Walking Impulses of Sound and Lame Dairy Cows

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Background

- High prevalence of lameness in dairy herds for decades

- Herd size

- Number of herdsmen

Need for **automated lameness detection**

Aims

- To create a (semi-) automatic set-up for capturing 3D forces from walking cows

- To test the ability of 3D derived gait parameters to detect lameness by investigating left/right symmetry

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Hypotheses

1. Claw trimming reduces lameness score
2. Trimming increases walking symmetry
3. Lameness reduces walking symmetry and speed

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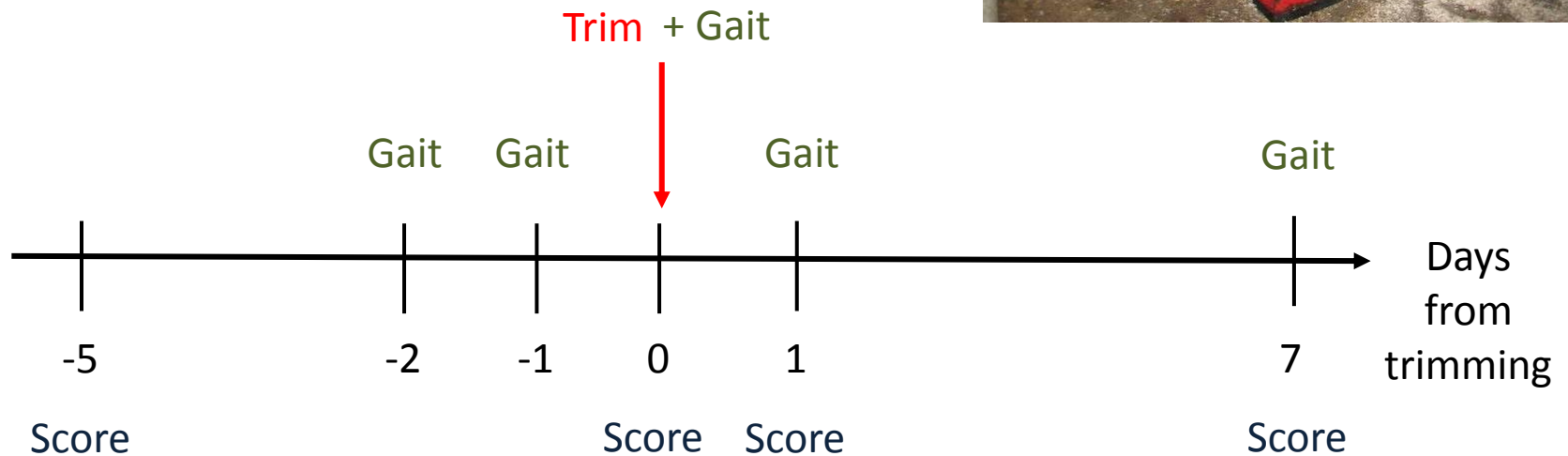DEPARTMENT OF ANIMAL SCIENCE

Materials

- 9 Danish Holstein cows

- Primi- and multiparous cows

- 5 healthy and 4 lame cows

- 36 $\pm$ 13 days after calving

- 39 $\pm$ 5 kg ECM/day

Experimental protocol

Lameness scoring = Score

Claw trimming = Trim

Gait measurement = Gait

Trim + Gait

Gait   Gait   Gait   Gait

-5   -2   -1   0   1   7   Days from trimming

Score   Score Score   Score

Gait measurement

3D strain gauge force plates,

0.46 x 2.07 m^2, Bertec, OH

Left force plate
Right force plate

Walking direction →

Horizontal force example

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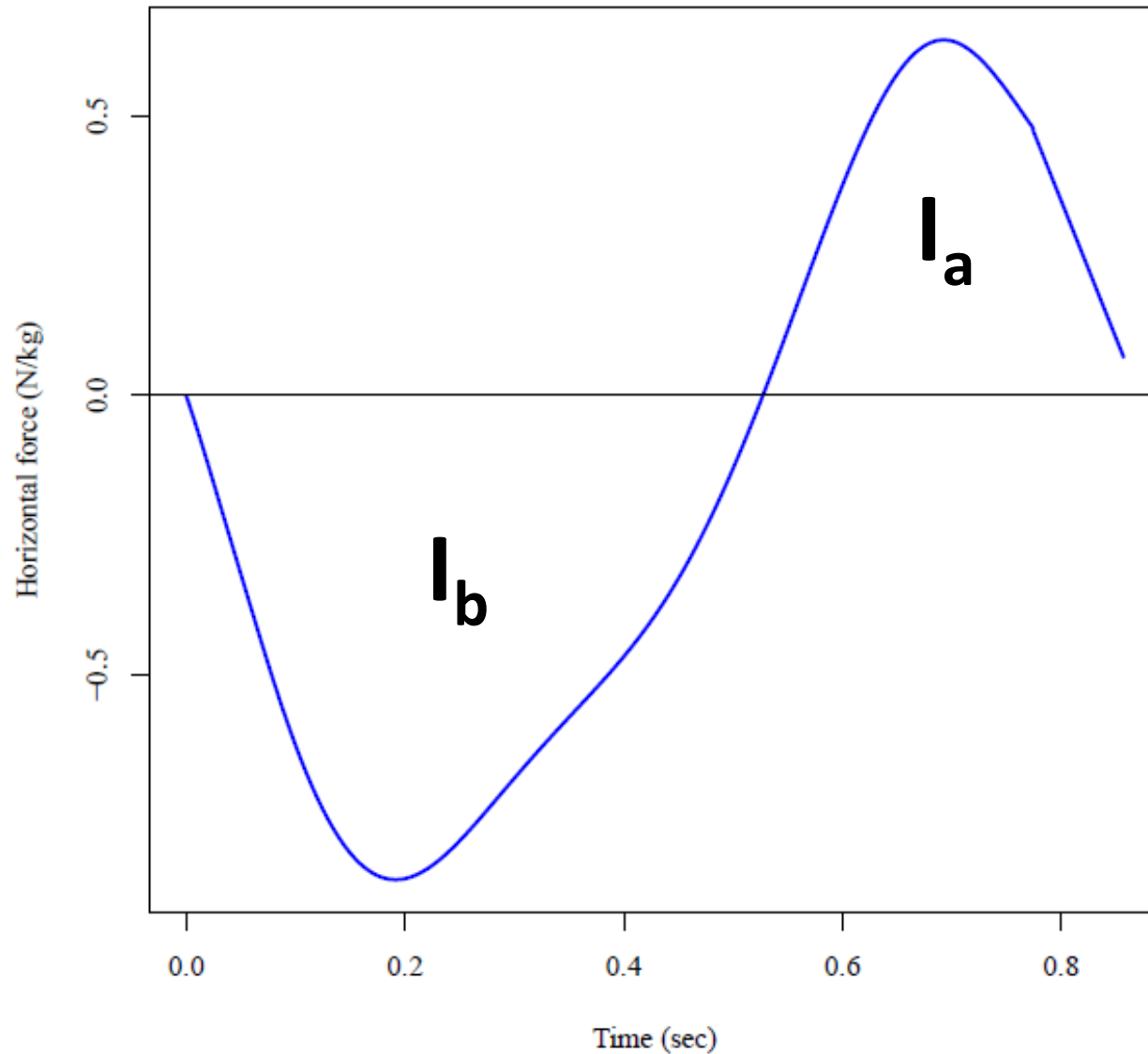
Analysis

Left/right symmetry index:

$$100 \times \min(P_R, P_L)/\max(P_R, P_L)$$

Mixed model:
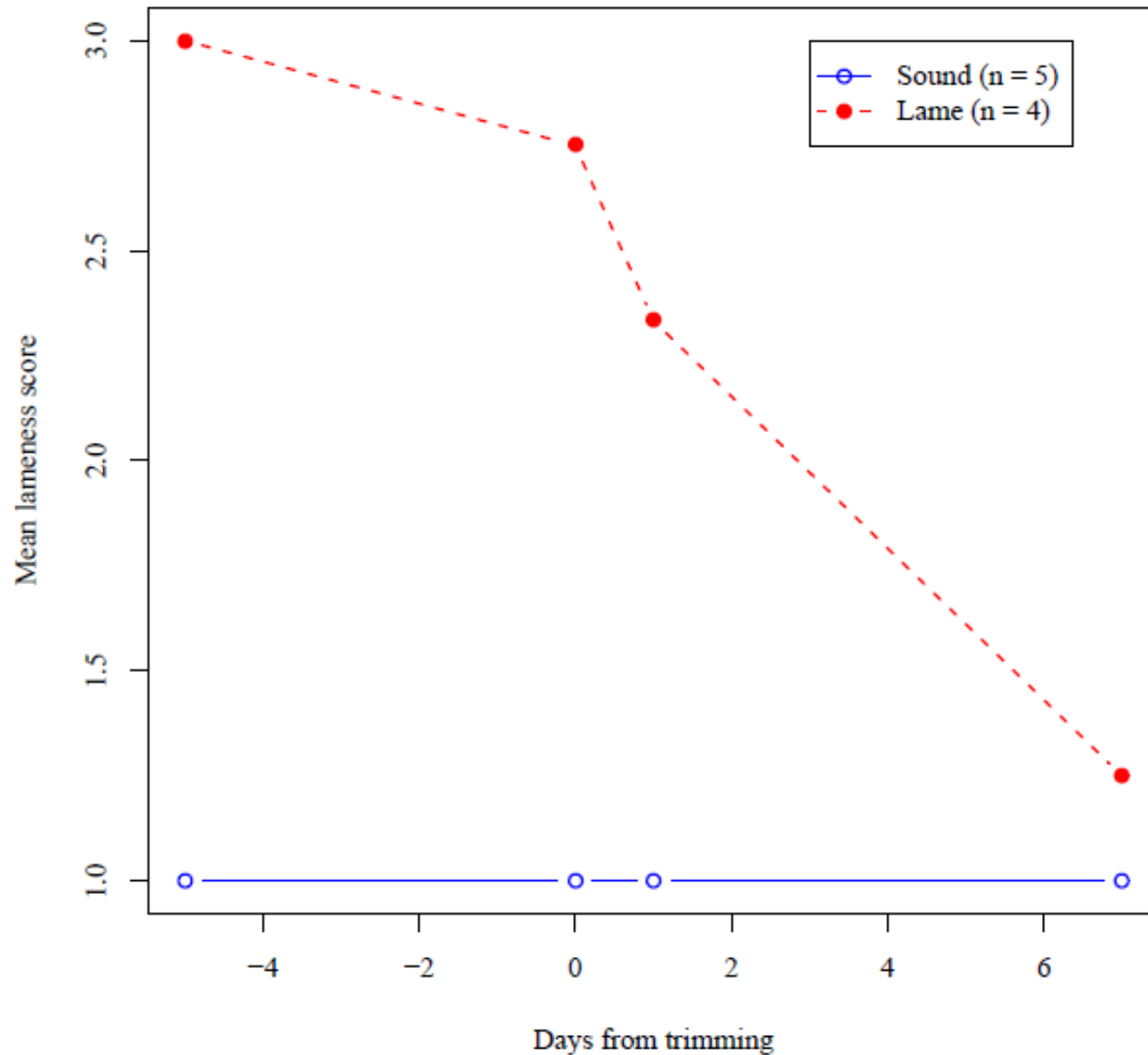
$$Y_{ijk} = \mu + \text{score}_i + \text{trimming}_j + \text{COW}_k + \varepsilon_{ijk}$$

score (i = ≤2, 3)

trimming (j = before, shortly after, 1 week after)

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Results – lameness score

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Results – walking speed

Range: 0.82 to 2.00 m/s

Sound group: 1.35 $\pm$ 0.15 m/s

Lame group: 1.23 $\pm$ 0.15 m/s***

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Results – hind leg symmetry

Base : Score < 3, day 7, LSM (SE)

Parameter (%)	Base	Untrimmed	Lame
I_v	86.4 (2.8)	4.9 (3.5)	-9.1 (3.4)**
I_b	66.9 (6.9)	1.3 (7.4)	-4.8 (7.8)
I_a	70.6 (5.5)	12.5 (6.3)*	-7.7 (6.4)

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Results – front leg symmetry

Parameter (%)	Base	Untrimmed	Lame
I_v	87.7 (3.2)	2.4 (4.2)	-1.8 (3.5)
I_b	73.5 (4.0)	7.1 (5.0)	-2.8 (4.7)
I_a	67.1 (6.8)	-2.6 (7.8)	12.1 (8.0)

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Conclusions

1. Trimming decreases lameness score
2. Trimming decreases symmetry (why?)
3. Lameness decreases symmetry

- Normal cows exhibit < 100% symmetry
- 3D forces enable a wider panel of parameters for lameness detection (than vertical force alone)

Future perspectives

- Examine a larger dataset, including severely lame cows , i.e. score 4 (and 5)

- Longitudinal experiment across lactation

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Questions?

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