

INTELLIGENT GRAZING MANAGEMENT USING WIRELESS SENSOR MATERIALS

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PERSONAL BACKGROUND

- > Studied arable farming and organic practice in Wageningen, NI
- > 12 years of advisory work in extension services in Denmark, organic farming, dairy farming, automation
- > 5 years as scientific manager of organic research station for dairy, and pig production in Denmark
- > 7 years of research and teaching in Biosystems engineering at University of Aarhus in Denmark (LCA, automation and ICT solutions)

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RESEARCH PROJECTS

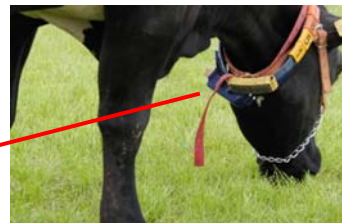
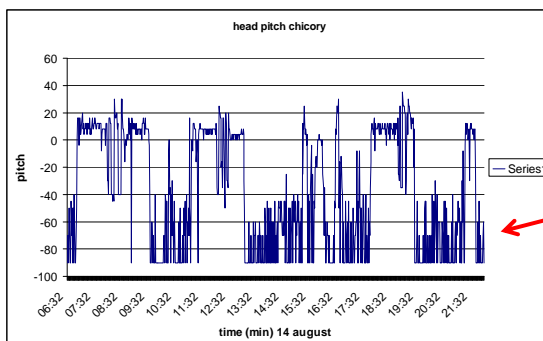
> Sustainability assessments of new technologies for organic dairy

Development of mobile robotic milking



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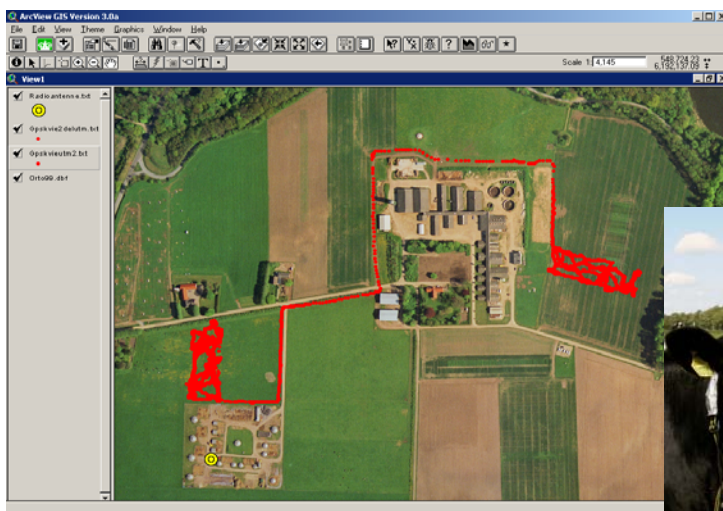
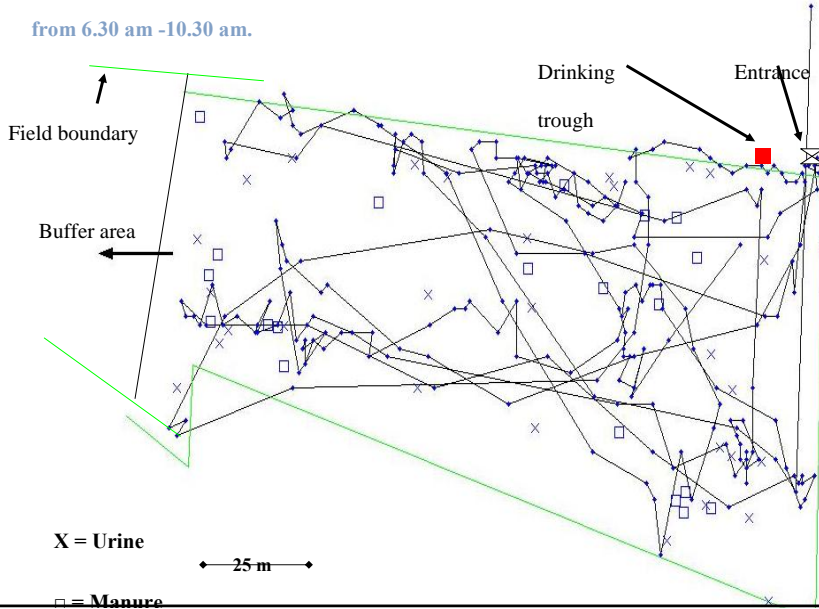
GPS TRACKING OF GRAZING BEHAVIOUR COMBINED WITH ROLL AND PITCH MEASUREMENTS



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Treatment P4, 4 hours of grazing,
from 6.30 am -10.30 am.



INTELLIGENT GRAZING

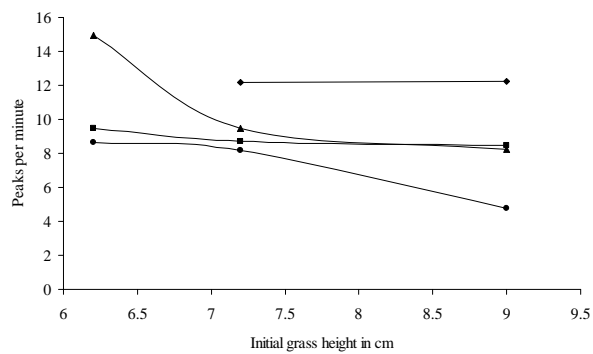
Using wireless sensors to track distance moved

Started very simple



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STUDYING GRAZING BEHAVIOUR AND BITE CHARACTERISTICS



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PRESENT RESEARCH; BACKGROUND

Grazing is becoming problematic in modern dairy farming (large herds, high yield)

Seen from the farmers point of view:

yield level: precise control of feeding level is necessary
allocation of fields, often not enough area for effective grazing
automatic milking systems (AMS) :demands individual traffic

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CONSUMERS

- > Seen from the consumers point of view:
 - > Increasing demand for dairy products from grazing cows,
 - > consumption % og organic milk in DK, > 50
 - > consumption of conv. milk from grazing cows: 5%
- > why ?
 - > cows on grass have less claw and leg problems
 - > documented quality increase
 - > landscape changes

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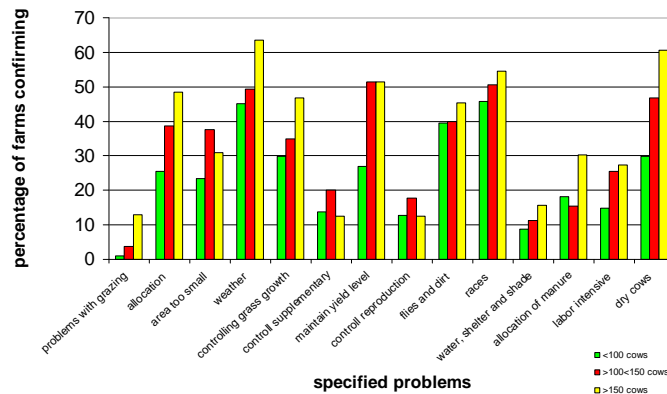
COMPLIANCE

- > Seen from the authorities point of view
- > Increasing demands for :
 - > documentation of product quality, medicine usage etc.
 - > documentation of animal welfare, laying time, coming outside etc.
 - > documentation of compliance, ECO, IF

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STAKEHOLDER INQUIRY ON PRIORITIZED DEMANDS FOR IMPROVEMENT

- > Question asked; why don't you graze the cows ? What obstacles, for three different herd sizes



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RESEARCH OBJECTIVE

How can modern technology contribute to improved control of management in order to satisfy farmers, consumers and authorities.

Technology is defined as hardware (sensors, automation,) , use of modeling and decision control , information capture and process steering.

Which existing technology was available and what needed innovation ?

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FIRST STEP: PARAMETERS TO MEASURE

- > Hunger: is eaten amount of food in alignment with production level
- > concentrate, grass, energy, vitamins, minerals
- > Thirst: Often the drinking pattern expresses if cow is at ease
- > Health: secondary interest

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EXISTING TECHNOLOGY TO MEASURE

> **Communication:**

- > RFID
- > Blue Tooth (wireless communication)
- > ZIGBEE (wireless sensor networks)
- > Wireless LAN

> **Sensing:**

- > 2 or 3 D accelerometers
- > GPS
- > Bite counters, step counters,
- > Temperature indicators
- > pH indicators embedded in bolus

NEEDED

- > Modeling to connect direct and simple measurements of vital parameters to usable indicators for farm management

> **Steps on the way to this process:**

- > Algorithm to calculate grazing time from head mounted accelerometers
- > (Ice robotics, cow detect, and others.)
- > Algorithms to calculate moving patterns of cows (loco-meters)

WHICH WAY DID WE GO ?

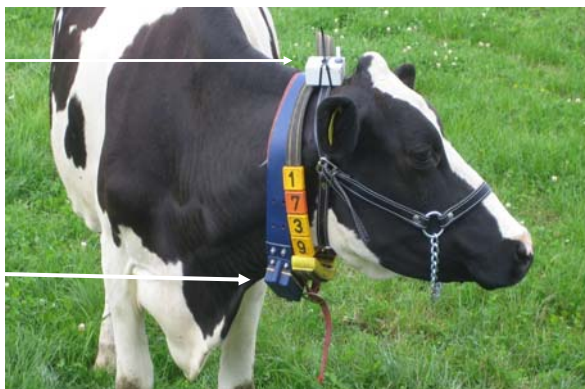
- > Involved scientists; Esmail Nadimi, Lene Munksgaard, Rasmus Jørgensen, Peter Lund, Troels Kristensen and undersigned.
- > By measuring cows grazing behaviour (time and vigor) ,
- > walking behaviour (speed and distance) and combining these to cow data, grass quality, and amount per ha, we try and find relations which might give information to estimate Dry matter intake of the cow.
- > We need to come nearer the bite amount and size.

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EXPERIMENTAL EQUIPMENT

Sensor mode,
including radio,
receiver,
accelerometer.

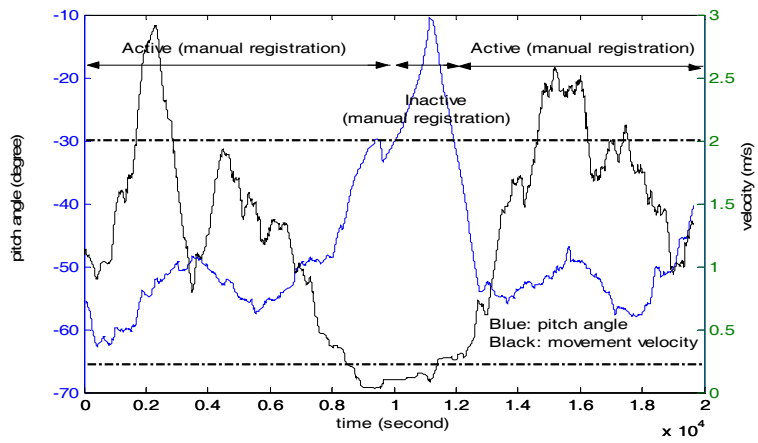
GPS, accelerometer and
short-distance receiver
and radio



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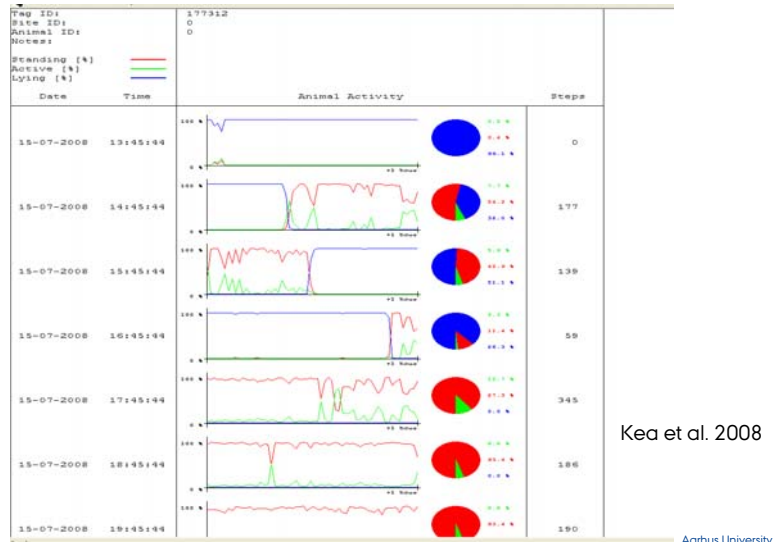
MEASUREMENTS WITH ACCELEROMETERS



WIRELESS SENSOR REGISTRATION OF PRODUCTION PARAMETERS



OTHER RESEARCH WITH 3D ACCELEROMETERS MOUNTED ON LEG.



Kea et al. 2008

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RESEARCH HYPOTHESIS

- > By measuring head movements using accelerometers, we can estimate grazing time
- > By measuring motion by GPS or RSSI we can increase the precision of the estimation
- > By measuring head movements using accelerometers we can estimate the amount of bites.
- > By analyzing and modeling the data we can estimate the bite size per cow
- > By modeling the set of data we can estimate DMI

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PRACTICAL USE

- > Farmer can get information on how to feed the cows when coming in the barn
- > Farmer can make a decision for changing field or taking in the cows
- > Additionally information on cow health

Does this contribute to sustainability

Depends on price

Depends on how authorities and consumers react to zero grazing

Graz2Milk

Thank you for your attention

