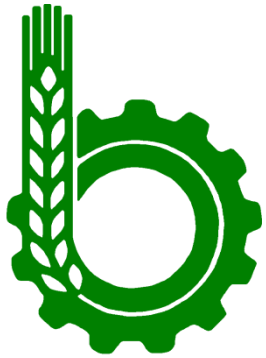
Agricultural Research Organization (ARO) Israel



Agricultural Engineering Institution

Feeding Behaviour

Ilan Halachmi

Ephraim Maltz, (Yevgeny Beiderman)

ARO, The Volcani Centre, Bet Dagan. Israel

The first DairyCare Conference

Copenhagen Denmark

2014

The 3 WWH questions

- Where we are ?.
- Where we go ?.
- How we go ?

EAAP- Monday 08:30

Industry session:

Precision Livestock Farming (PLF)

Making sense of sensors to support farm management

- ✓ Session 05 - Part 1
- ✓ Session 10 - Part 2
- ✓ Session 11 - Part 3
- ✓ Session 12 - Part 4 etc

Panel Discussion - Grouping strategy:

	Session 05a part 1 **PLF – applications of automatic lameness detection** Chair: Ilan Halachmi (EU-PLF)		
08:30–09:00	1. Value creation through PLF 19473 (Berckmans, EU, **invited**)		
09:00–09:15	2. Lameness pigs 19004 (Scheel)		
09:15–09:30	3. Lameness sheep 19196 (Radeski)		
09:30–09:45	4. Lameness cows 18995 (Van Hertem)		
09:45–10:00	5. Lameness cows 18465 (Salau)		
10:00–10:15	6. Panel Discussion. Note takers –Andres and		
10:15–10:45	Coffee		
	Session 05b part 1 **How PLF deliver added-value to farmers** Chairs: Joerg Hartung (EU-PLF).		
10:45-11:00	7. What have we learned? (Bewley, USA, **Invi**		
11:00-11:15	8. Added value 18585 (Steeneveld)		
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11:30-11:45	10. Smart farming 19516 (Lehr)		
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12:00-12:15	Panel discussion. Note takers – Tom, Andres		
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12:30–14:00	Lunch break	Lunch break	
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14:00–14:15	12. Calves sensing 18612 (Johnston)	19. Poultry sensing 18933 (Butterworth)	26. infrared body temperature (Hoffmann) 18592
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17:15-17:30	35. Feed intake 19037 (Pahl)	
17:30-17:45	36. Precision feeding (**invited**, Halachmi)	
17:45-18:00	37. Panel discussion, general discussion and the symposium conclusions. Note takers – Tom, Andres, Sara	
	Evening	Evening Ever

Industry session: Precision Livestock Farming (PLF)

making sense of sensors to support farm

EAAP Session 05, 10-12 - Part 1-7

Panel Discussion - Grouping strategy:

In brief

A potential research subject within DairyCare – feed intake/efficiency

- **Monitoring/ estimating cow individual feed intake:**
  - **direct measurement**
  - **Sensor-based model**
    - **A walk-through body weight scale**
    - **Automatic body condition scoring (BCS) (EU FP6 OptiScore)**
    - **Cow Health:**
      - **Automatic cow lameness detection (EU FP7 BioBusiness)**
      - **Automatic post-calving disease detection**
    - **other sensors , feeding behaviour (EU FP7 EuPLF)**
  - **The model output (results)**

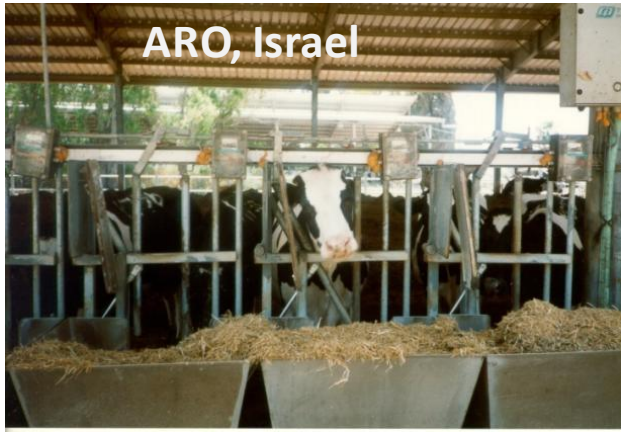
Incentive

- **Feed intake is the most costly single factor in intensive livestock operation. Thus feed efficiency is of importance**

- **Feed costs make up 64% of the total farm day-to-day costs.**
- **(medicine, vet treatments < 20 % ; labor < 20 % , energy, water etc)**

- **Other intensive livestock species: over 70% fish netcages (FAO 2008) , Beef, and poultry**

Direct monitoring of feed intake

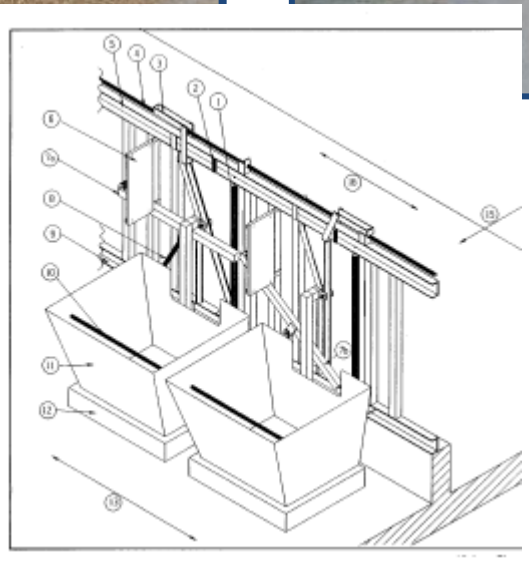


DCRC Foulum Denmark

Halachmi I., et al., **Animal individual Feed intake monitoring.** *Computers and Electronics in Agriculture*, 1998. 20: p. 131-144.

I. Halachmi et al. / Livestock Science 138 (2011) 56–61 I. Halachmi C.F. Børsting, M.R Weisbjerg et al

A commercial farm



The ARO's research farm

Halachmi I., Maltz, et al., **Animal individual Feed intake monitoring.** 1998.
Computers and Electronics in Agriculture, 20: p. 131-144.

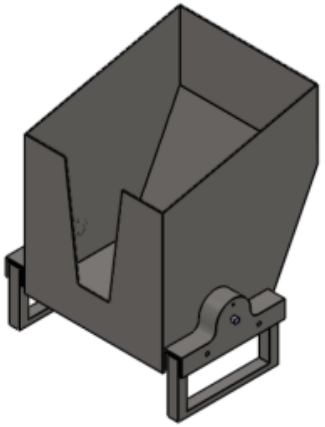
DCRC Foulum Denmark Research farm

The classic ways: direct monitoring of feed intake

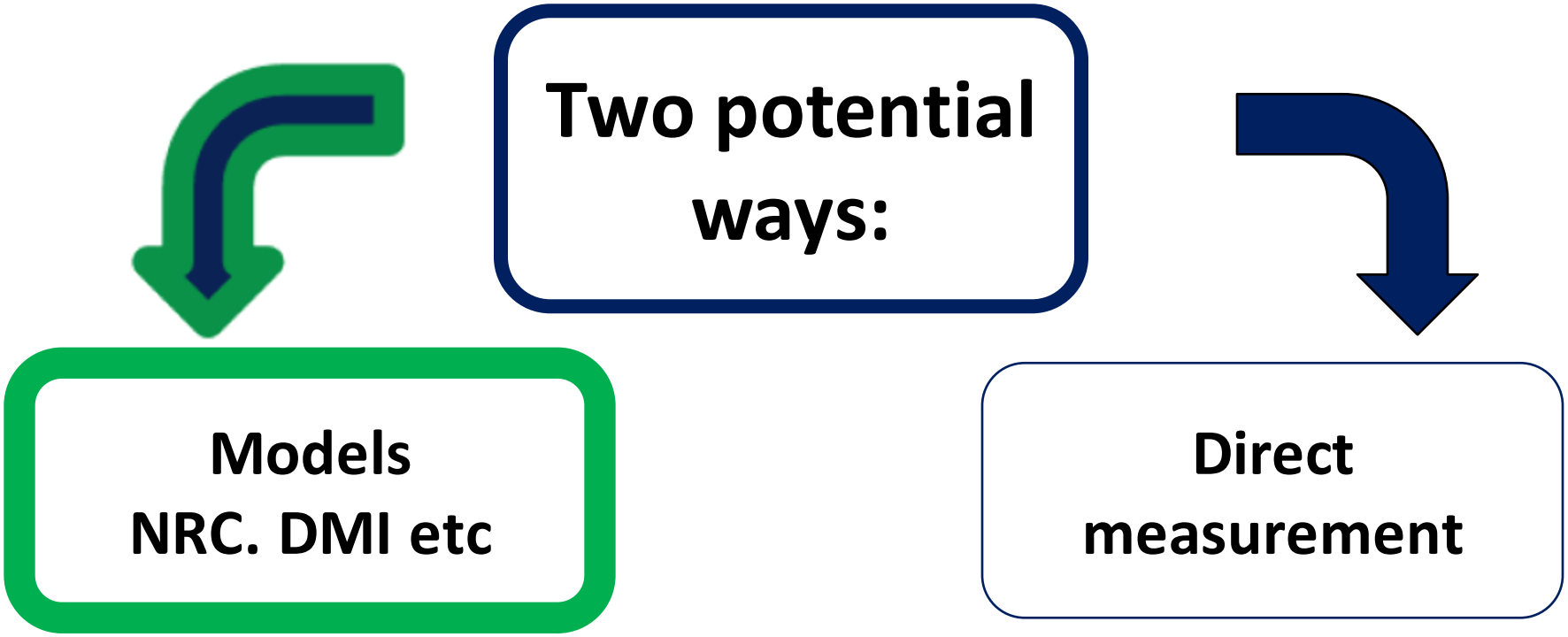
Picture taken at Newe Yaar, ARO's northen research centre, Israel

Low cost feed intake monitoring.

New project 'design to cost'



Knowing the cow individual feed intake:



regression, indirect, interpretation (NRC, Halachmi et al., JDS 2004. cow individual DMI

First components in a model

Milk meters
Milk analyzer

Walk-through body weight scale

Peiper, U.M., et al Maltz, E., 1993. Automatic weighing of dairy cows. J. Agric. Eng. Res. 56 (1), 13–24

Schmilov ...001)
Spectros ...tion
no. 1464

Asensor that maybe used in a FI model

Automatic body condition scoring

The Problem

- Manual
  - Hard work
  - Labor & Time consum
- Subjective
  - Technician
  - Previously seen cows

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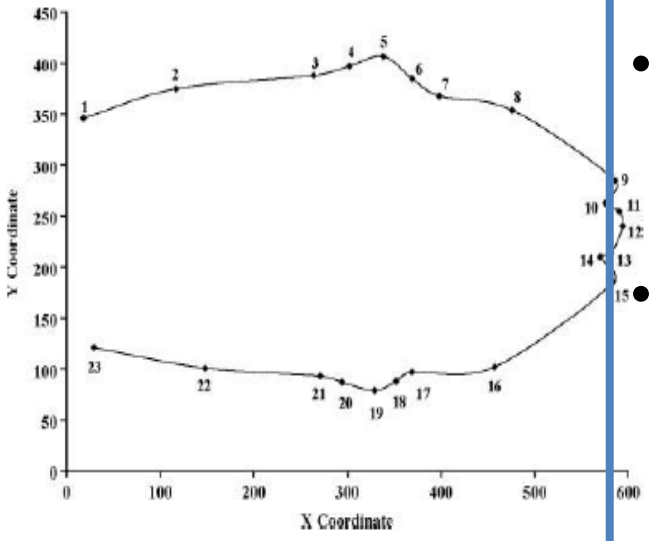
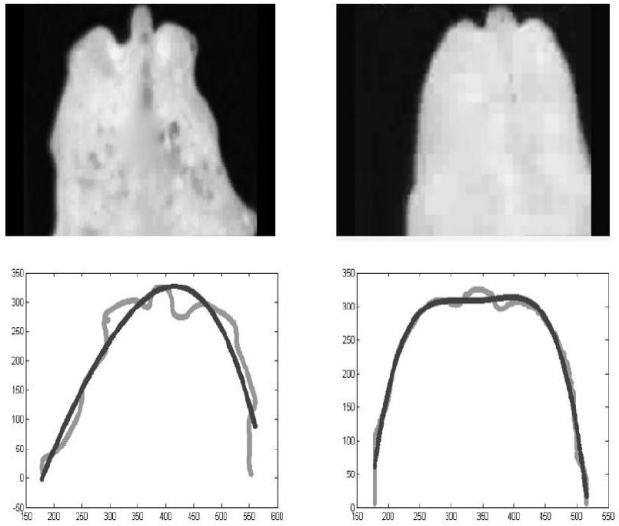
Previous vs. new work

Manual labeling of
23 anatomical points
Bewley et al., JDS 2008
Azzaro et al., JDS 2011

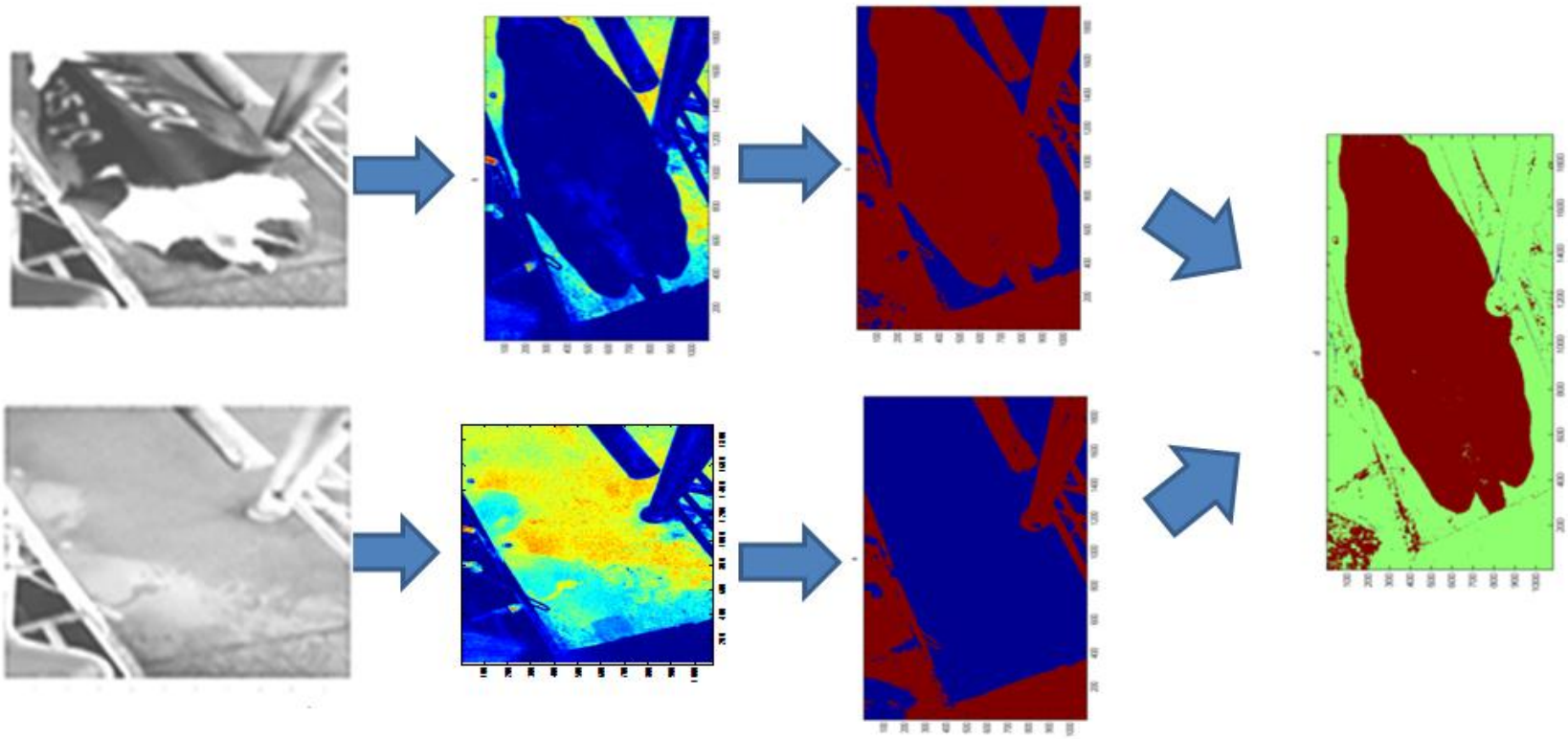


Polynomial fitting to cow contour
Thermal or 3D camera

- **Halachmi,** Klopcic et al., JDS 2008
- **Halachmi I**; Klopcic , M.; Polak, P; Roberts, D.J.; Bewley J.M. (2013). *Computers and Electronics in Agriculture* 99, 35-40.
- Bercovich, et al., **Halachmi, I** Journal of Dairy Science. 2013 ; 96(12):8047-59
- Bring to the market ?



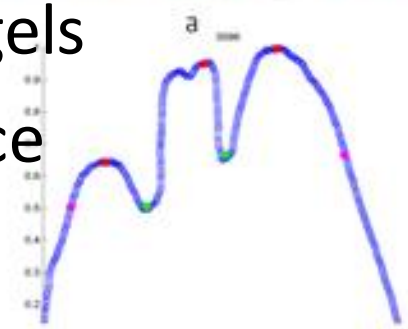
Algorithms-segmentation

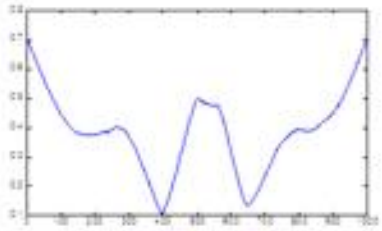


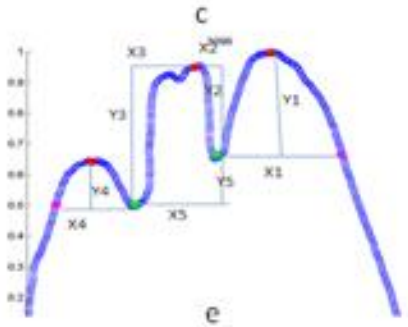
Automatic BCS-solutions

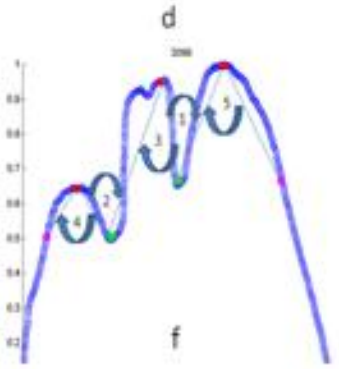
Cow contour:

- Interpolation 1000 points
- Scaling to 0-1 range
- 5 anatomical points and 5 angels
- Horizontal and vertical distance
- 1 dimension curve
- PCA Analysis
- Fast Fourier transform



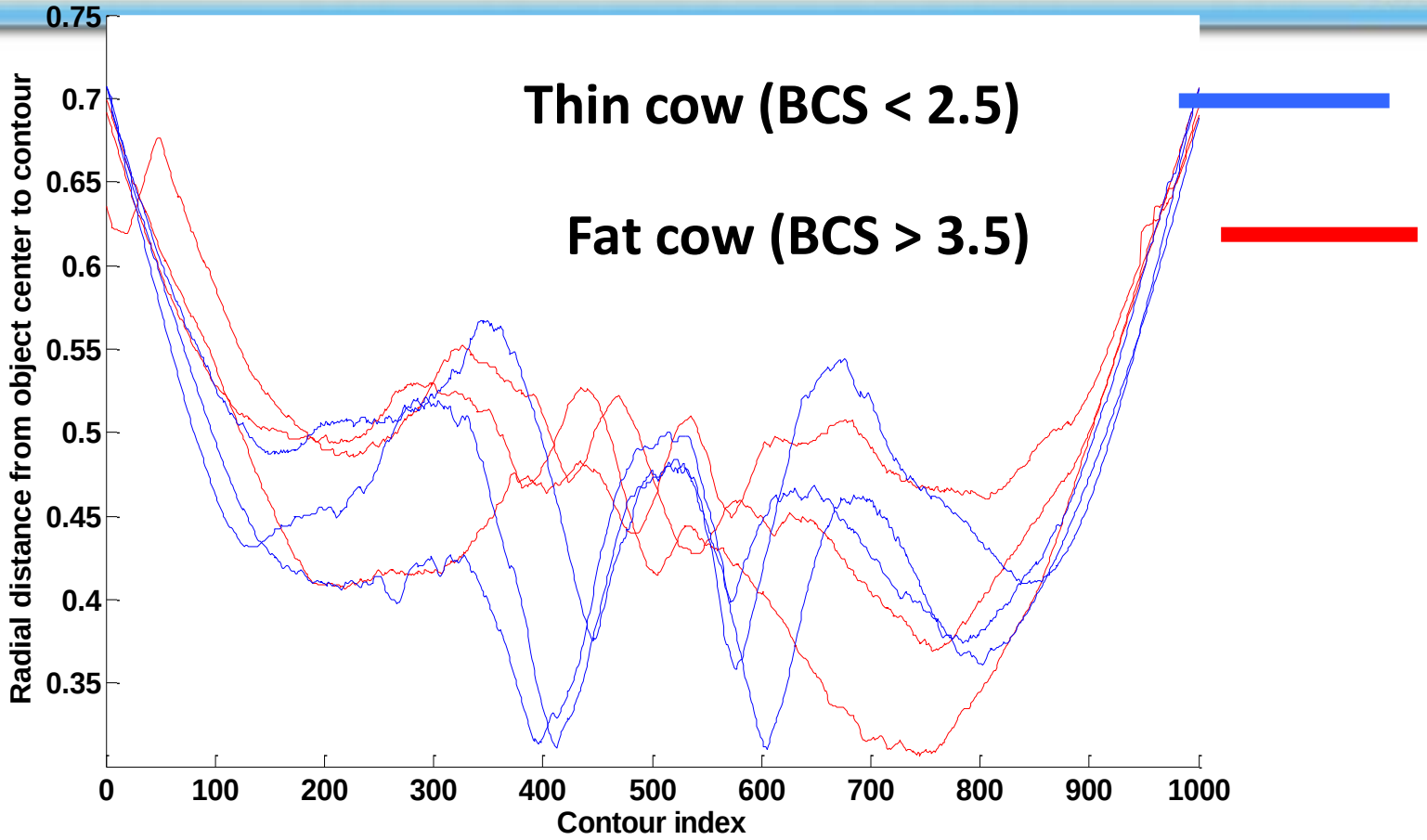






Algorithms

Fast Fourier transform



Bercovich, Maltz et al., Halachmi, I
Journal of Dairy Science. 2013 ; 96(12):8047-59

Health status ?

State-of-the-art commercial sensors

Automatic early detection of calving diseases

Machteld Steensels 's Ph.D. thesis

To be presented on Monday – the PLF session

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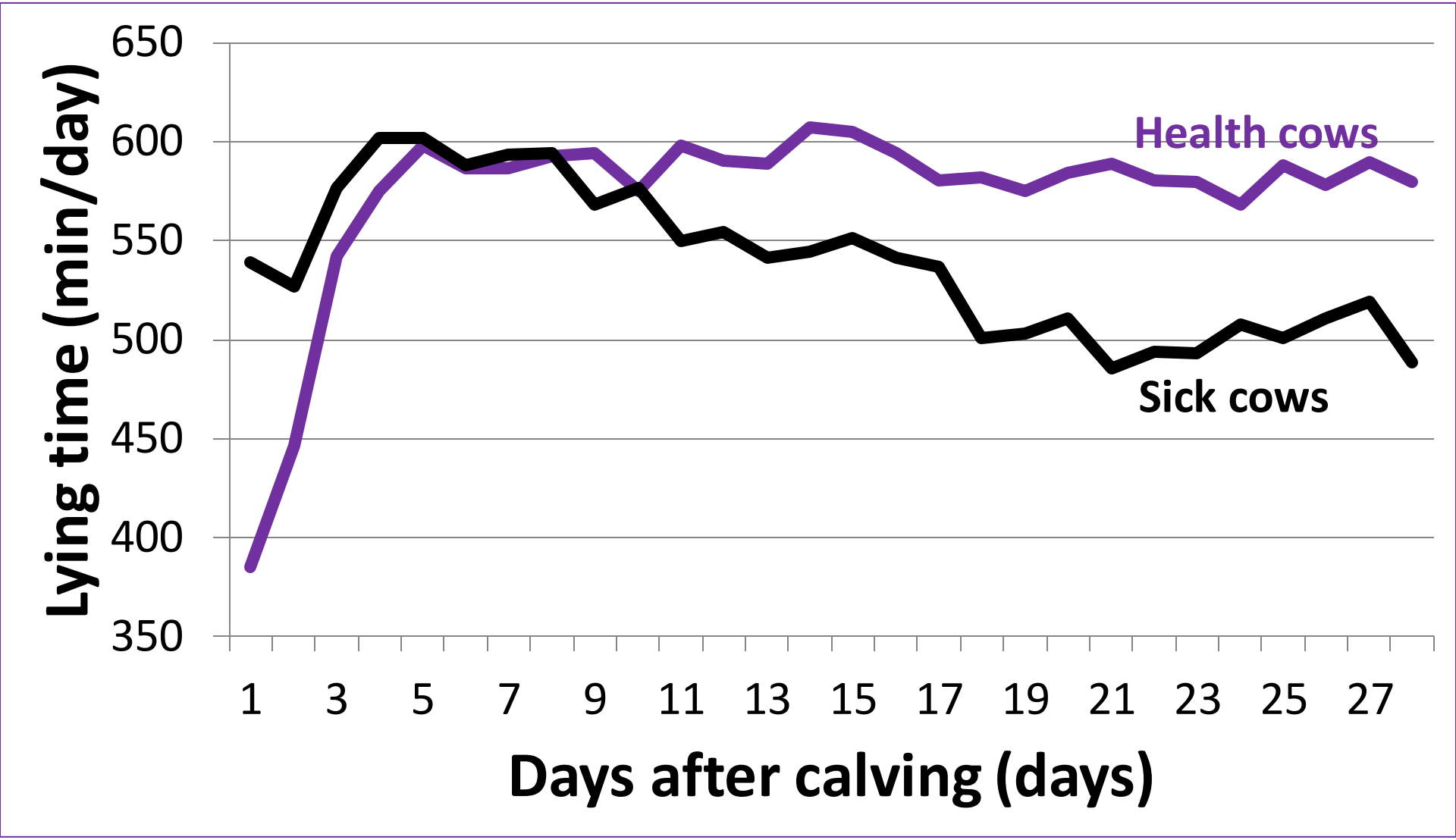
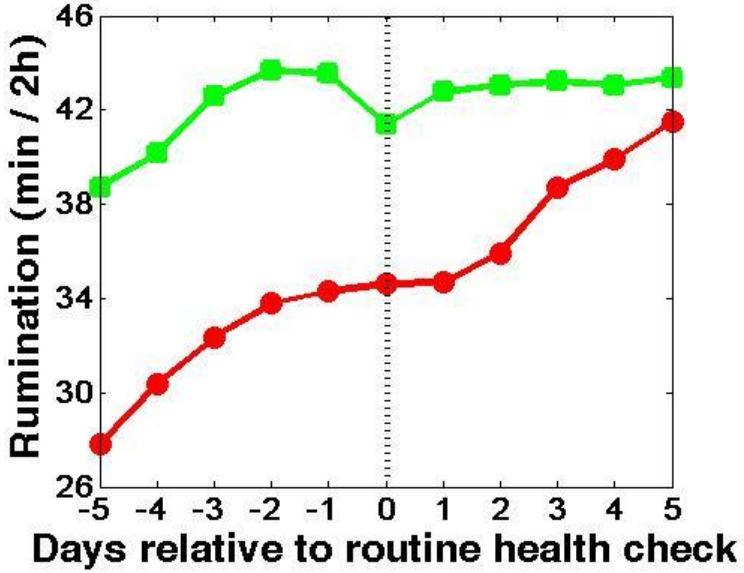
Preliminary results: Lying behavior



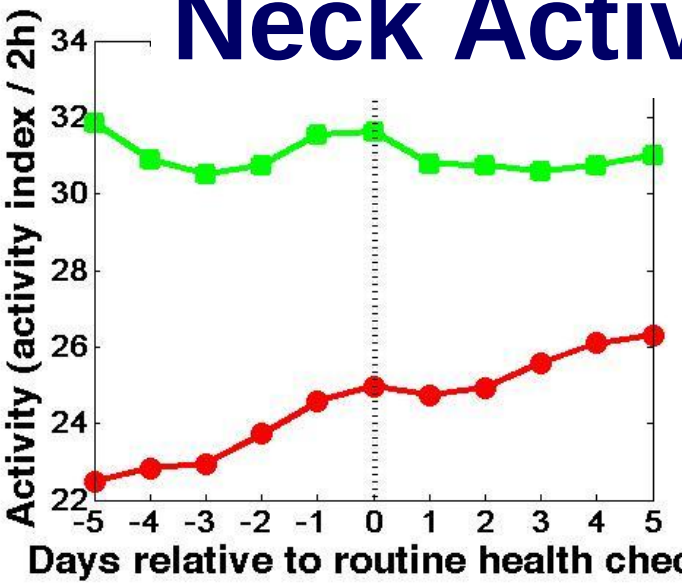
143 sick cows – 140 healthy cows, Summer

Healthy vs. ketotic cows

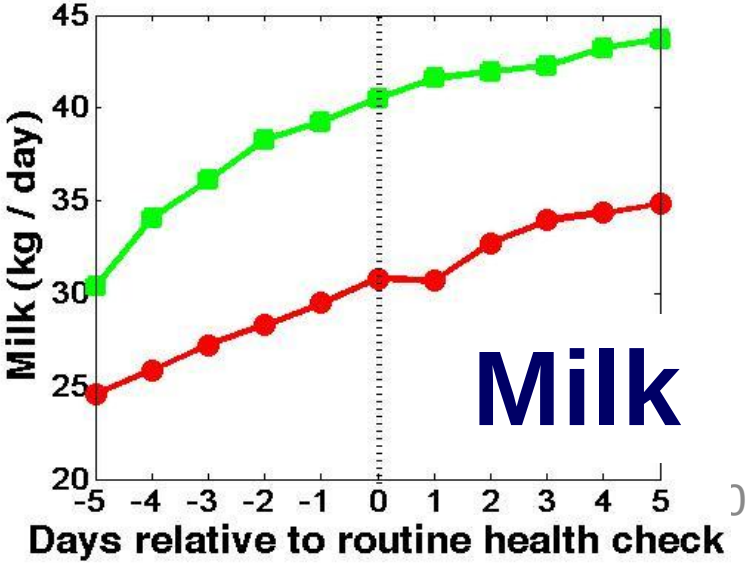
Runimation



Neck Activity

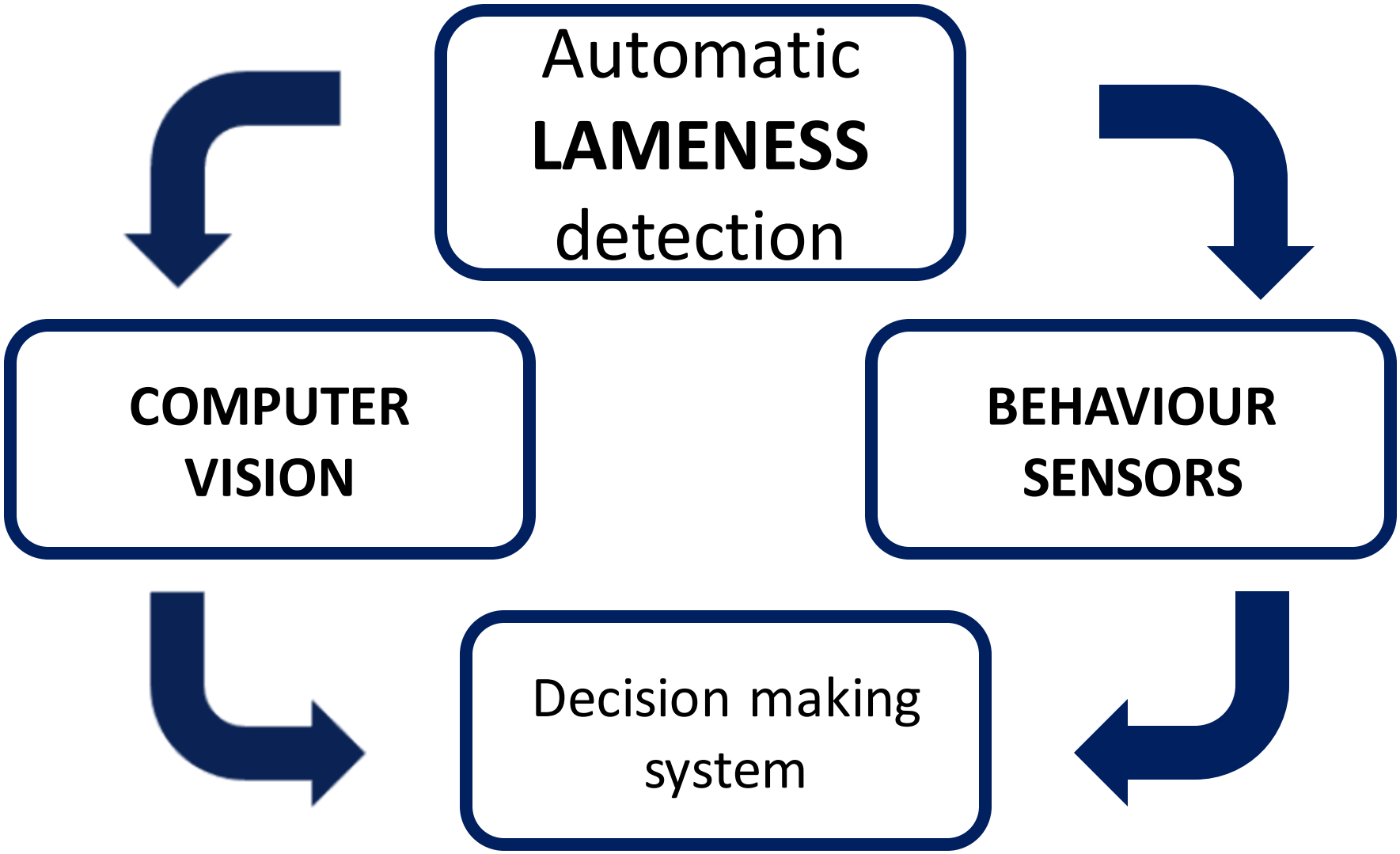


Milk



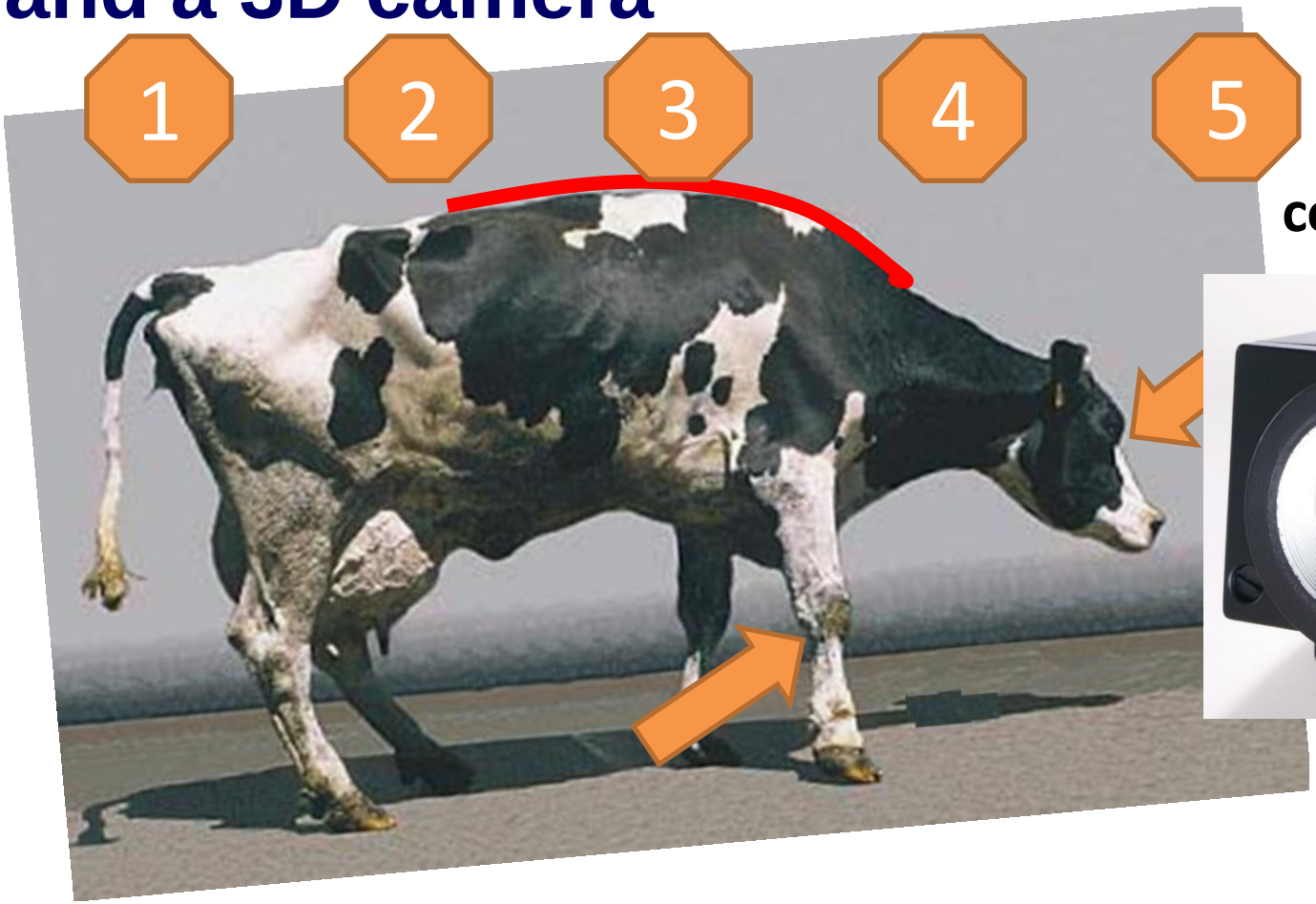
(BioBusiness Project)

Combined two ways



Automatic lameness detection

Could use: Lying behavior , Rumination, Neck Activity, Body Weight, Milk components. etc , and a 3D camera



computer vision

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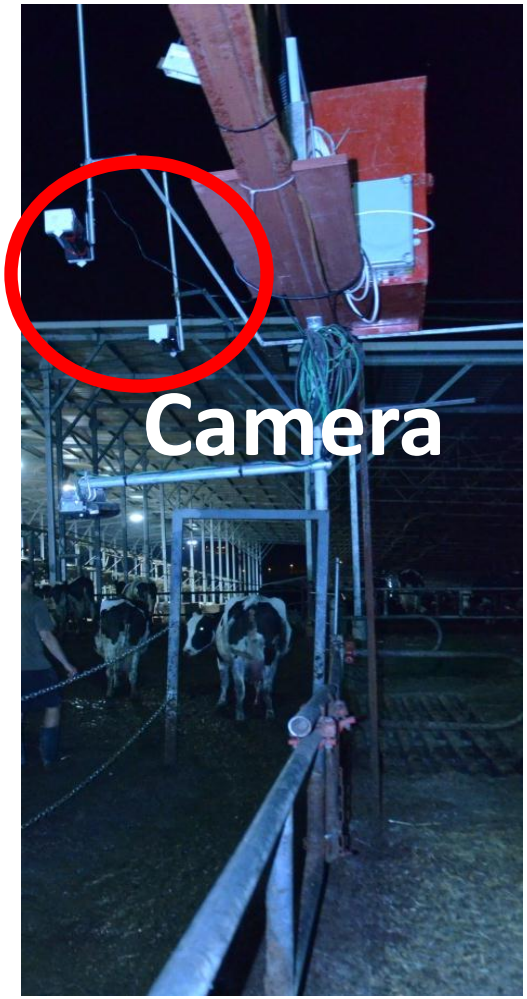
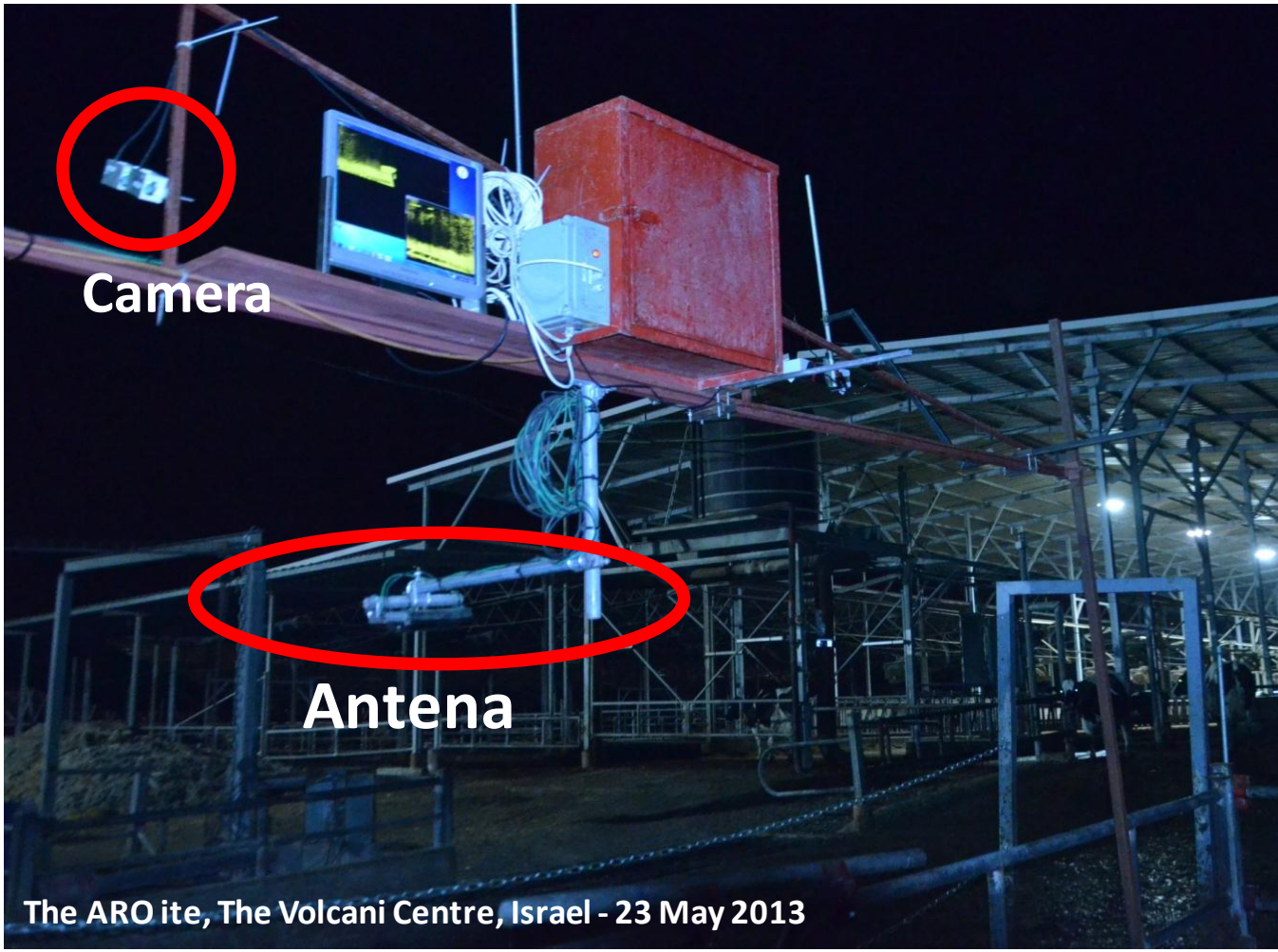
3rd Setup: 3D-camera





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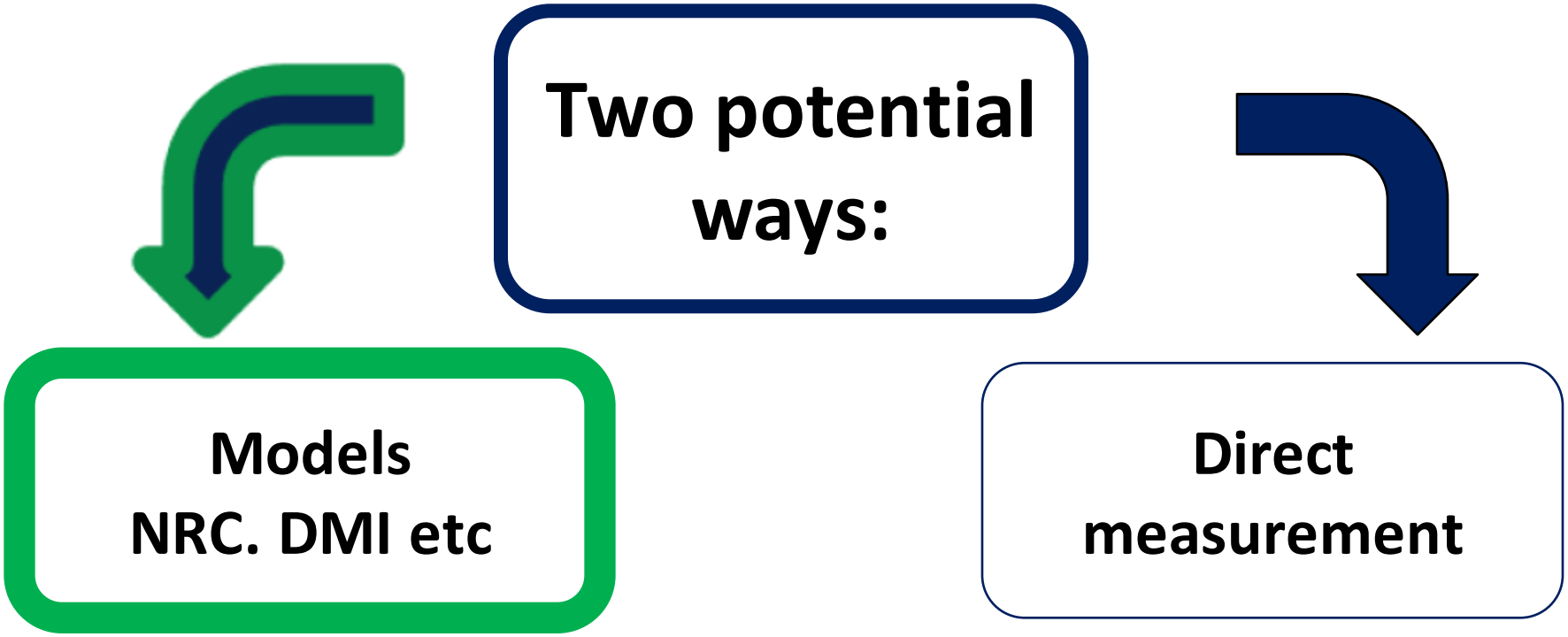
Automatic lameness detection

Tom van Hertem ‘s Ph.D. thesis (BioBusiness)

To be presented on Monday Morning – PLF session

Knowing the cow individual feed intake:



regression, indirect, interpretation (NRC, Halachmi et al., JDS 2004. cow individual DMI

Potential existing sensors to be taken into account:

- Milk production, milk contents (milk analyzer)
- A walk-through body weight scale
- Automatic body condition scoring (BCS) (EU FP6)
- Health status of the animal
  - Automatic cow lameness detection (EU FP7)
  - Automatic post-calving disease detection
- other sensors

Models. NRC and…

Cow individual feed intake =

(==> cow individual efficiency) =

=

$$DMI_{0,i} = b_{0,i} + b_{1,i}\frac{MY_0}{BW_0} + b_{2,i}\frac{MY_{-1}}{BW_{-1}} + b_{3,i}\frac{MY_{-2}}{BW_{-2}} + b_{4,i}BW_0 + b_{5,i}\frac{BW_{-1}}{BW_0} + b_{6,i}fat + e,$$

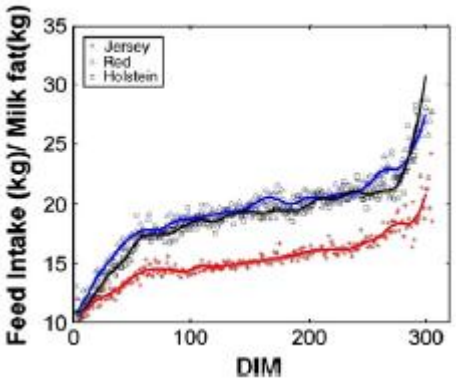
J. Dairy Sci. 87:2254–2267

Predicting Feed Intake of the Individual Dairy Cow

I. Halachmi,[1] Y. Edan,[2] U. Moallem,[1] and E. Maltz[1]

Models for cow individual feed intake (2)

DMI vs. NRC



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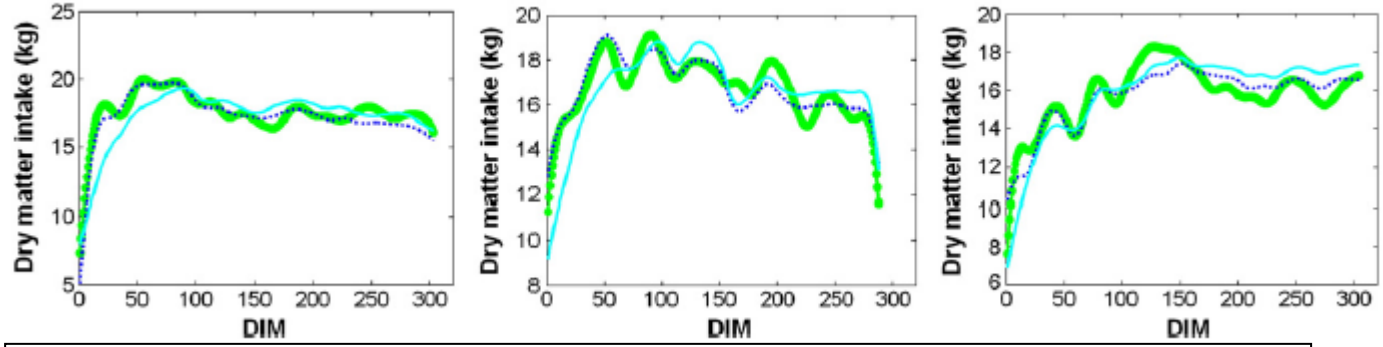
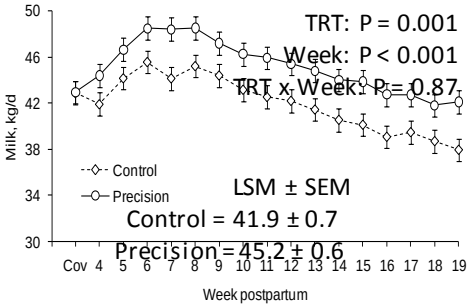


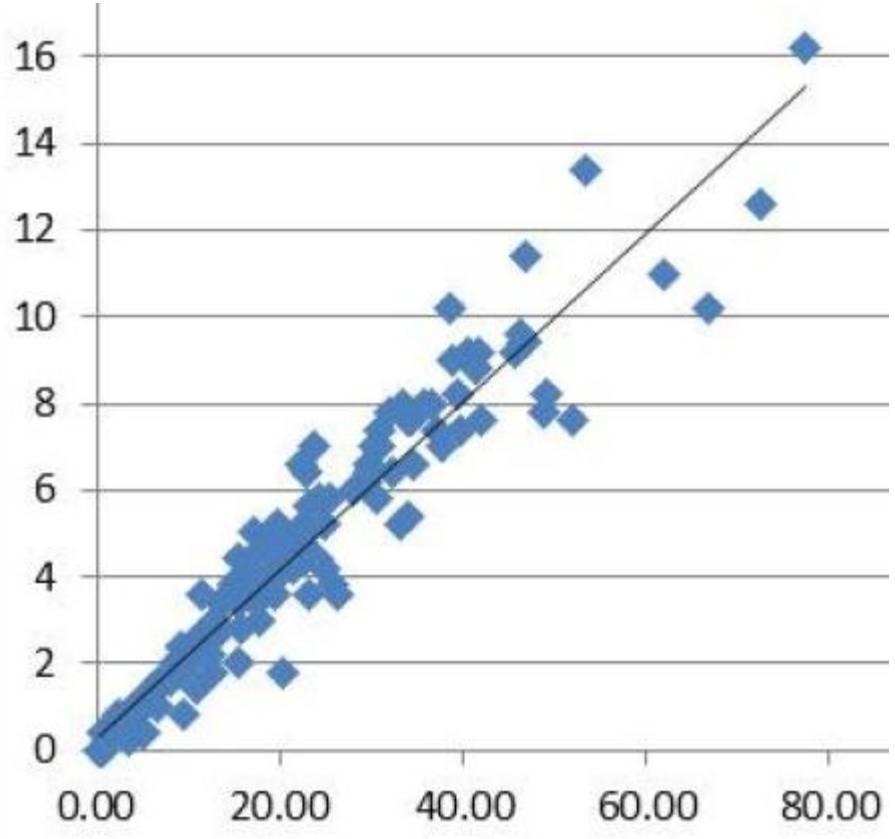


Feed intake of Holstein, Danish Red, and Jersey cows in automatic milking systems

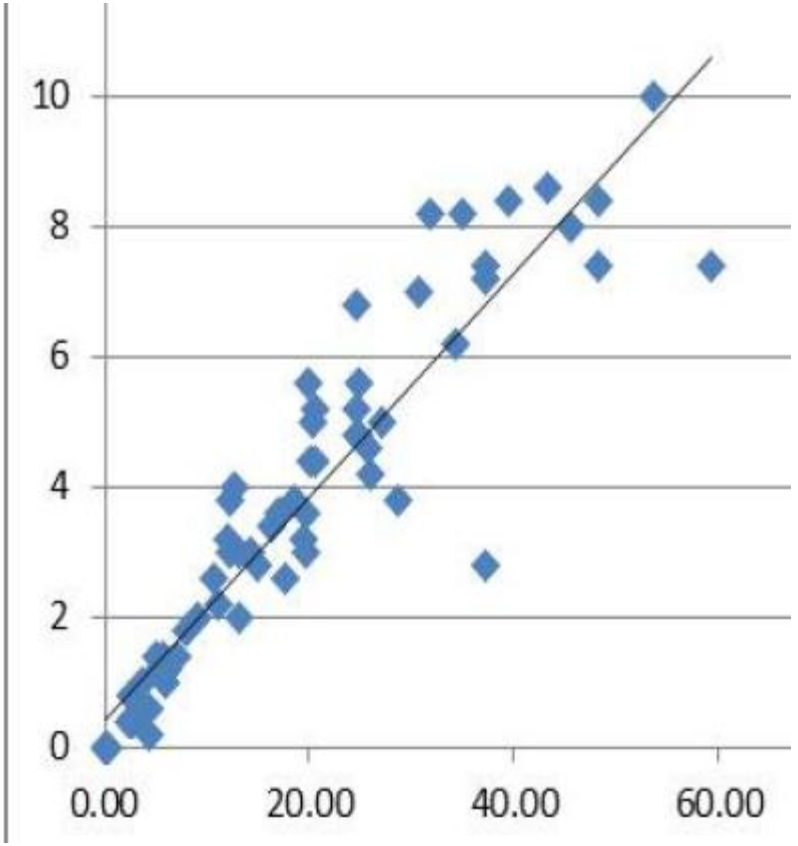
I. Halachmi [a,*], C.F. Børsting [b], E. Maltz [a], Y. Edan [d], M.R. Weisbjerg [c]

Feeding according to cow individual energy balance. Maltz et al. JDS 2013

The DMI Model with additional parameter



Cow individual (2628) Feed intake over time. R^2= 0.91



Cow individual (2573) Feed intake over time. R^2= 0.86

Ephraim Maltz, 2014 unpublished data

In brief – WWH questions

Monitoring cow individual feed intake / feed efficiency :

- Direct measurement
- Indirect - sensor based feed intake model
  - Milk analyzer, A walk-through body weight scale
  - Automatic body condition scoring BCS (EU FP6)
  - Health issues:
    - Automatic cow la
    - Automatic post-c
  - other sensors (EU-PLF
- The model output (results)
- Potential DairyCare research area

Further research & discussion

halachmi@volcani.agri.gov.il,

Ilan Halachmi

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	Evening	Evening	Ever

Industry session: Precision Livestock Farming (PLF)

making sense of sensors to support farm

EAAP Session 05, 10-12

Panel Discussion - Grouping strategy:

halachmi@volcani.agri.gov.il, Ilan Halachmi