Automated lameness monitoring in dairy cows

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("*Plane b": Presented by Ilan Halachmi)

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• Introduction
• Objective
• Materials and Methods
• Results and discussion
• Conclusion
Feature variables to detect lameness

- Deviation in gait and posture…

**Gait**
- Uneven Gait
- Reluctance Bear Weight
- Speed
- Short Strides
- Tracking-up
- Affected Leg Evident
- Abduction-Adduction
- Joint Flexion

**Posture**
- Arched-Back
- Head-Bob
- Hip Hick

**Others**
- Difficult turning
- Difficult rising
- Tenderness
- Affected behaviour
Previous work (Bio-Business)
ARO, Volcani Research Centre (Israel), WUR (The Netherlands), KU Leuven

Published by Viazzi et al. (2014) & Van Hertem et al. (2014)
2D video recordings for back posture as main feature variable

Picture taken at Kibbutz Yefat, ARO Volcani Research Centre (Israel),

Picture taken at KU Leuven (before The project start )
Previous work - Continuation

Published by Viazzi et al. (2014) & Van Hertem et al. (2014)

**3D video recordings for back posture**

Real-Time image analyses

Based on pictures taken at Kibbutz Yefat, ARO (Israel),
Evolvement of back posture values in time

- Back posture values
- Gold standard
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Develop a prototype of an early warning system
• Introduction
• Objective
• **Materials and Methods**
• Results and discussion
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Materials and Methods

Subjects & infrastructure
Commercial dairy farm with 2500 cows

Data collection
Back posture values collected daily August 2014 – October 2015
Data from 1908 different cows

Gold standard
Manual scores collected weekly September 18th 2016 – October 23rd 2016
5592 manual scores from 1465 different cows
• Selection of a **reliable dataset**

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**Cow nr 8512 - healthy**

**Cow nr 8520 - newly lame**

Newly lame: a cow becomes lame
• Selection of a **reliable dataset**

![Graphs showing manual score over time for two cows](image)

**Cow nr 7032 - severely lame**

**Cow nr 8815 - unreliable**

**RELIABLE**

**UN-RELIABLE**

*Graphs illustrate the manual score over time for two cows, one reliably lame and the other not.*
Selection of a **reliable dataset**

From 1908 cows, with at least 4 manual scorings over a period of 6 weeks,

**209 cows** were withheld for further analysis
• Define a **group level baseline**

_The healthy baseline on group level is calculated_
• Define a **group level threshold**

An alarm is generated when a back posture value exceeds the group level baseline

**Performance evaluation:**

<table>
<thead>
<tr>
<th>Manual score of 1 or 2 (not lame)</th>
<th>Alarm generated by the algorithm (lame)</th>
<th>No alarm generated by the algorithm (not lame)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FP</td>
<td>TN</td>
</tr>
<tr>
<td>Manual score of 3 or higher (lame)</td>
<td>TP</td>
<td>FN</td>
</tr>
</tbody>
</table>
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Alarm generation performance

Group level baseline

Sensitivity 76.1%
Specificity 83.9%
Developing a **prototype** that can be used on a commercial farm and that **brings value to the farmer**
Graphical User Interface

Date Warning List: 20151010  Create  Save as Excel file  Sort on: BP alarm  Rel. Act.  Dev. Milk

Warning List

DUMMY COW 3564

Back posture score vs Day

Relative activity vs Day

Milk yield change vs Day

Treatment history

View ... days of data  View cow that is not on the list

Cow ID
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• Conclusion
• Using historical back posture animal data, a healthy baseline can be defined.

• Deviations from this baseline based on a threshold result in alarms that can be raised with 76.1% sensitivity and 83.9% specificity.

• Alarms can be translated into useful information that can be implemented on a commercial farm through a GUI.
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