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Automated Daily Analysis of Milk Components and Cow Behavior

Developing New Applications in The Dairy Herd

36th ICAR Session and Interbull Meeting 16-20 June 2008

Why Applications are Needed ?

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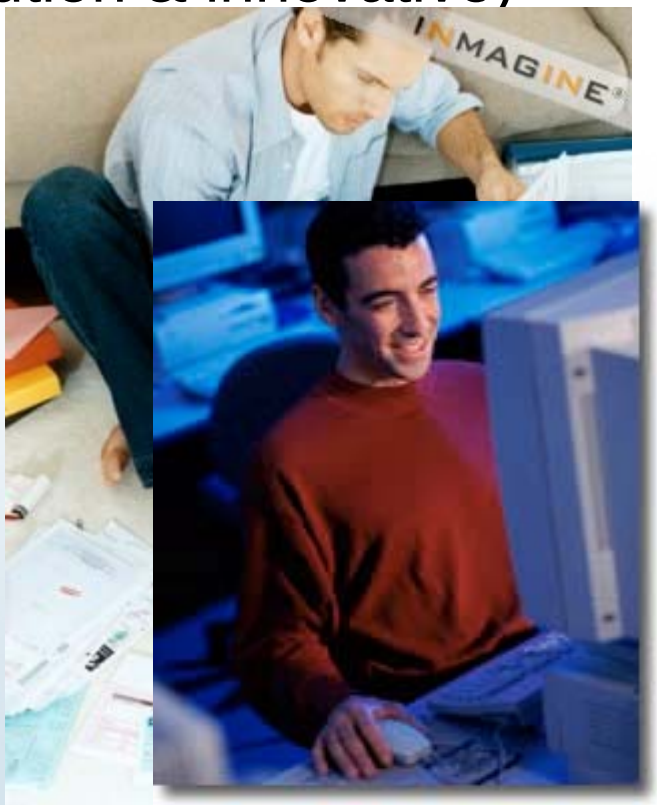
- Herd size increasing
- Sensors range and diversity is rising

=> Quantity of data increasing (resolution & innovative)

- Benefit for the end users ? Appli

⇒ **Research for developing applications is needed**



Applicative Research in Firms
What are The Options ?

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- Applicative research ? R&D
- Research team – Experts
- Academic institutes and Research centers

Two New Advanced Sensors

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- Afilab™ - Milk analyzer

- Pedometer+™ - Behavior meter

Milk Analyzer (Afilab™)

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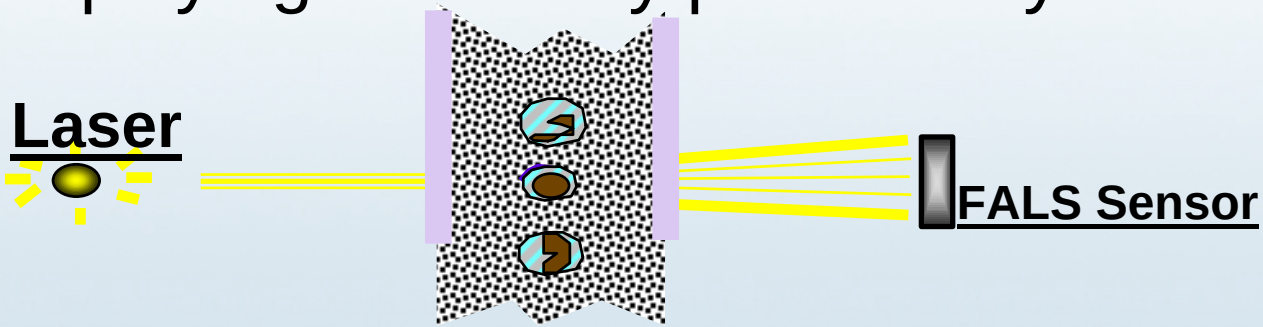
- Measures milk solids (fat, protein, lactose)
- Indication – SCC, Blood
- Technology –Optical characteristics of light scattering off matter

- On-line, In-line (each stall)
- Concept – amplifying laboratory periodically tests



Field Study - Material & Methods

S.A.E. Research Application Team (Schcolnik et. al.)

- Large commercial dairy farm (~800 milking cows)
- May 2007 – July 2007
- Analyzer data were recorded for each cow every milking
- Milk samples collected once a week – analyzed for solids and SCC - Israeli Milk Central Laboratory (Combi Milkoscan™, Foss)
- Blood samples for BHBA thrice weekly - fresh cows (1-21 DIM)
- Statistic analysis - JMP® 6, SAS

Derived Applications

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- Control nutritional status – herd and groups
- Individual feeding
- Predictions (diagnosis) metabolic diseases
- Follow ups dairies' milk payment
- Retrospective analysis
- Milk separation based on its quality
- Early detection of mastitis (under research)

Control nutritional status

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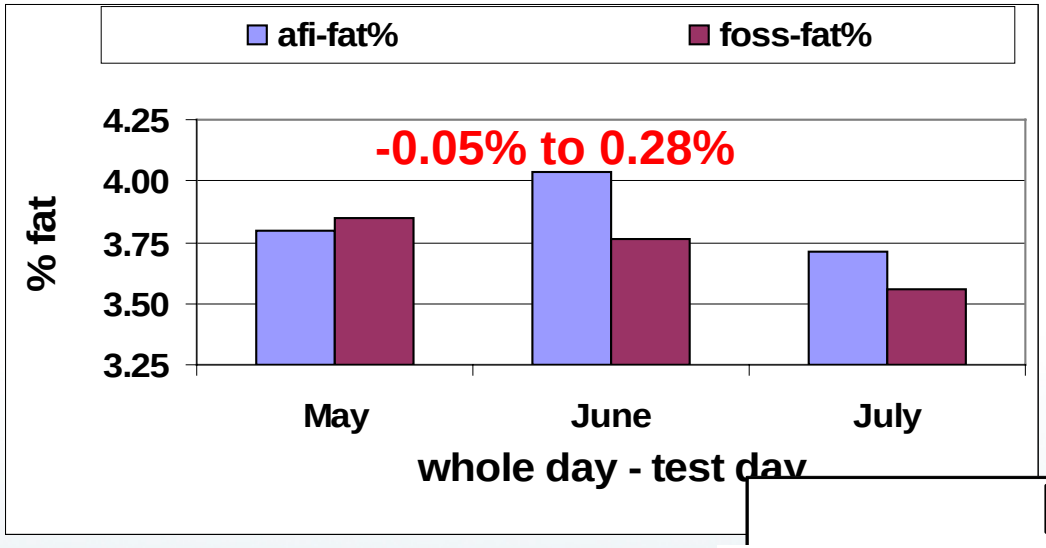
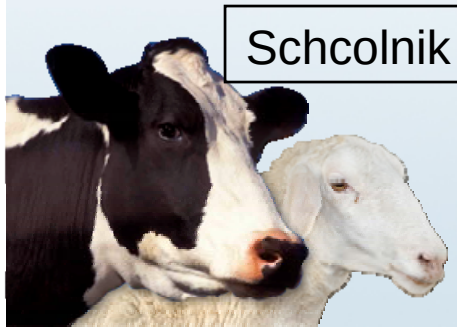
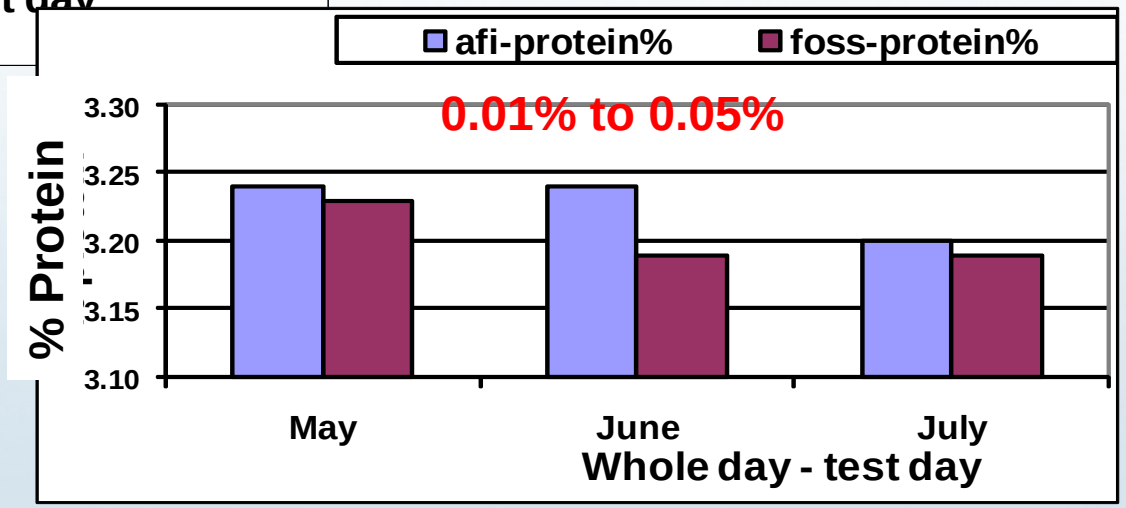
- Milk components utilized with herd health program ? rapid detection nutritional changes => metabolic and reproduction problems (Eicher, 2004)





Schcolnik et al, 2007



Individual Feeding

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- High importance – Management where supplement of additional concentrate feeding is needed (pasture, fresh cows, non homogenous groups)

NRC 2001 formula:

$$DMI_{(kg/day)} = (0.372*FCM^{0.75} + 0.0968*BW)*(1-e^{-0.192*(wol+3.67)})$$

Predictions (diagnosis) Metabolic Diseases

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- Correlation between metabolic diseases and milk components
- Ketosis (NEB) – Fat/Protein Ratio (FPR)> 1.35-1.50
  (Heuer et. al., 1999)
- SARA – FPR< 1.0 or more then 10% with fat < 2.5%
  (Tomaszewski and Cannon, 1993; Nordlund et. al., 2004)

Predictions of Ketosis – Through FPR

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FPR	BHBA>1.4 (31.3%*)	
	Sensitivity (%)	Specificity (%)
>1.2	59.3	56.1
>1.4	33.3	82.7
>1.6	11.1	92.4
>1.8	2.8	98.3

* % of cases with BHBA above threshold

Schcolnik et. al., 2007

Predictions of Ketosis – Multifactorial Approach

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FPR cut off	Model	
	FPR + 3 SHI*[2]	
	Sensitivity	Specificity
1.30	73.0	68.3
1.35	69.6	71.7
1.40	60.9	77.1

* SHI – "Sound Health Indicators"
[2] Model FPR + activity, conductivity and urea (** 3/48, 125, 8.7, 17)

Livshin et. al., 2008

Milk Separation Based on Quality

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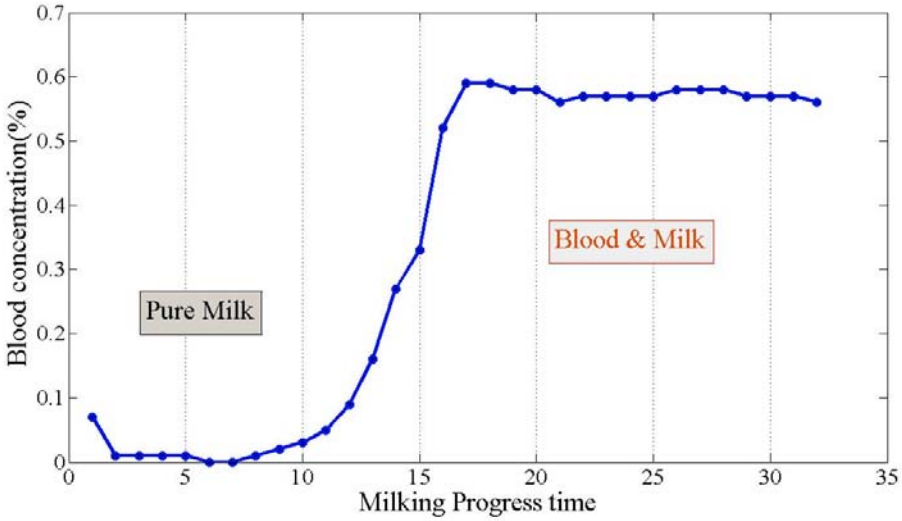
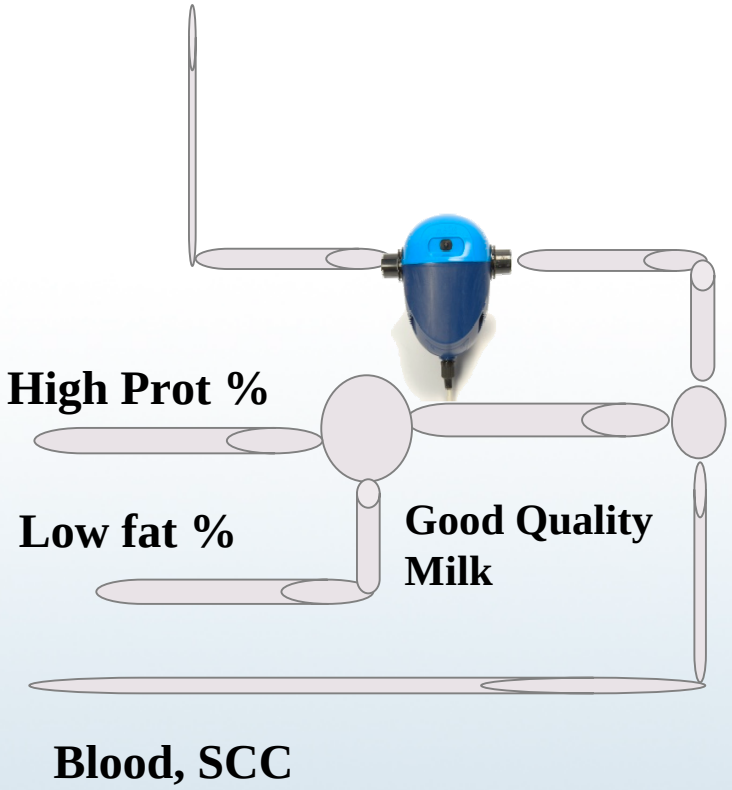
- Separation based on Protein%, SCC, presence of Blood





Early Detection of Mastitis

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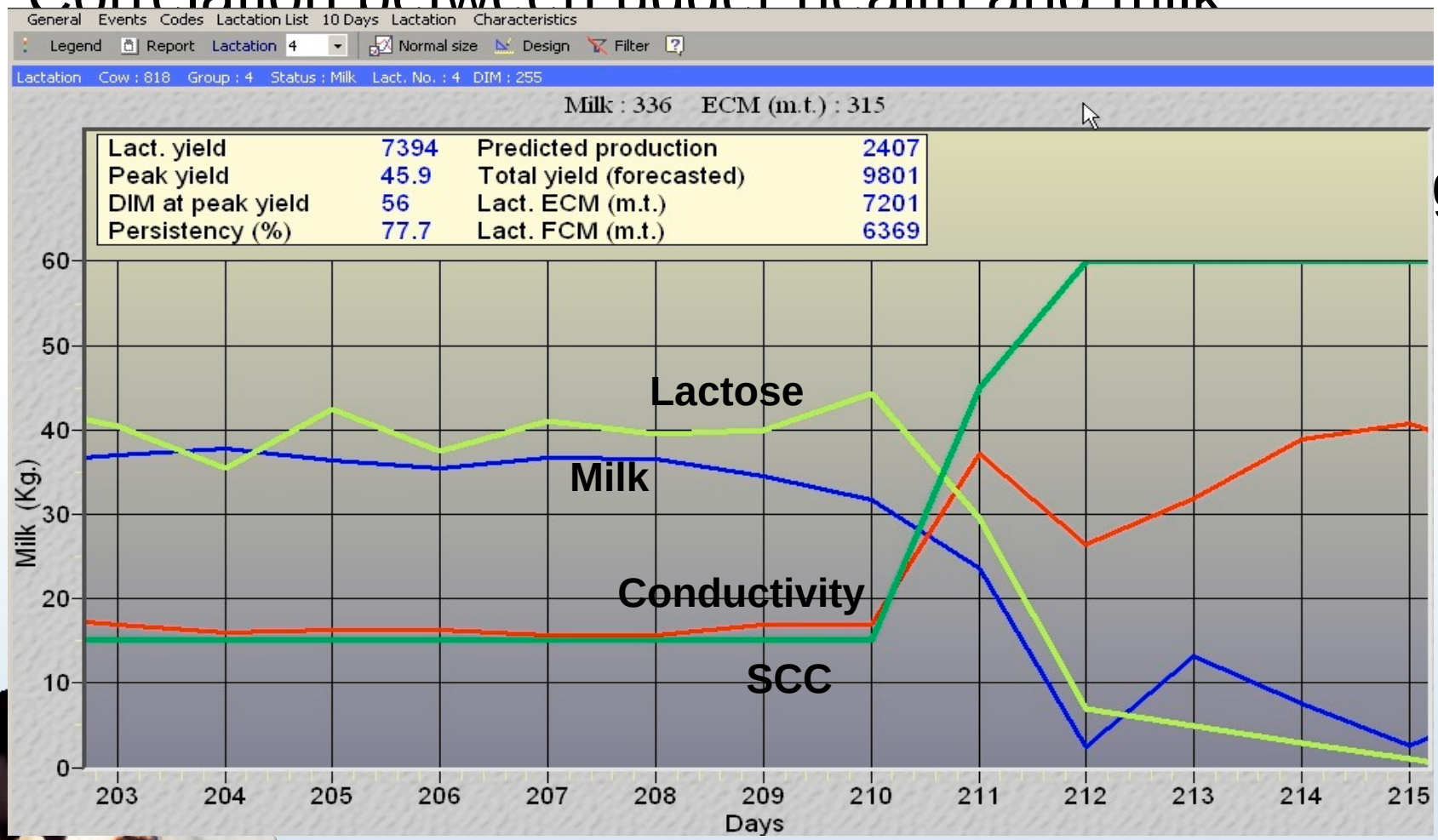
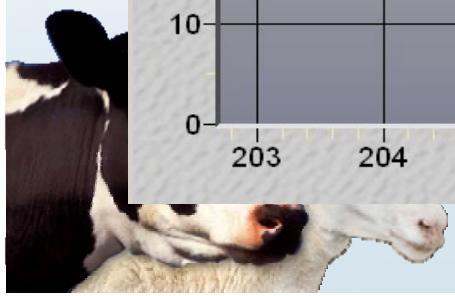
- **Mastitis – Case Report – Commercial Moshav Farm**
- Correlation between udder health and milk
- g





Derived Applications

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- Control nutritional status – herd and groups
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Behavior Meter (Pedometer+™)

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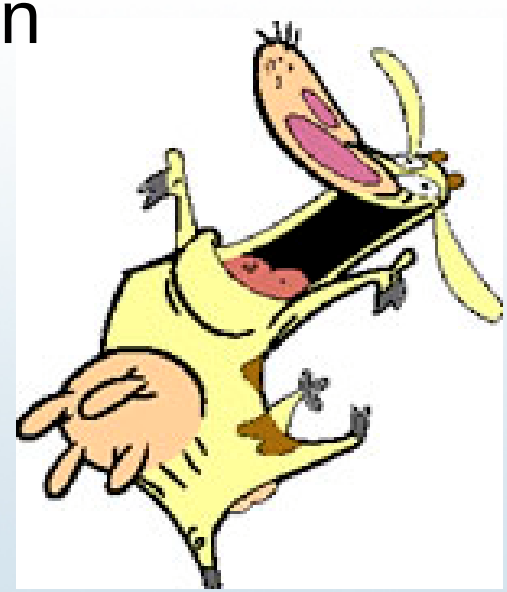
- Records - activity (steps/hr), Lying time, Lying bouts
- Technology – 3 dimensional sensor
- Concept – determine routine behavior of the animal and pinpoint exceptions
- Animal Welfare & Comfort indication



Materials and Methods

A.R.O. The Volcani Center (Maltz et. al)

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Study 1

- Commercial dairy farm (550 MC)
- 1st trial – lying behavior (12 MP)
- 2nd trial – two different barns – free stall vs. no stall (8*2 PP)
- 3rd trial – changed over 4 cows from each group
- Student T-test

Study 2

- Volcani Center dairy farm
- 14 cows prior calving
- 5 kg concentrates feed (1kg*5) using CCSF
- Activity, lying and feeding behavior – recorded last 7 days prior calving
- T-test (each day vs. previous day)

Derived Applications

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- Animal Welfare & Comfort assessment
- Detecting calving time of dairy cows
- Heat detection under unfavorable condition (tie stall, heat stress)
- Define the optimal stocking density

Animal Welfare & Comfort Assessment

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Lying time (mean ± SD) in between milking diurnal intervals of 8 cows in no stalls barn and in free stall barn

(activity = 100%) → Stable parameter

Time interval	Lying Time (min)
	No stall barn
Morning (04:00-12:00)	157±42 (29.4*)
Noon (12:00-20:00)	118±50 (22.1)
Night (20:00-04:00)	258±51 (48.4)

* % from daily lying time

From Livishin et. al., 2005

Animal Welfare & Comfort Assessment

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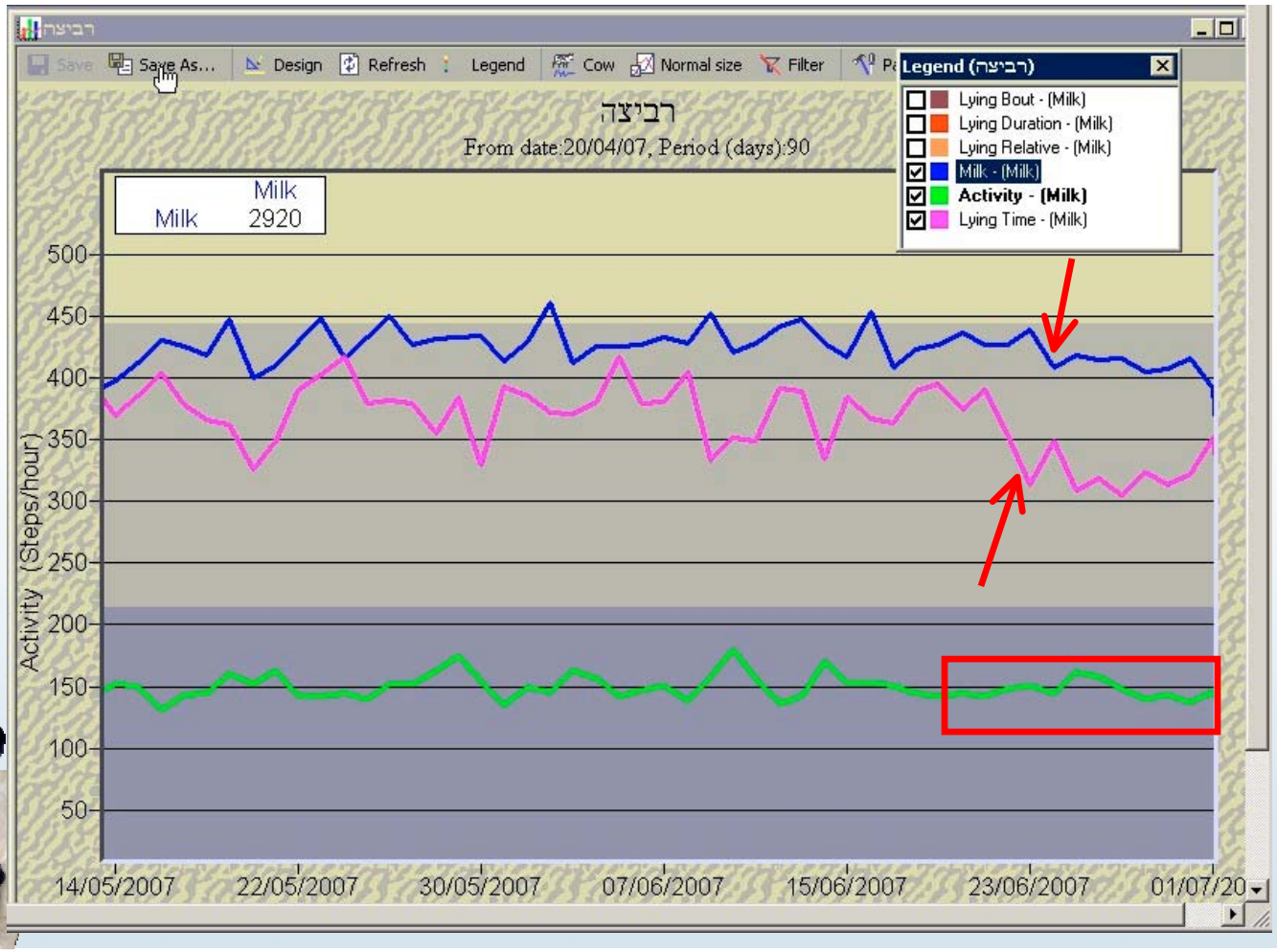
Heat Stress (During Israeli Summer) – Case Report – Lying behavior Vs. Activity Whole Group Level – Commercial Moshav Farm



Animal Welfare & Comfort Assessment

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- Evaluation of housing management

Changing of Lying Time (minutes) after transferred between 2 different housing barns

Time Interval	Period 1	Period 2	Period 1	Period 2
	No stall	Free stall	Free stall	No stall
Morning (04:00-12:00)	153±41*a	126±55	120±39*	178±55a

* p<0.01 of the same cows when transferred from one barn to the other
[a] p<0.01 between groups (4 cows) inhabiting different barns within period

From Livishin et. al., 2005

Detecting Calving Time

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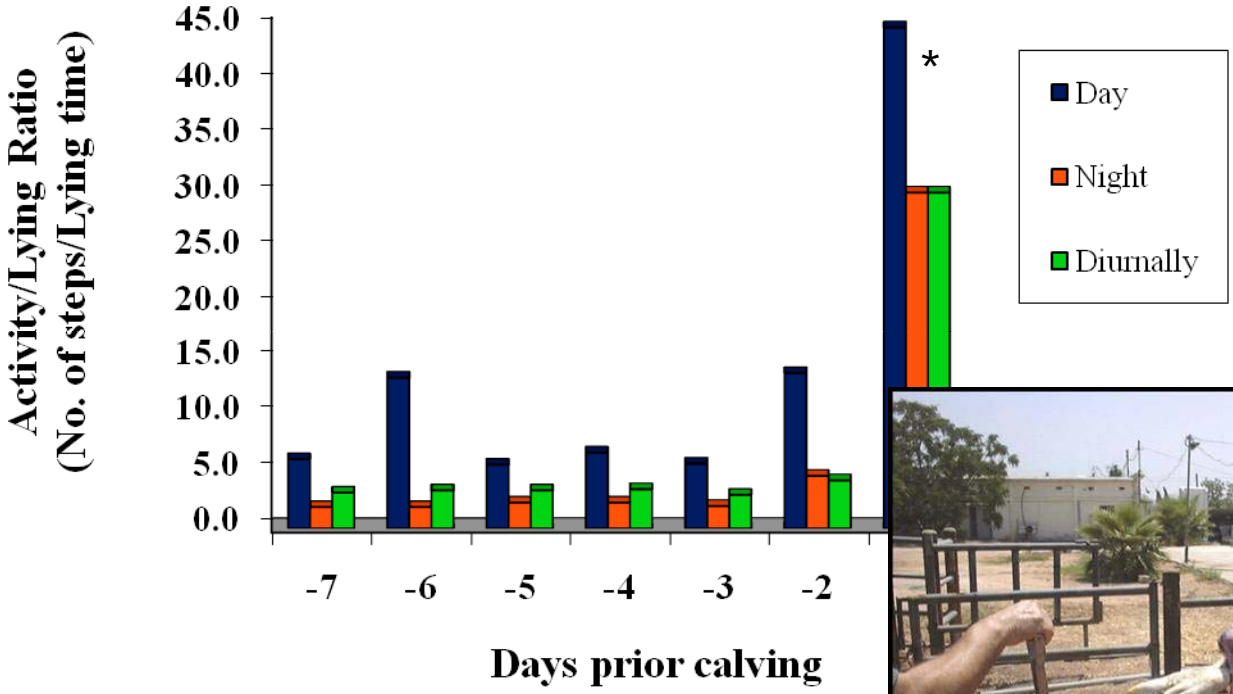
- Cows behavior change prior to calving

Activity/Lying ratio in the last 7 days prior to calving

- Calv avior para
- Help
- Atter



* P< 0.01 day -1 vs. day -2

Heat Detection in Unfavorable condition

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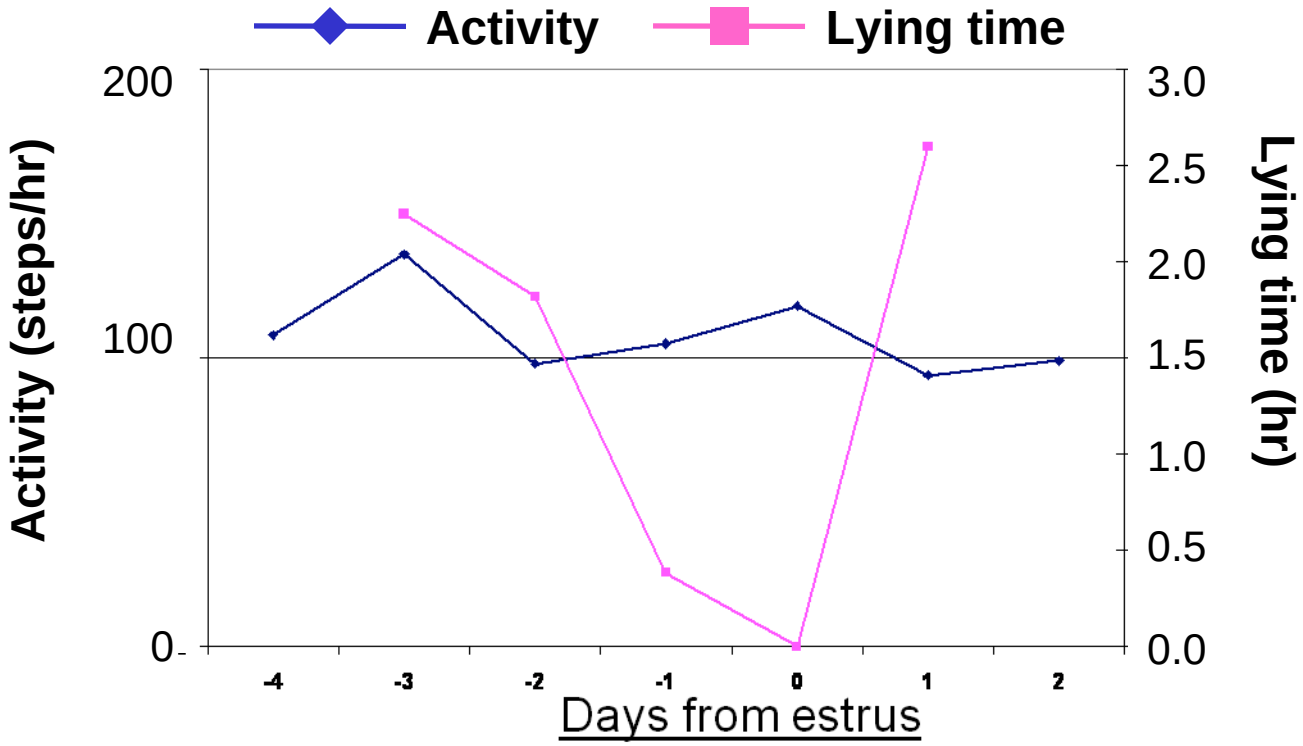
Heat Detection – Case Report – Changing only in Lying Behavior



Maltz et. al.

Derived Applications

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- Animal Welfare & Comfort assessment
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Applications Derived from Interactions of Sensors

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- Interaction between large range of data from varied sensors (Milk meter, Weight scale, Self feeders)
- Developing innovative models
- Developing new applications and improving established ones
- **Early** detection and **specify** of health, fertility and welfare problems

Summary

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- Modern farm - Herd size increasing ? Amount and range of data increasing
- Sophisticated applications are needed
- Applied research is required
- Two new advanced sensors were developed by S.A.E. Afikim
- **The sky is the limit**

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THANK YOU