Using real time cow information for daily grazing management

Bert Ipema, Gertjan Holshof and Rudi de Mol
Introduction

- **Autograssmilk – FP7 SME-project EU**
  - **Objective**
    - Develop and implement improved sustainable farming systems that integrate the grazing of dairy cows with Automatic Milking
  - **Partners**
    - Ireland (IGA and Teagasc)
    - Netherlands (LTO and WLR)
    - Denmark (VFL and AU)
    - France (CNIEL and IDELE)
    - Sweden (SDF and SLU)
    - Belgium (CDL and ULg)
Introduction

- Focus of project on integration of AM with cow grazing
  - WP1 - Feeding strategies
  - **WP2 - New technologies**
  - WP3 - Sustainability
  - WP4 - Tools to optimise economic efficiency
  - WP5 - Dissemination
Introduction

Within WP2 – New technologies

- Task 2.2. Evaluate technologies to support the integration of grazing and AM systems

- Aim: Use sensor data to develop practical tools for farmers that can be used
  - to maintain high milk yield
  - to improve grassland management
  - to detect problems, e.g. cow health
  - to detect cows in heat
Materials and methods

- Experiment on research farm Dairy Campus in 2013

- Grazing system: strip grazing
  - Herd size: ~55 HF-cows
    - Additional silage in barn: 8 kg d.m./cow/day
    - At least 8 kg d.m./cow/day from grazing
  - 2 blocks for grazing: 8 ha per block
    - 2x 6 hours daily during at least 120 days
    - Daily grazing periods:
      - Strip 1 from 06:00~12:00h
      - Strip 2 from 12:00-18:00h
Materials and methods
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Materials and methods

- Available real time information
  - Milking robot
    - Milk yields
    - Milking intervals
    - Milking refusals
  - Cow activity
    - Walking (Steps)
    - Lying
    - Standing
    - (Eating/grazing)
Materials and methods

Further available information for analysis

- Management actions
  - Grassland management
  - Grazing regime
  - Additional feeding in barn

- Weather conditions
  - Temperature
  - Precipitation (amount and duration)
  - Sunshine
  - ......
Real time information for grazing management

Source: milking robot

Robot visits with milk yield for cow 607 on August 14-15

- Milked
- Refused
- Mlk Yld (kg)

[Graph showing robot visits with milk yield for cow 607 on August 14-15]
Real time information for grazing management

Source: milking robot
Real time information for grazing management

Source: milking robot
Real time information for grazing management

Source: milking robot

number of milkings/cow/day

1-6-2013  1-7-2013  31-7-2013  30-8-2013  29-9-2013
Real time information for grazing management

Activity cow 607 during August 13 and 14
Real time information for grazing management

Lying time cow 607 during August 13 and 14
Real time information for grazing management
Real time information for grazing management

Distribution of lying time over 24 hours
Real time information for grazing management

Average daily activity during experiment

- steps night
- steps day
Real time information for grazing management

Average daily lying time during experiment

- Lying night (min)
- Lying day (min)
Alerting deviating cows

- Used data for analysis of alerts
  - Milk yields: 4400 cowdays – 29 heat cases
  - Activity: 3750 cowdays – 21 heat cases

- Alerts analysed for significant
  - decreased milk yield
  - decreased lying duration
  - increased activity (total or maximum number of steps)
  - increased number of lying bouts
Alerting deviating cows

Activity cow 607 during August 13 and 14
Cow 603 – activity days and nights (2 months)
## Results heat detection (1)

### 24 hrs (18:00-18:00h) periods

<table>
<thead>
<tr>
<th></th>
<th>lying duration</th>
<th>lying bouts</th>
<th>total steps</th>
<th>maximum steps</th>
<th>milk yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity</td>
<td>57.1</td>
<td>28.6</td>
<td>42.9</td>
<td>52.4</td>
<td>31.0</td>
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<tr>
<td>Specificity</td>
<td>86.0</td>
<td>87.5</td>
<td>86.0</td>
<td>85.2</td>
<td>80.7</td>
</tr>
</tbody>
</table>

### days (06:00-18:00h = grazing) periods

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</thead>
<tbody>
<tr>
<td>Sensitivity</td>
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<td>28.6</td>
<td>38.1</td>
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<td>Specificity</td>
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<td>86.3</td>
<td>86.0</td>
<td>85.1</td>
<td>81.1</td>
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</tbody>
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### nights (18:00-06:00h = in barn) periods

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</thead>
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<td>14.3</td>
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<tr>
<td>Specificity</td>
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<td>87.6</td>
<td>80.9</td>
<td>82.3</td>
<td>80.9</td>
</tr>
</tbody>
</table>
Results heat detection (2)

Steps – not normally distributed
  ● Log transformation
    ● Sensitivity decreases
    ● Specificity increases

Further improvements to be explored
  ● Correction of individual parameters by group mean
  ● Combining alerts of different parameters
  ● Ideas?

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<th>over night (18:00-06:00 h = in barn) periods</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>total steps</td>
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<td>Sensitivity</td>
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<tr>
<td>Specificity</td>
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</table>
Real time information for grazing management

- Output from model
  - Alerts for individual cows
    - In heat
    - Health problems
  - Alerts for herd
    - Milk yield decreases
    - Milking frequency decreases
    - Activity changes
Effects of management and weather

Average Milk Yield/Cow/Day

5d Moving Average Steps/Cow/Day

Livestock Research Wageningen

Autograsmsilk

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Effect of weather conditions – precipitation duration
Effect of weather conditions – precipitation amount

Total precipitation amount (mm) during daily grazing periods
Effects of management and weather

Average Milk Yield per Cow per Day

5d Moving Average Steps per Cow per Day

9-6-2013 to 17-9-2013

20.0 to 35.0

500 to 4500

22.0

25.0

27.0

29.0

31.0

33.0

35.0

9-6-2013

29-7-2013

17-9-2013

number of steps
Effect of weather conditions - precipitation
Effect of weather conditions - temperature

Average temperature (degrees Celsius) during daily grazing periods
Effect of grazing management

Daily grass allowance

- grass offered morning
- grass offered afternoon

kg dm/cow/day

1-6-2013 16-6-2013 1-7-2013 16-7-2013 31-7-2013 15-8-2013 30-8-2013 14-9-2013 29-9-2013
Effect of feeding management

Daily feed intake

- in barn

Graph showing daily feed intake from 1-6-2013 to 29-9-2013.
Effect of grazing management

Daily grass allowance

[Graph showing daily grass allowance from 1-6-2013 to 29-9-2013, with bars for grass offered morning and afternoon.]
Effects of management and weather
Conclusions for herd level

- Sensor information
  - Early detection of effects of weather conditions and feeding/grazing management on cow behaviour and milk yield are realistic
  - **Question?** What to do when information signals lower activity and milk yield?
    - Increase supplementary feed in barn!
    - Detrimental effect would be less grazing
      - **Solution:** Improve grassland management
  - **Have always good quality fresh grass available**
Conclusions individual cow level

- Heat detection
  - Sensitivity and specificity are too low
    - Currently used sensor information and detection models need further development
  - Other sensors?
  - Better models?
Thank you for your attention !!