Sensor-based monitoring of post-calving cows in a robotic dairy farm

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Outline

• Aim
• Why post-calving diseases?
• Why in robotic dairy farm?
• Material & Methods
• Results
• Discussion
• Conclusion
Aim

• Apply a behaviour and performance based disease detection model for post-calving cows in a robotic dairy farm
Why post-calving diseases?

• Prevalence

  o 10 to 50 % of cows ketosis and/or metritis
Why post-calving diseases?

• What is:
  o Ketosis?
    • Metabolic disorder
  o Metritis?
    • Inflammation of the uterus

• Diagnosis
  o Veterinarian → routine check
Why post-calving diseases?

- Early lactation: 3 weeks after calving
- Causes
Why in robotic dairy farm?

- Cows ‘choose’ how to spend their time
Why in robotic dairy farm?

• But: Fetching cows disturbs routine
Why in robotic dairy farm?

- Availability of sensors
  - Milk yield
  - Body weight
  - Visits to the robot
  - Rumination time
  - Activity
  - …
Material and Methods

- Commercial robotic dairy farm
  - 250 Israeli-Holstein cows

- 5 milking robots – behaviour and performance sensors
  - Milk yield
  - Body weight
  - Visits to the robot
  - Rumination time
  - Activity
DO you have pictures or give a description of the sensors. Which behaviour is being measured? which performance?

Van Herem, Tom, 23/08/2014
Model calibration

- All post-calving diseases 5-21 DIM
- Variables: Milk yield, rumination time, activity, body weight relative to body weight at calving, number of milkings
- Model development with historical data (1 year)
- Tree Based Model – cut-off threshold 0.5

<table>
<thead>
<tr>
<th>Calibration</th>
<th>Reference = Veterinarian</th>
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<tbody>
<tr>
<td>N = 111</td>
<td>Healthy</td>
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<tr>
<td></td>
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<td>Healthy</td>
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<tr>
<td>Sick</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>0.95</td>
</tr>
</tbody>
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Agricultural Research Organization (ARO) Israel
Model validation

Cows divided into 2 groups – Two validations:
- Validation I:
  Model is followed - cows only brought to veterinarian when model indicates disease
- Validation II:
  All cows checked by veterinarian, data fed to model and compared to diagnosis of veterinarian
Validation I

• Every Sunday:
  o Model check of cows 5-21 days after calving
  o List of cows at risk for disease → to farmer
    • Cut-off threshold = 50% chance of being ill
  o Veterinarian check
Validation I: Preliminary results

- **34 cows**

<table>
<thead>
<tr>
<th>Model outcome</th>
<th>Diagnosis of veterinarian</th>
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<tr>
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<td>0.85</td>
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</table>

- Veterinarian confirms model outcome
Validation II: Preliminary results

- Behaviour and performance data are fed to model and compared to the diagnosis of the veterinarian

- 31 cows

<table>
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<tbody>
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<td>Ill</td>
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</table>

- Model ≠ reference (veterinarian)
Discussion

• Severe – moderate – light cases of ketosis / metritis
• Model = tool, farmer = decision (e.g. risk cows)
• Separating only part of the cows for the veterinary check
  o Time saving
  o Less disturbance for cows
• Model: daily 🔄 Vet: weekly
  o Now model is only compared with the day of the diagnosis of the veterinarian → too early or too late to detect problem?
Discussion

• Imbalance in parity
  o Disease prevalence is different in younger and older cows

• Future research:
  o Consequences
    • Fertility
    • Culling rate
    • Milk yield
    • Labour
Conclusions

Combine existing robotic milking farm data → develop and validate tree-based model → detect post-calving health problems

Thank you!

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