Hoof lesion detection with manual and automatic locomotion scores in dairy cattle

Hoof lesion importance

Prevalence
[> 60%]

Causes

Welfare

Cost
Manual and automatic locomotion score

Alterations Gait and Posture

Locomotion score

Not Lame

Lame

Lesio
Lameness is an visual sign

Manual locomotion score

Automatic locomotion score

Aim

Lameness

Lameness is a sign
Not the problem
Problem = hoof lesions?
Objectives

consistency between **manual** and **automatic locomotion scoring systems** for scores assigned to a cow.

performance of **manual** and **automatic locomotion scoring system** for detecting hoof lesions in dairy cow.
Materials and Methods
Farm

Located in Belgium

210 – 240 Holstein cows in milk

Rotary milking systems Twice a day

TMR and automatic concentrate supplier on barn
Manual locomotion score

1 experienced rater

5-level scale:
• 1: a smooth and fluid movement
• 5: ability to move was severely restricted

Lame $\geq$ Score 3

Credit: Zinpro
Automatic locomotion score
Manual and automatic locomotion scoring
Trimming and hoof lesion detection

Two professional trimmers (approx. half cows each)

Two observer recording lesions (not trimmers)

Lesion scored as:

0: no lesion
1: slight lesion
2: moderate lesion
3: severe lesion
Consistency between manual and automatic locomotion score

**Percentage of agreement (PA):** Identical scores to a cow.

**Weighted kappa (κw):** Assign weight to the disagreements

5-level scale
Lame/not lame classification (Locomotion Score ≥ 3)
Performance for detecting hoof lesions

**Sensitivity:** Capability of a test for detecting cow with lesions

**Specificity:** Capability of a test for detecting cows without lesions

**Locomotion score**
- Lame $\geq 3$

**Lesions score**
- Hoof lesion $\geq 1$
- Severe hoof lesion $\geq 2$
Results and Discussion
Descriptive results

Cow locomotion scored
- Manual: 216
- Automatic: 104

Lameness Prevalence
- Manual: 32%
- Automatic: 47%

Hoof trimming
- Trimmed cows: 244
- Hoof lesions Prevalence: 83%
- Severe hoof lesions prevalence: 54%
# Consistency between manual and automatic locomotion scores

<table>
<thead>
<tr>
<th></th>
<th>Kw/K</th>
<th>PA</th>
</tr>
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<tbody>
<tr>
<td>Five-levels</td>
<td>0.29</td>
<td>33.9%</td>
</tr>
<tr>
<td>Non-lame/lame</td>
<td>0.33</td>
<td>67.2%</td>
</tr>
</tbody>
</table>

Good

\[ Kw \geq 0.6 \]
\[ PA \geq 75\% \]
Cows with and without hoof lesions (manual locomotion score)
Cows with and without **hoof lesions** (Automatic locomotion score)
Cows with and without severe hoof lesions (Manual locomotion score)
Cows with and without severe hoof lesions (Automatic locomotion score)
## Sensitivity and specificity of manual and automatic locomotion scores

<table>
<thead>
<tr>
<th></th>
<th>Sensitivity</th>
<th>Specificity</th>
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<tbody>
<tr>
<td><strong>Hoof lesions</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manual</td>
<td>35.6%</td>
<td>80.6%</td>
</tr>
<tr>
<td>Automatic</td>
<td>46.9%</td>
<td>77.7%</td>
</tr>
<tr>
<td><strong>Severe hoof lesions</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manual</td>
<td>42.5%</td>
<td>52.4%</td>
</tr>
<tr>
<td>Automatic</td>
<td>58.0%</td>
<td>62.9%</td>
</tr>
</tbody>
</table>
### Sensitivity and specificity of manual and automatic locomotion scores in the literature

<table>
<thead>
<tr>
<th></th>
<th>Lesion</th>
<th>Sen</th>
<th>Spe</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Manual</strong></td>
<td>Sole ulcer</td>
<td>54%</td>
<td>70%</td>
<td>Chapinal et al (2009)</td>
</tr>
<tr>
<td></td>
<td>Painful lesion</td>
<td>67%</td>
<td>84%</td>
<td>Bicalho et al (2007)</td>
</tr>
<tr>
<td><strong>Automatic</strong></td>
<td>Painful lesion</td>
<td>33%</td>
<td>90%</td>
<td>Bicalho et al (2007)</td>
</tr>
<tr>
<td></td>
<td>Hoof lesions</td>
<td>74-78%</td>
<td>86-93%</td>
<td>Van Hertem et al (2013)</td>
</tr>
</tbody>
</table>

**Locomotion is affected by many different factors:**
Material of the walking surface, Anatomical conformation of cows, Parity, Breed, Hoof trimming, Degree of udder distension
Conclusions

GOOD NEWS!
Automatic locomotion score perform similar as human raters for locomotion scoring (and lameness detection) and hoof lesions detection

BAD NEWS!
Manual and automatic locomotion scores have modest capability for detecting hoof lesions and severe hoof lesions
Are locomotion score useful?

- **Trimming schedule:**
  - **Pros** = Trim all cows, also preventive
  - **Cons** = require important organization skills, what is best? Every 2, 3, 6 months?

- **Visual detection at milking**
  - **Pros:** Save time, cheap (treat only cows with lesions)
  - **Cons:** Mostly useful for digital dermatitis, not preventive

- **Manual locomotion scores**
  - **Pros:** Cheap and easy to perform
  - **Cons:** Takes time, not preventive

- **Automatic locomotion scores**
  - **Pros:** Similar performance as manual locomotion scores, save time
  - **Cons:** Expensive, not preventive
THANKS

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http://www.bio-business.eu/