Stiftung Tierärztliche Hochschule Hannover
University of Veterinary Medicine Hannover, Foundation

EAAP Annual Meeting 2018

Sound Hooves: Detection of lameness in dairy cows by acoustic analysis

N. Volkmann[1], B. Kulig[2], N. Kemper[1]

[1]Institute for Animal Hygiene, Animal Welfare and Farm Animal Behaviour
[2]Section of Agricultural and Biosystems Engineering; University of Kassel

Dubrovnik, 29.08.2018

Introduction

- **Detection of lameness = important indicator for animal welfare!**
- **Currently:**

  <u>No practical systems</u>

  for an early and automated diagnosis of lameness!

Introduction

Claw lesion

→ Pain

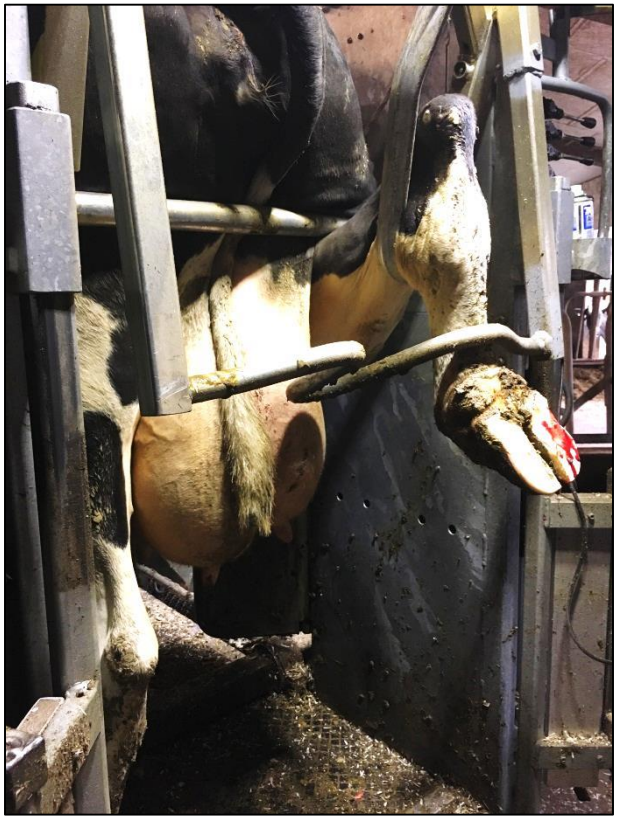
→ Altered weight distribution

→ Shorter and careful steps

(NEVEUX et al., 2006)

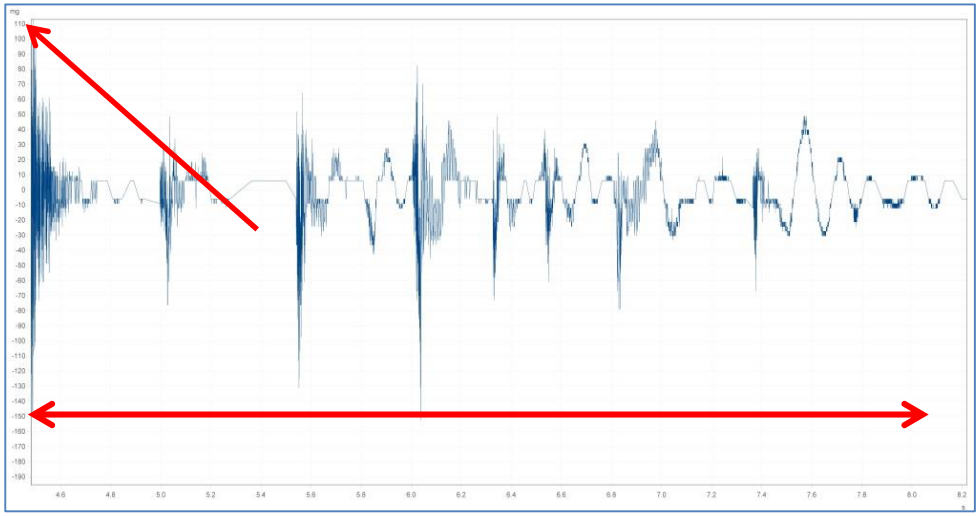
→ Systems working with weighing platforms or pressure sensitive walkways

(PASTELL et al., 2010; MAERTENS et al., 2011)



Aim

- Each step on solid surface produces a sound signal
- Signal differs between healthy/unhealthy claws



1. Duration:

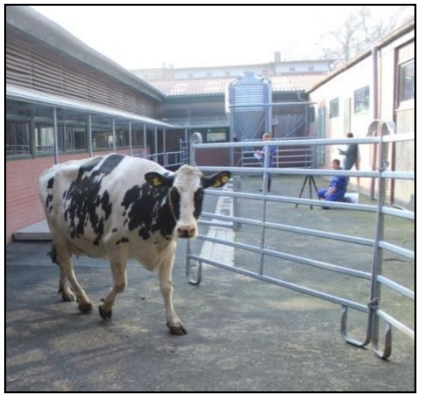
- Lame cows do not run!

2. Maximum Volumen:

- Lame cows do not do such powerful steps

Animals, material and methods

- 77 lactating cows
  - Group 1: slatted floor, milking robot
  - Group 2: deep straw, milking parlor

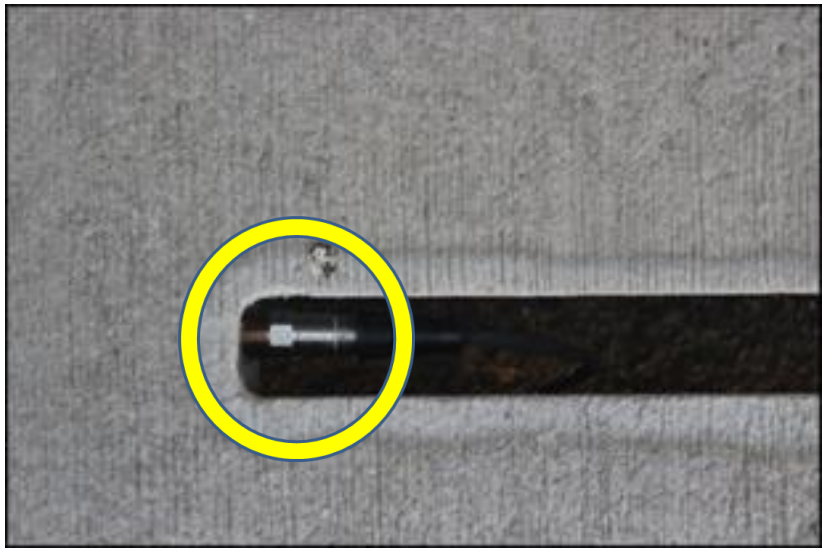


- Alley with parts of slatted floor
- Cameras for sideview and on the limbs
- Animal weigh scale

Animals, material and methods

Piezoelectric Sensors:

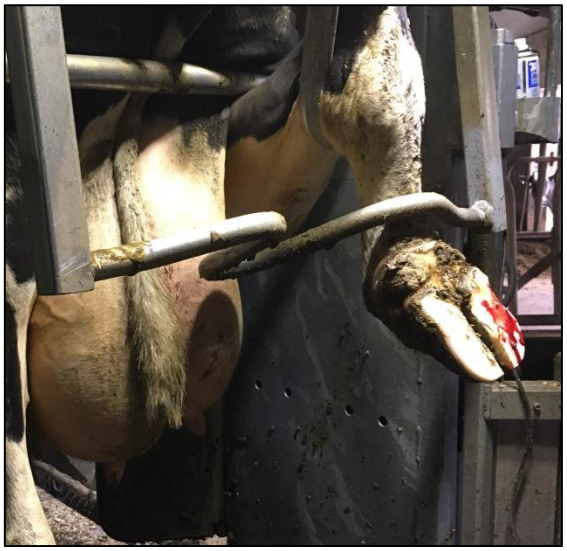
- **Measurement of changes in pressure, strain or vibration and converting them to an electrical charge**
- **In this case:**
  Recording
  sound pressure (dB) !



Animals, material and methods

Locomotion scoring

- **LS0 = non-lame**
- **LS1 = lame**



Claw lesions at hoof trimming

- **Groups of diseases**
  - **0 = none**
  - **1 = non-infectious**
  - **2 = infectious**
  - **3 = both (infectious and non-infectious)**

Animals, material and methods

Parameters:

1. **Duration of walking on the section of measuring (WS)**
2. **Standard deviation of volume in the recorded signal (StDevLoud)**

Statistics:

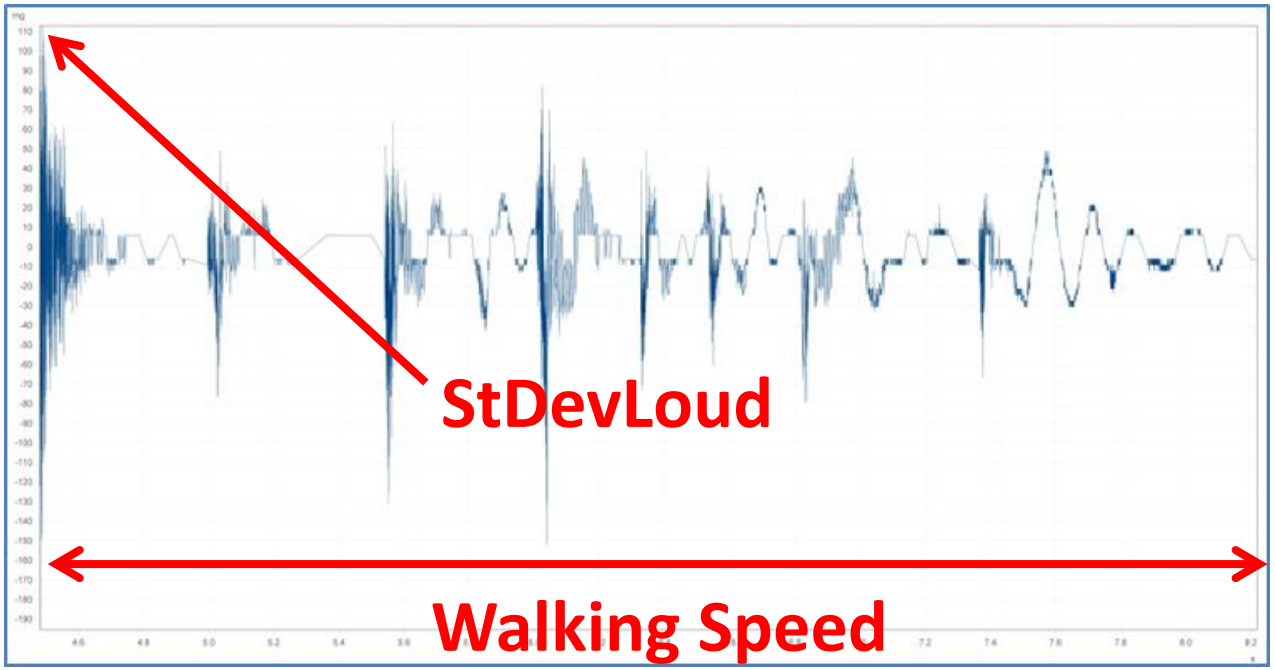
SAS 9.4 (SAS INSTITUTE, 1999)

Comparison of means (PROC TTEST; PROC GLM)

Results

Results

Results



Results

Variable	mean	min	max	STD
WS (s)	3.71	2.12	5.82	0.78
StDevLoud (dB)	0.019	0.009	0.049	0.007

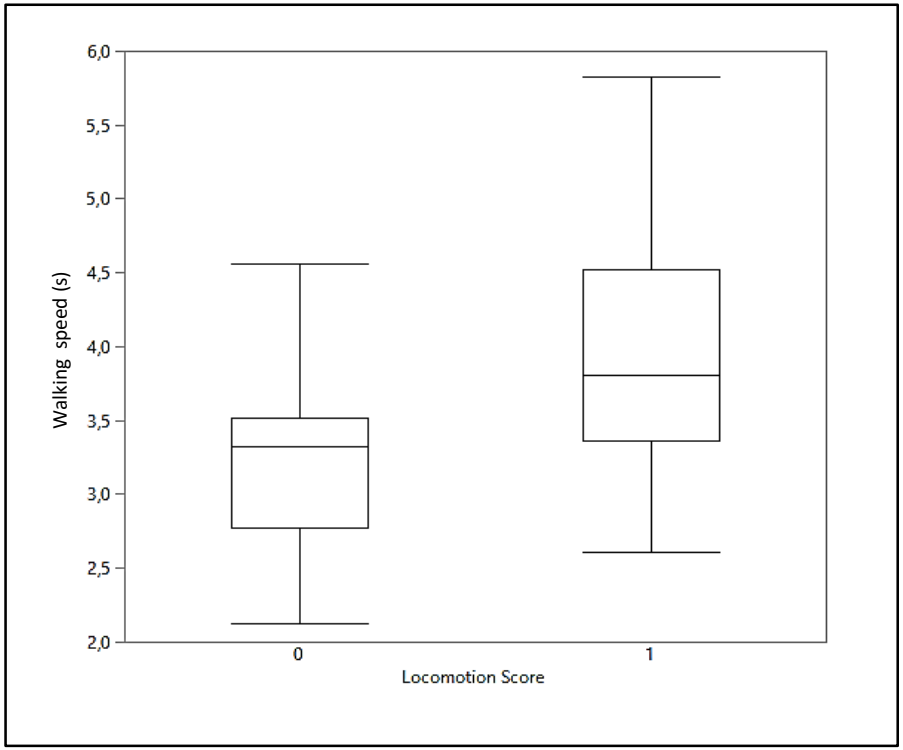
Analysed factors (P-values):

	Locomotion Score	Group of diseases	Type of pen	Weight
WS	< 0.0001	0.0812	0.5863	0.1829
StDevLoud	0.0010	0.0430	0.3120	0.5711

Results

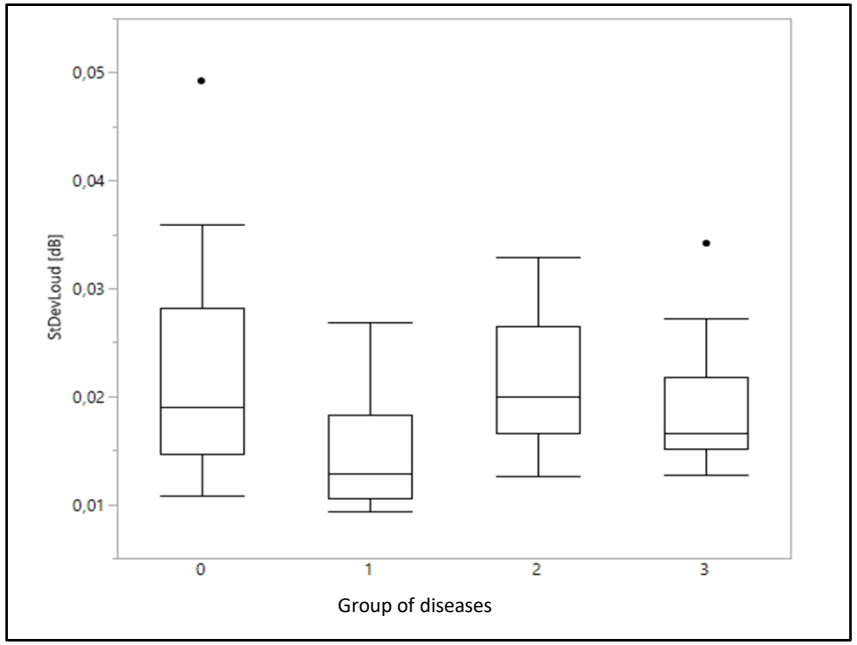
- **Mean WS was faster in cows with LS0 (non-lame) compared with score LS1 (lame)**

- **Conformation of LS: Cows with a smoother and quicker gait pattern got the lower score (FLOWER et al., 2006)**



Results

- **Significant difference of volume (STDevLoud) between healthy animals (Group 0) and those with non-infectious diseases (Group 1)**



- **Cows with non-infectious diseases have a greater sensitivity to pain** **(PASSOS et al. , 2017)**

Conclusions

- **Walking speed allows to draw conclusions to a smooth gait pattern. But: caution is required when using speed for lameness detection!**

- **If standard deviation of volume in the recorded signal (StDevLoud) can be interpreted as a variable for weight load of footsteps…**

- **…first results clearly show the potential of walking sound analysis for lameness detection.**

Outlook

- Recordings in the regular environment of the cows
- Testing of other factors (e.g. pollution of the claws)
- Clearer description of the sound signal
  - Number of steps
  - Stride duration and length
- Allocation of the sound to the individual limb
- Development of an individual (healthy) pattern for each cow

Thank you for your attention!

With support from

Federal Ministry of Food and Agriculture

ptble
Projektträger Bundesanstalt für Landwirtschaft und Ernährung

by decision of the German Bundestag

The project is supported by funds of the Federal Ministry of Food and Agriculture (BMEL) based on a decision of the Parliament of the Federal Republic of Germany via the federal Office for Agriculture and Food (BLE) under the innovation support programme.

Ökologische Agrarwissenschaften
UNIKASSEL

Hölscher+Leuschner
Stallbau + Stalltechnik