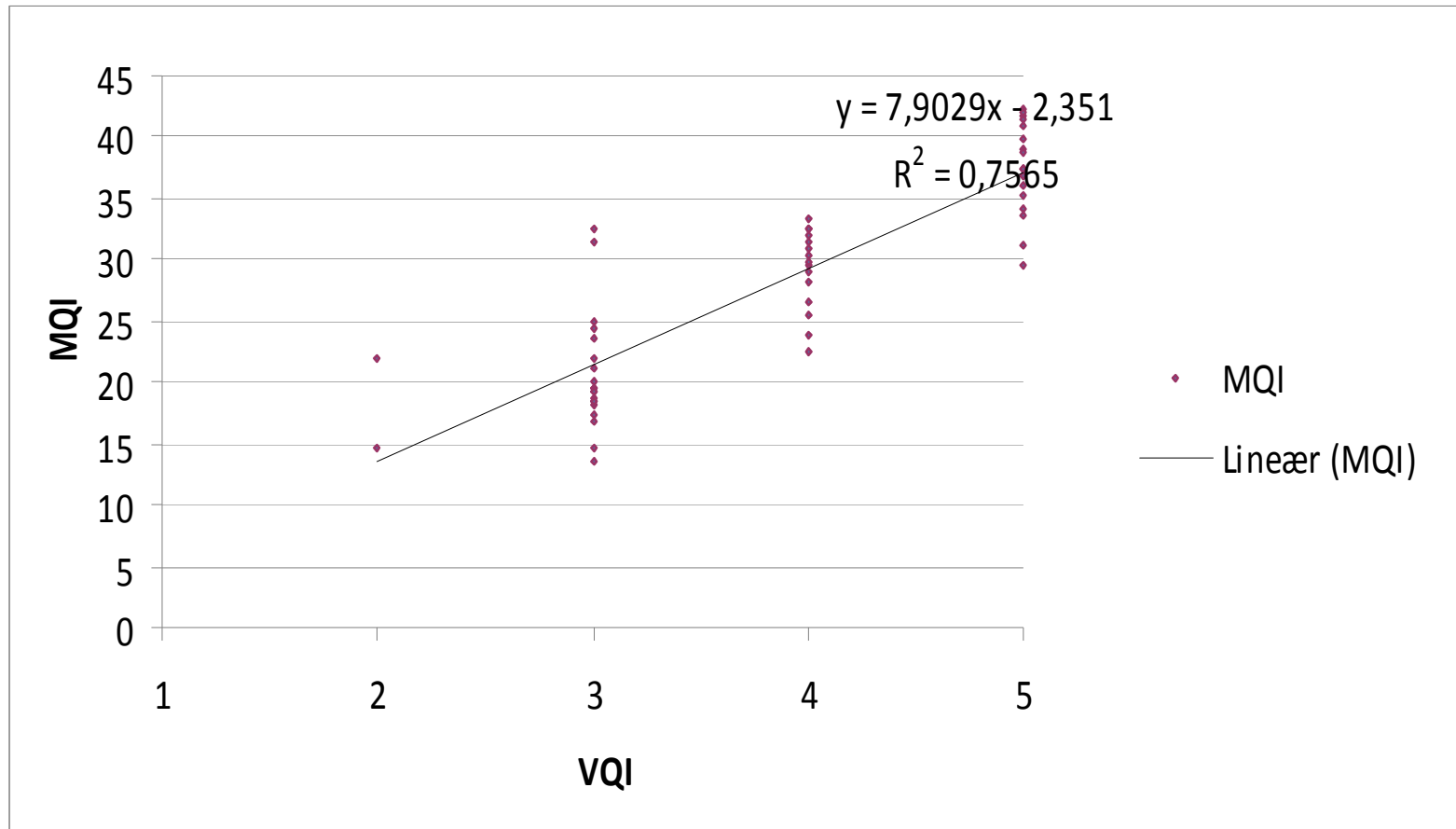


Meat Index, MQI:

$$\text{MQI} = \frac{(L+R)*100}{(W/10)^2}$$

- L = liver content
- R = Roe content
- W = Width of the crab shell

Relation between MQI and VQI for 50 crabs (Visually assessed Quality Index : 1-5)

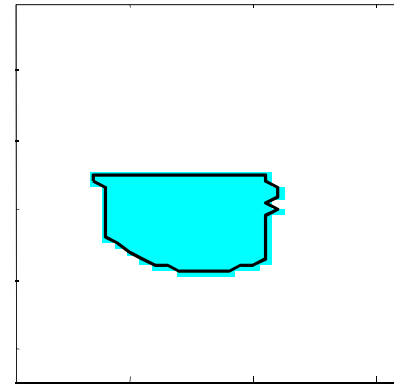
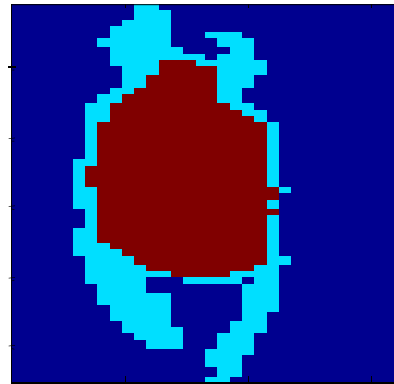
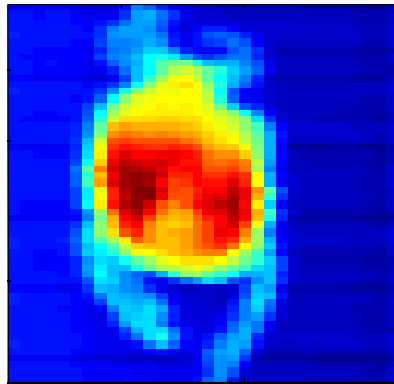


Where on the crab should we measure?

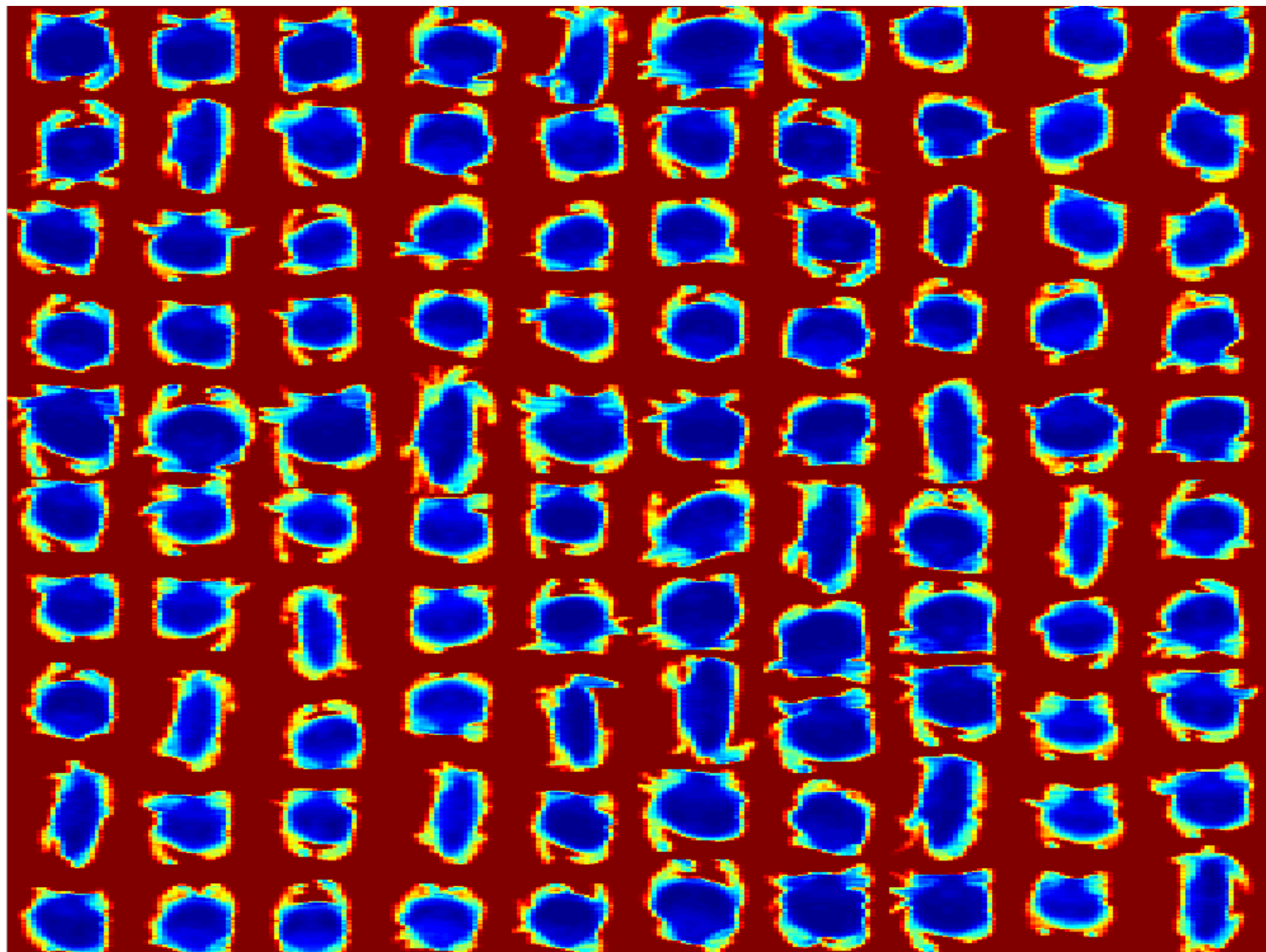
Raw image from scanner

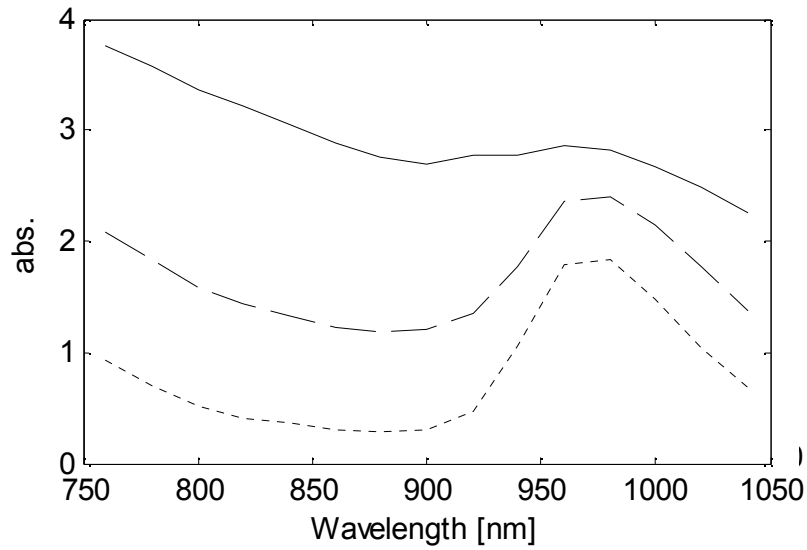
Detected shell and legs

Selects region for measurement



- Pick out front part of shell
- But: difficult to determine certain area of the crab if it is randomly oriented
- Crabs have to be sent with back first



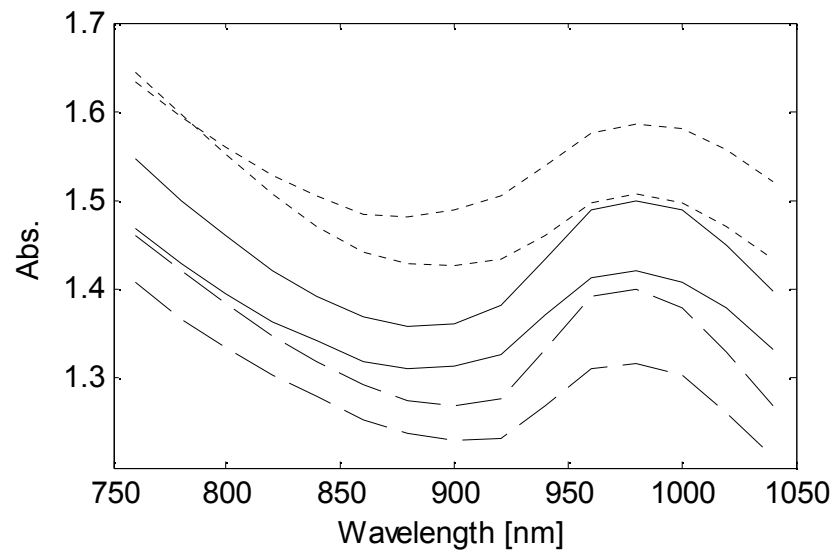


NIR spectra from

Liver

Roe

Water

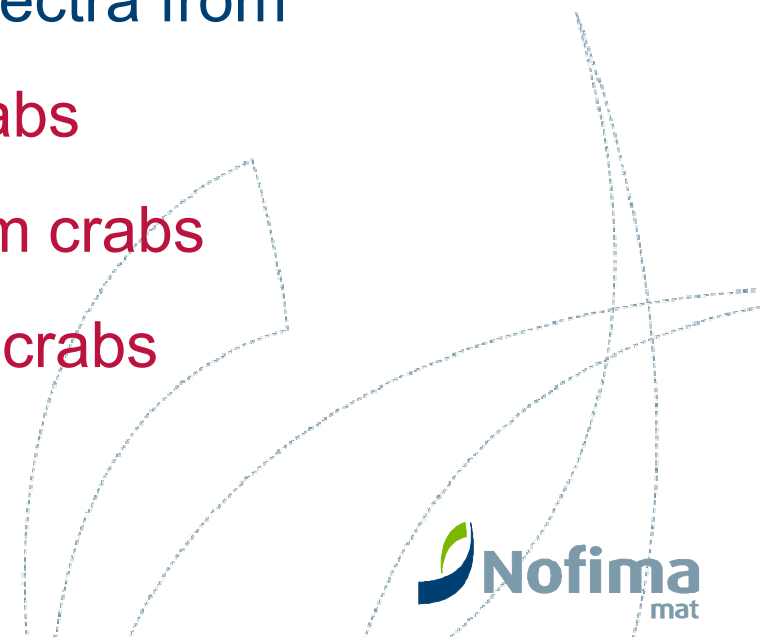


NIR spectra from

Full crabs

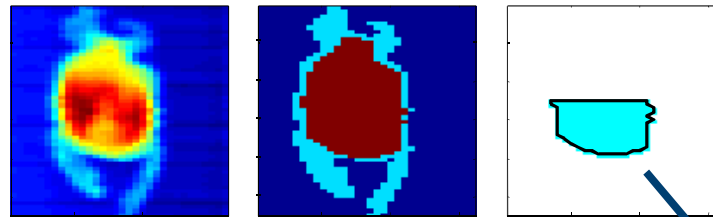
Medium crabs

Empty crabs

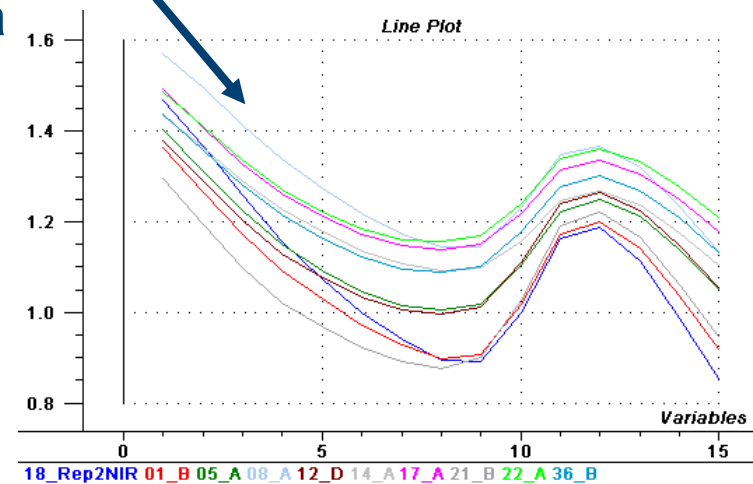


Development of calibration

- Extract average spectrum from crab.

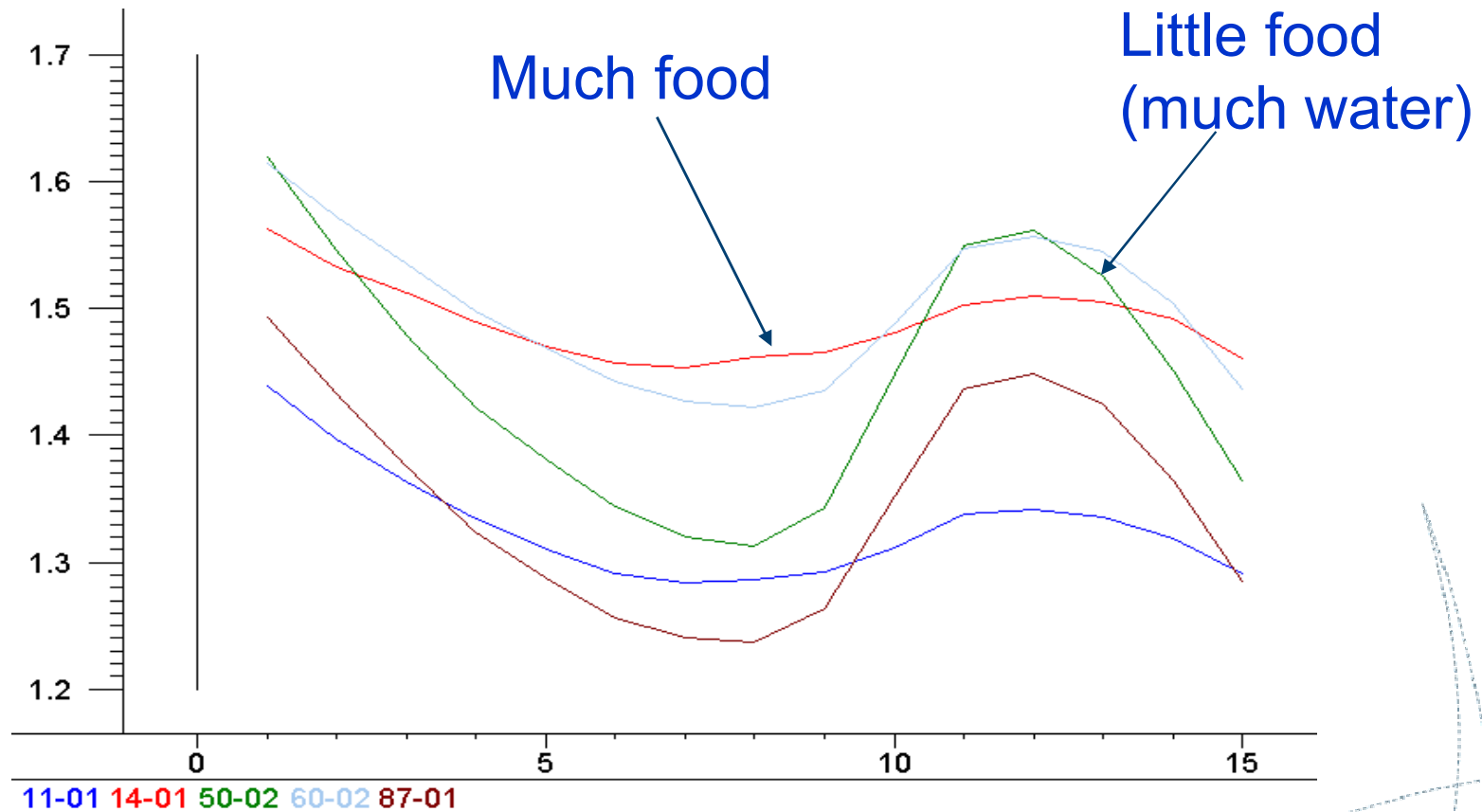


- Make model based on these spectra



- Model is used to estimate MQI in new crabs

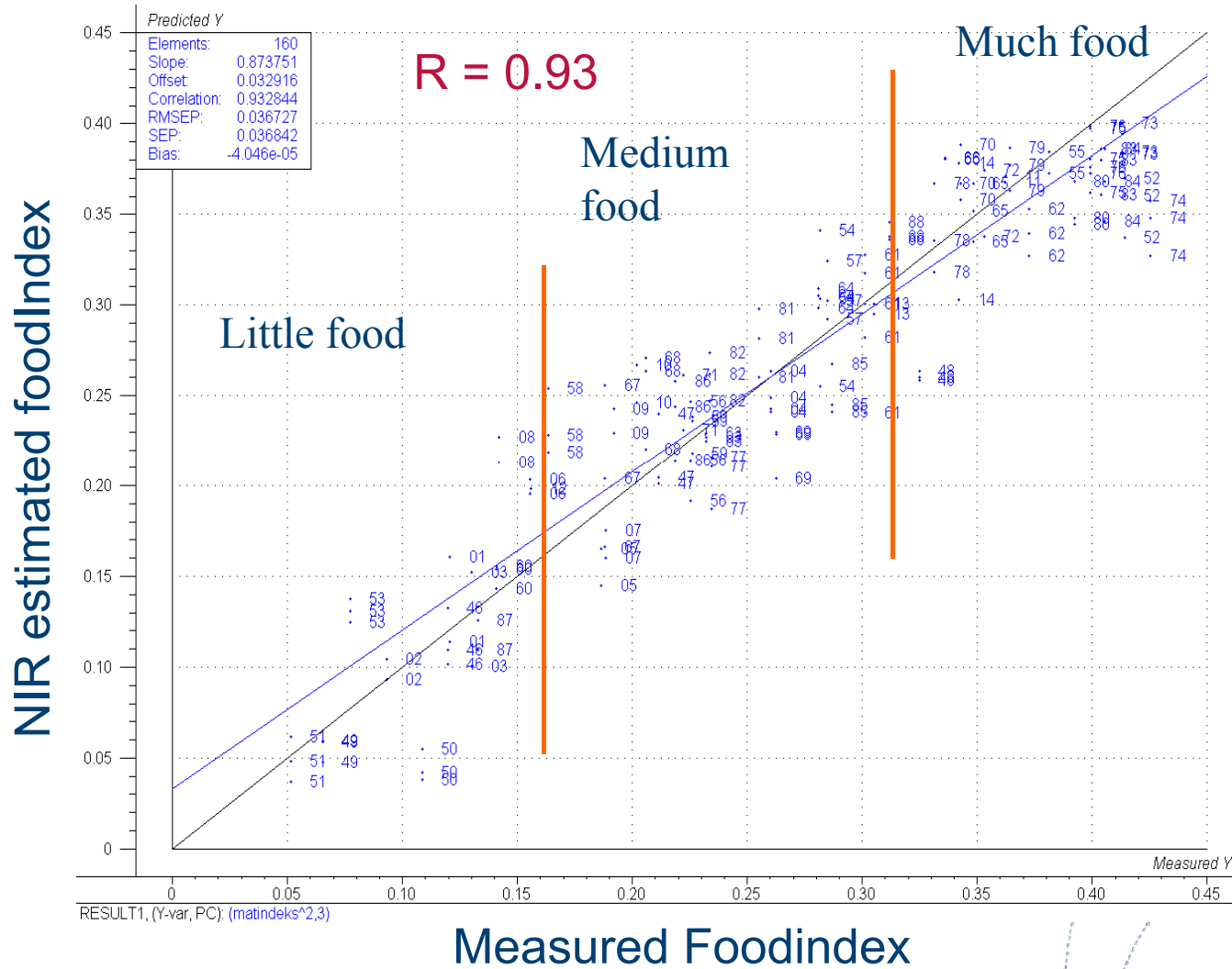
2. Extraction of NIR spectra:



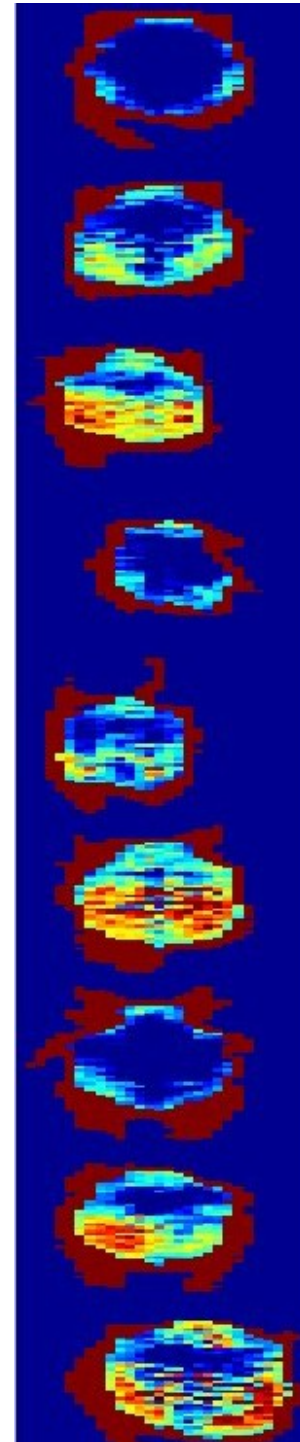
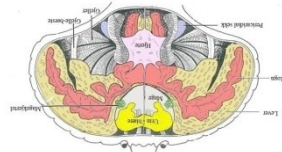
One spectrum per crab is input to the model, which then estimates the food index

Model for food index

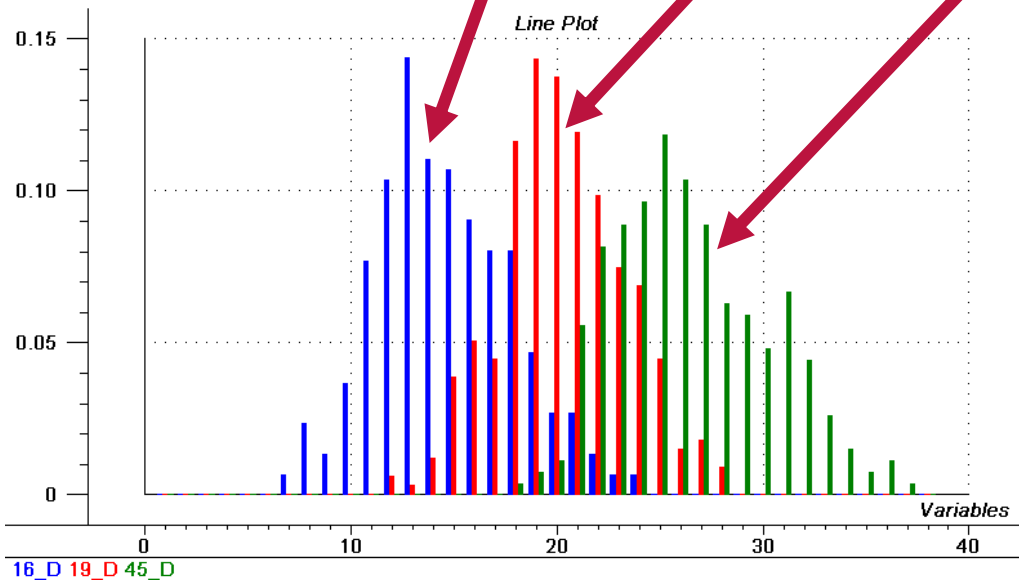
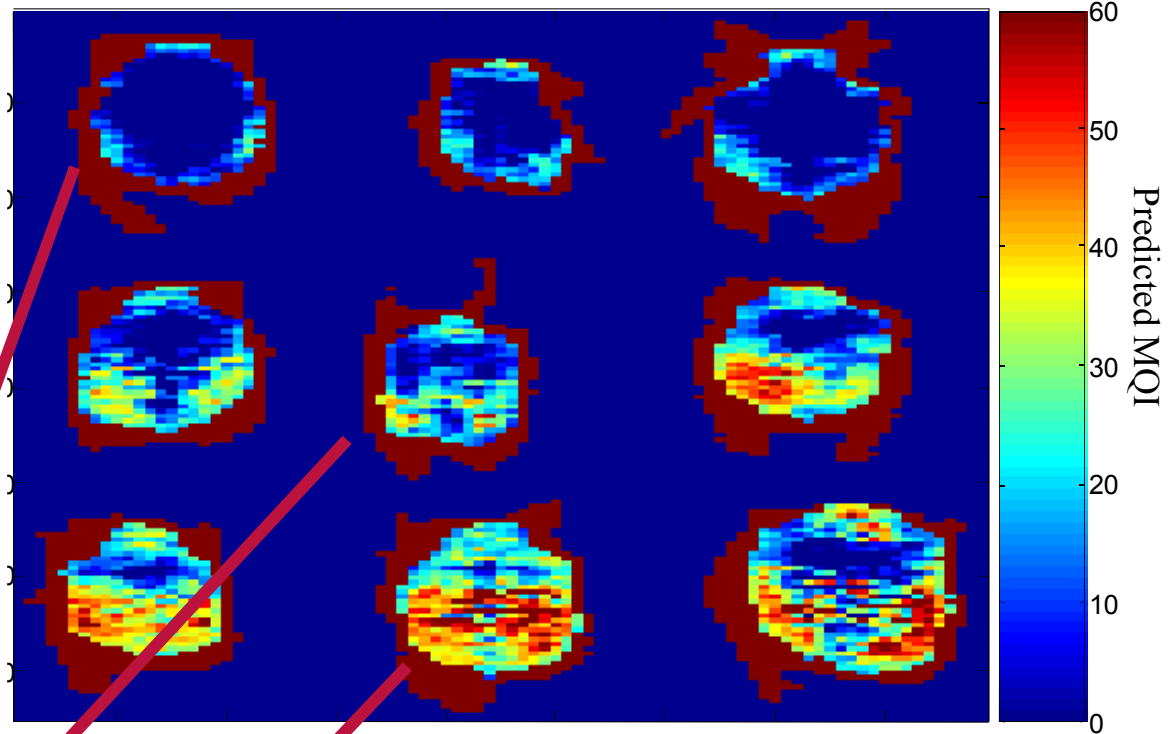
RMSEP=3.2



Vi ser inn i krabbene:



Model applied at pixel level:

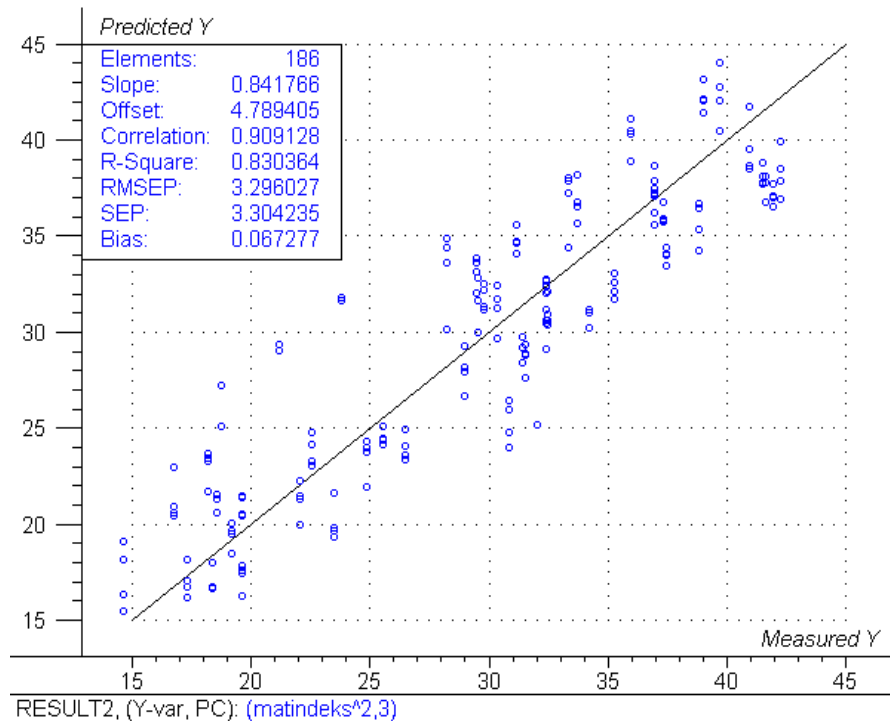


Histograms of predicted pixel values from
Empty (blue)
Medium (red)
Full crab (green)

Model invariant of orientation

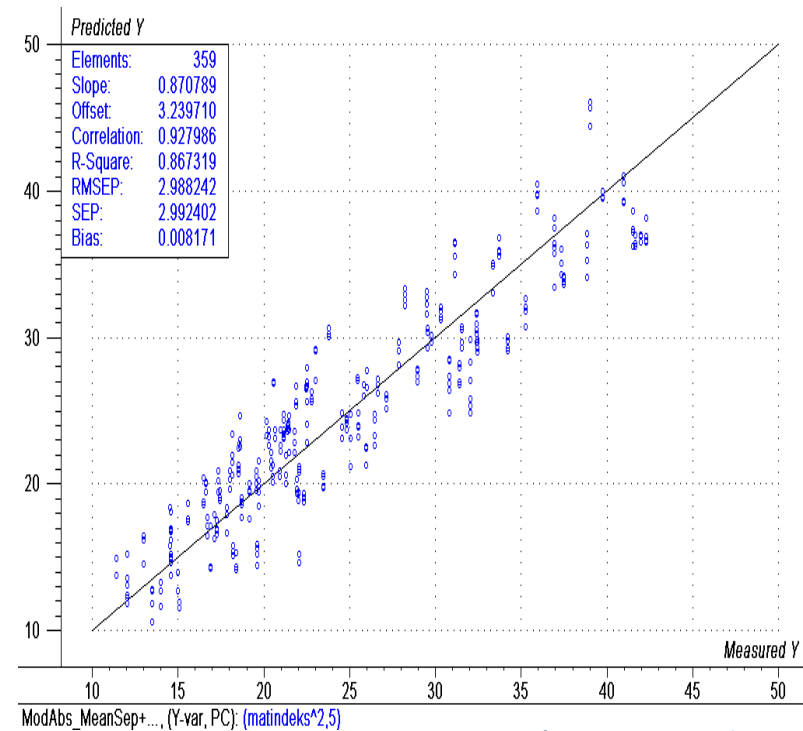
Histogram

RMSEP=3.3

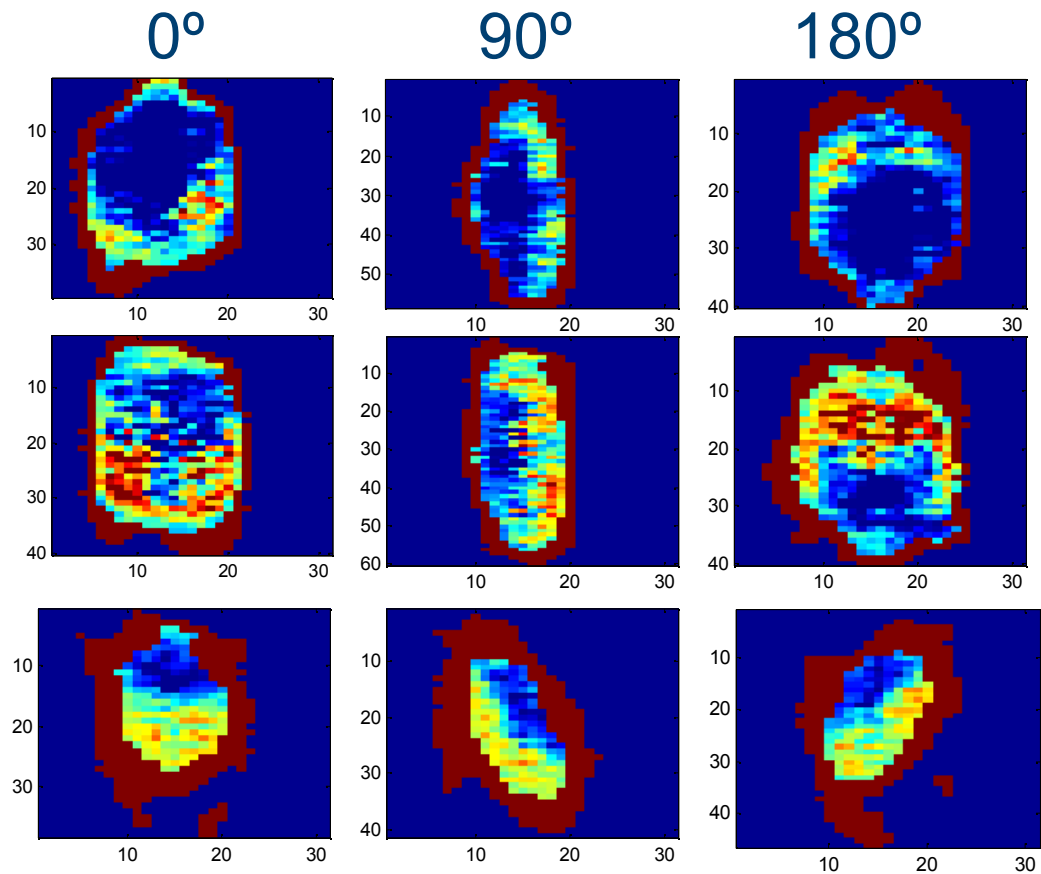


Average spectrum

RMSEP=3.0

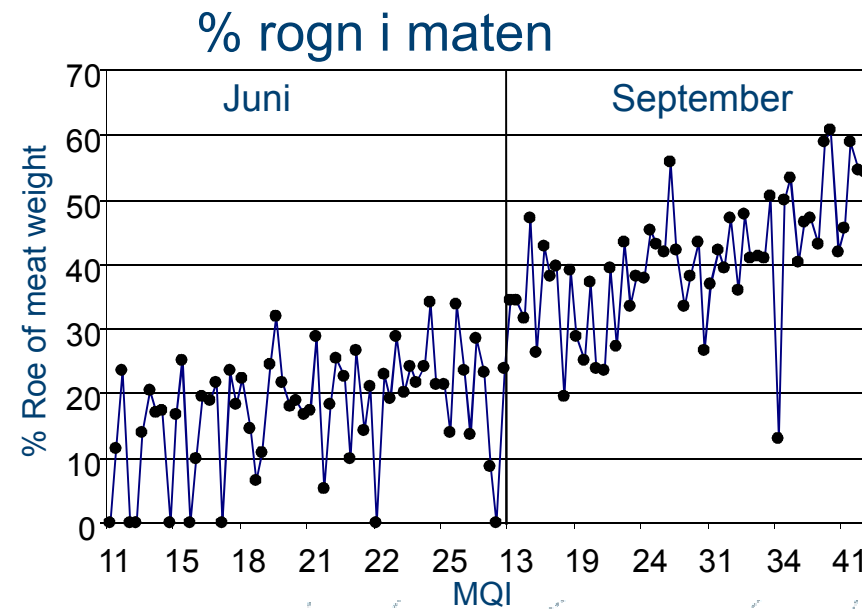


Varying orientation



Mulig utfordring

- Sesongvariasjoner
 - Matsammensetning varierer
- Men: Det er mulig å estimere mengde rogn og lever hver for seg.
- Mye rogn: Ekstra god kvalitet



Practical challenges

- The crabs can walk on the belt or rise up. This can obscure the measurements and reduce accuracy.
- Preliminary solution: cool the crabs, or electrical stunning
- Up till now the crabs have been scanned with back first, so that we easily can extract the optimal region for spectral extraction.
- With the histogram method, the orientation is not critical
- We have had some technical challenges, but system seem to work well now.



Praktiske resultater

- Krabbene sorteres i 3-4 klasser, 1-2 krabber / sek
- Raskere og mer pålitelig enn manuell gradering
- Utbytte i prosessen har økt, mindre svinn
- Kan garantere kvaliteten på superior krabber, noe som er meget viktig for å opprettholde markedet
- Systematiserte data gir oversikt over regionale og sesongbaserte kvalitetvariasjoner
- Vil kunne brukes som underlag for betaling til fiskerne



Secondary QVision product: The QPoint



Qpoint is a transportable NIR instrument.



Key features:

- Transportable.
- Two spectrosopes
- Easy to operate.
- Easy to maintain and clean.
- Easy calibration.
- Water proof (IP 67).
- Configurable input fields.
- Easy to integrate with other systems.

Qpoint: Applications for complete and live fish



Applications for salmon

Measurement of fat and pigment in complete salmon. Typically used to sample alive fish.

Typical customers

- Salmon farming companies who want to optimize feeding and reduce the amount of expensive pigment feed given to the fish
- Feed producers who research effects of different feeds and feeding procedures
- Companies concerned with quality control

Qpoint: Application on live crabs



Applications for crabs

Measurement of food content

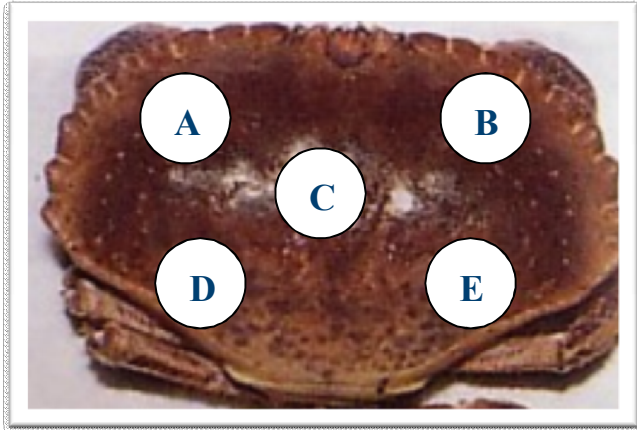
- The Qmonitor scanner is able to scan whole crabs and measure the food content.
- Analysis of scanner data shows that the front part of the crab is more important for food content determination.
- Is it possible to measure the food content of the whole crab using only a single point on the crab?

Qpoint: Application on live crabs

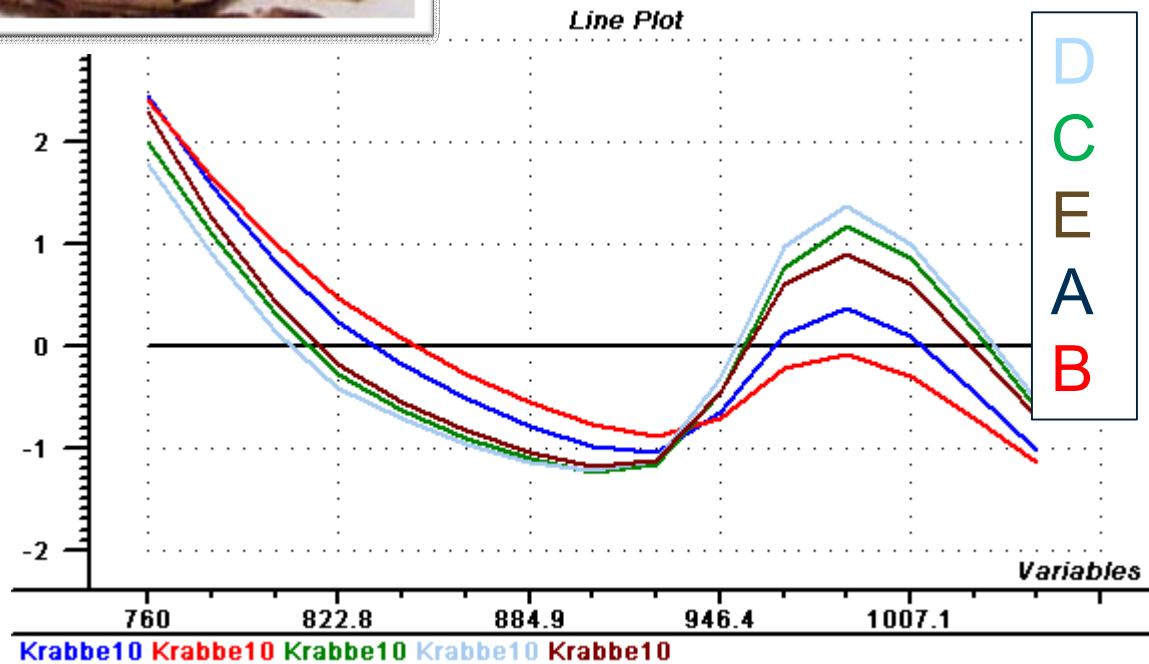


- 15 crabs of varying quality were selected for testing.
- Scanning of all crabs was performed on the Qmonitor skanner.
- Estimated meat index values were used as references.
- Posterior measurements were done on the point measurement system: QPoint.

Qpoint: Application on live crabs

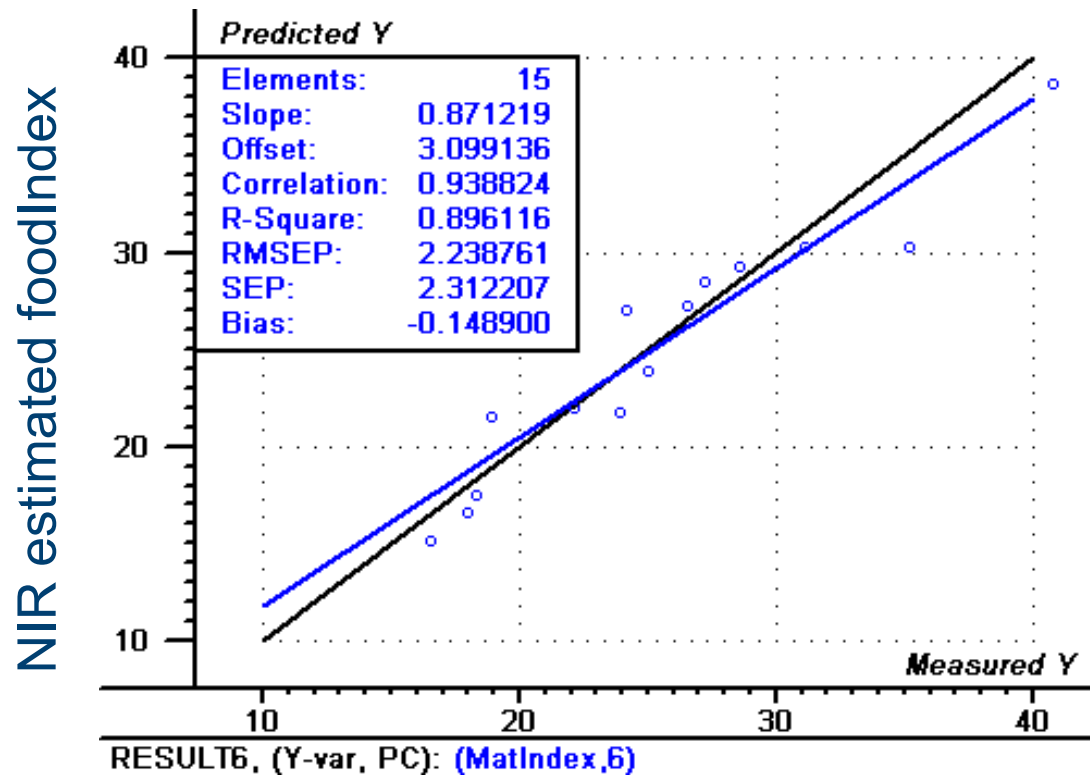


- 5 points were selected for point measurements.
- Point A was found to give best the result and used in further analysis.



Qpoint: Model for food index

RMSEP=2.23



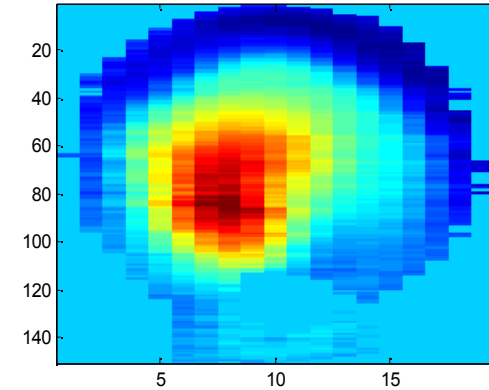
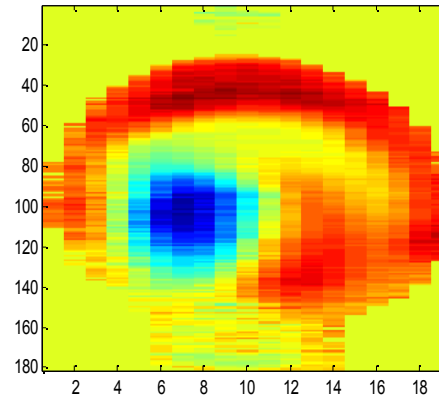
Measured Foodindex

The model shows a performance comparable to the scanner.



Measurement of muscle size and dry matter in muscle of live scallops

- Interesting for selection during breeding
- Andre skalldyr?
- Kongekrabbe?



Sammendrag

- Vi har utviklet et system kan måle matinnhold I ktabber raskt og ikke-destruktivt
- Systemet er installert hos Hitramat og er i drift
- Samme type målinger kan gjøres på båt med enklere og billigere systemer. Plassert I en liten boks eller et håndholdt
- Tomme krabber kan da slippes ut, og god kvalitet kan garanteres på de som selges.