Automated estimation of pose features in broilers using computer vision
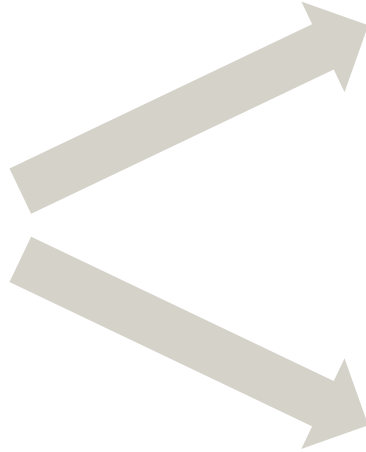
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Relevance

Health & welfare

Affects 14-30% of broilers[1]

Economics

Losses, e.g. culling, mortality, carcass condemnation[2,3]

Images: https://www.thepoultrysite.com/articles/leg-health-in-large-broilers, Kapakin et al. (2019)

[1] Kittelsen et al. (2017), [2] Mendes et al. (2016), [3] Sanotra et al. (2001)

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Precision phenotyping

Gait scoring

- Subjective
- Labour-intensive
- Low throughput

Sensor-based

- Objective
- Less labour-intensive
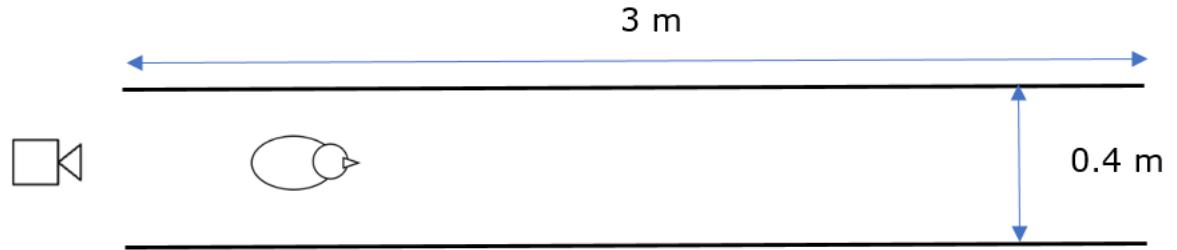- Potentially high throughput

Aim

- Analyse pose features of individual broilers across ages using video in a pilot study

  → How the setup works

  → Utility of features

  → Age differences

  → (Relationship with gait)

Materials and methods

Setup

Intel® RealSense™
Depth Camera D415 (2D RGB)

- Individually tagged ♂, same cross
- D14 (n=109), D21 (n=108), D33 (n=87)
- Body weight

Materials and methods

Keypoints

Pre-trained model

DeepLabCut:
a software package for
animal pose estimation

Doornweerd
et al. (2021)

New environment

- Illumination
- Drinkers
- Other chickens

Novel video analysis

Spline filter

Dynamic cropping (D14)

Re-training

181 frames

100k iterations, 4.0 px test error

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Materials and methods

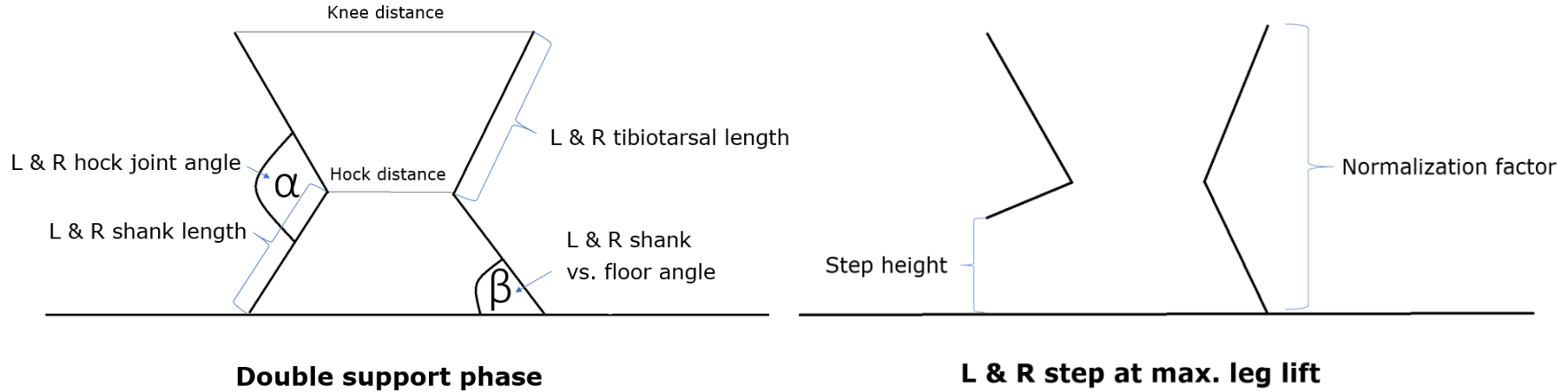*Automated pose extraction*

- 2 poses of interest:

  - Double support

  - Max. leg lift at step (L & R)

- Pose extraction:

  - Keypoint (x, y) coordinates by frame
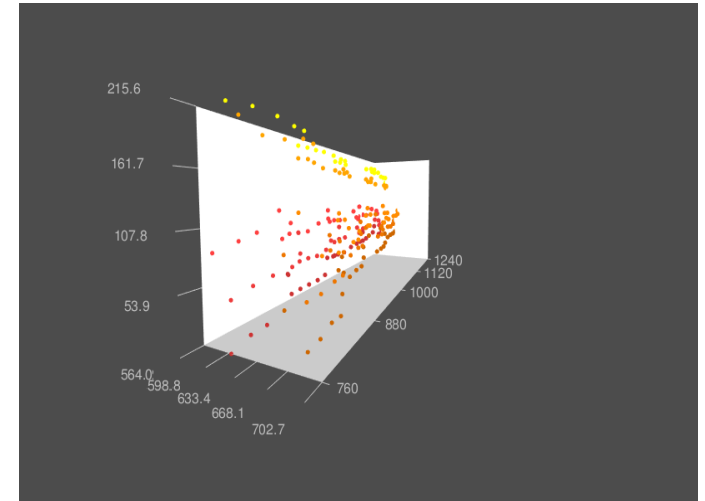
Materials and methods

Pose features

11 features (legs only, L & R separate features)

Knee distance

L & R hock joint angle

Hock distance

L & R tibiotarsal length

L & R shank length

α

L & R shank
vs. floor angle

β

Double support phase

Step height

Normalization factor

L & R step at max. leg lift

Pose feature comparisons:

- Age groups
- Gait (normal vs. impaired)

Controlled for
BW differences

Results

Limited extra training → adapted to new environment

**Pre-trained model
in new environment**

**After limited
extra training**

Results

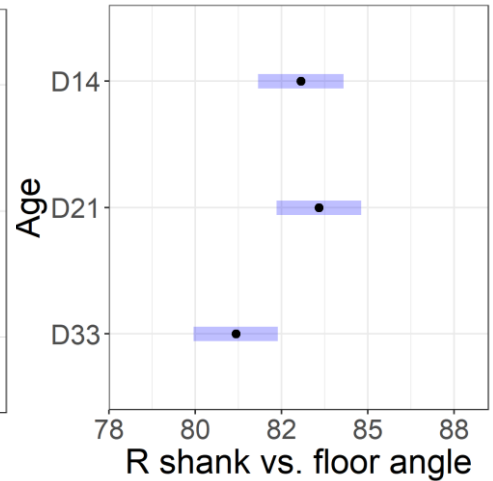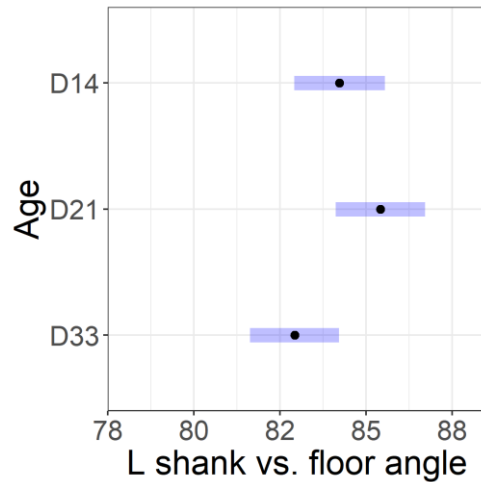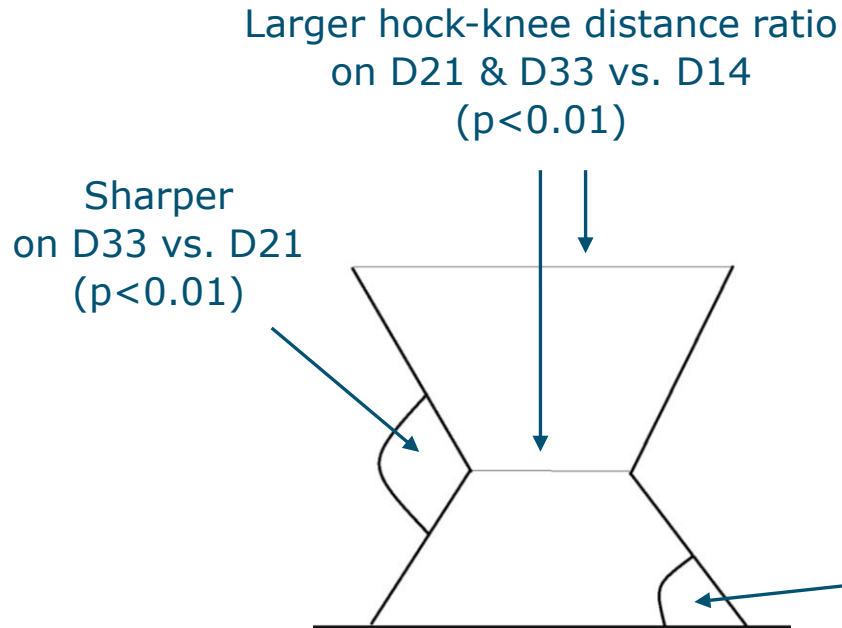*Automated pose extraction is feasible*

D14

D33

Results

Few differences by age

Larger hock-knee distance ratio
on D21 & D33 vs. D14
(p<0.01)

Sharper
on D33 vs. D21
(p<0.01)
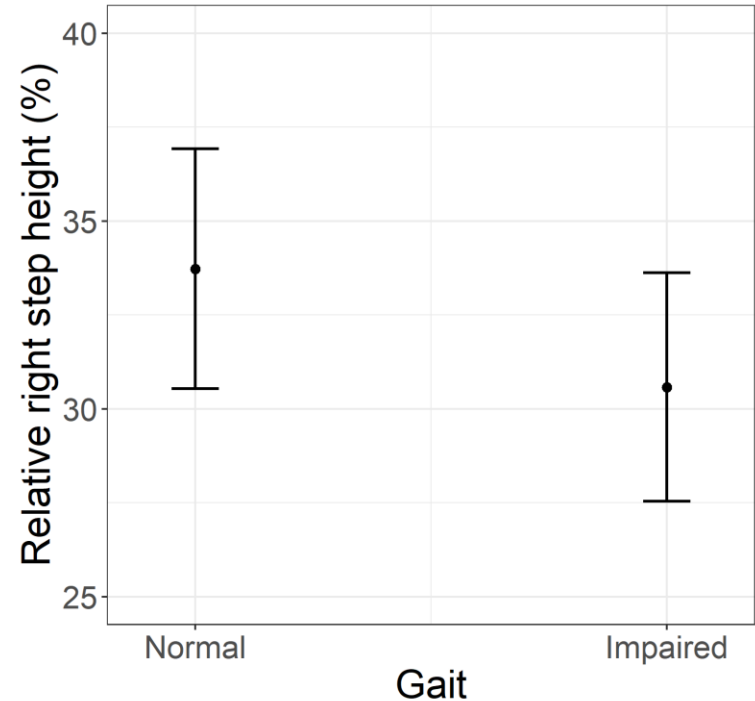

Sharper on D33 vs. D21 (p<0.05)

Preliminary results

Association with gait scores

- Gait scoring on D33: scale 0-2[1]

- Score 0: normal (46.4%)

- Score 1 & 2: impaired (53.6%)

- E.g. leg lift ≈10% lower

[1] Webster et al. (2008)

Conclusions

- Adapt pre-trained model to new environment

    ← Limited No. of frames

- Most informative in this setup:

    o Angles

    o Hock-knee distance ratio

    o Step height

    → Add to candidate features of leg health

- Follow-up studies & upscaling needed

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Thank you!

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