Automatic lameness detection in sows using the Sow Stance Information System (SowSIS), a pilot study

P. Briene, O. Szczodry, P. De Geest, A. Van Nuffel, J. Vangeyte, B. Ampe, S. Millet, F. Tuyttens, J. Maselyne

petra.briene@ilvo.vlaanderen.be

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Royal Veterinary College

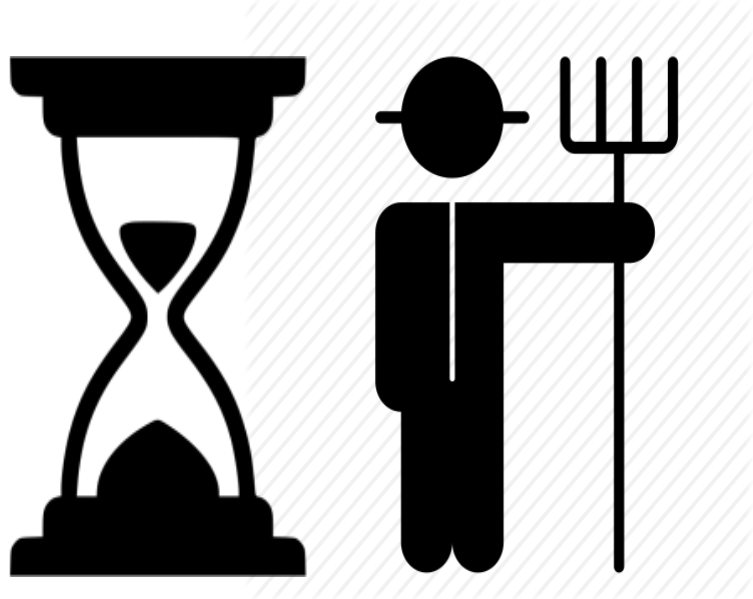
Why detect lameness in sows?

- High prevalence (8-22%)
- Painful and stressful: Animal welfare ↓
- Fertility and production ↓
- Risk of early culling ↑
- Costs ↑
- Difficult to detect visually

Why is lameness difficult to detect?

Sows rest most of the day

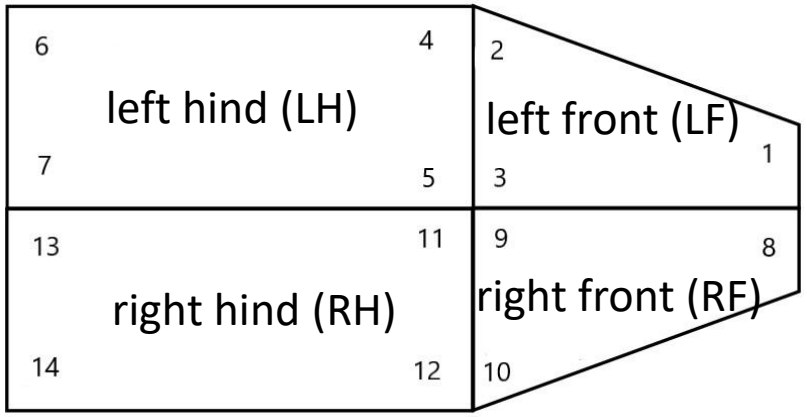
Pigs hide lameness



Time consuming and subjective

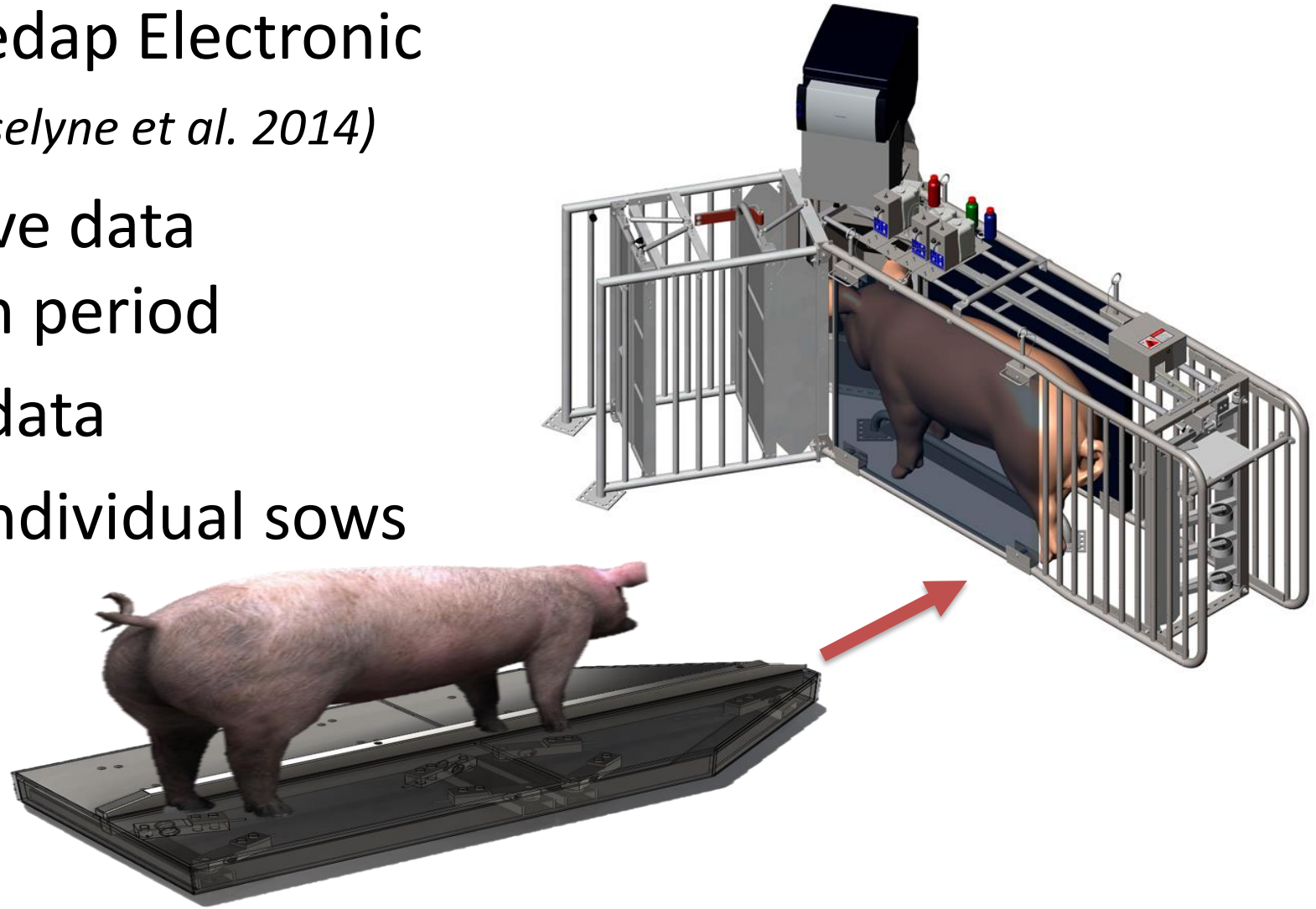
Automatic lameness detection: SowSIS

- Developed at ILVO (*Pluym et al. 2013)*
- Force plate system: plate per leg
- Multiple load cell-mounting
- Data output in kg per leg



SowSIS

- Adapted to fit into Nedap Electronic Sow Feeder (ESF) *(Maselyne et al. 2014)*
- Non-invasive, objective data collection in gestation period
- ESF Sow ID linked to data
- Daily stance data of individual sows during feeding visits



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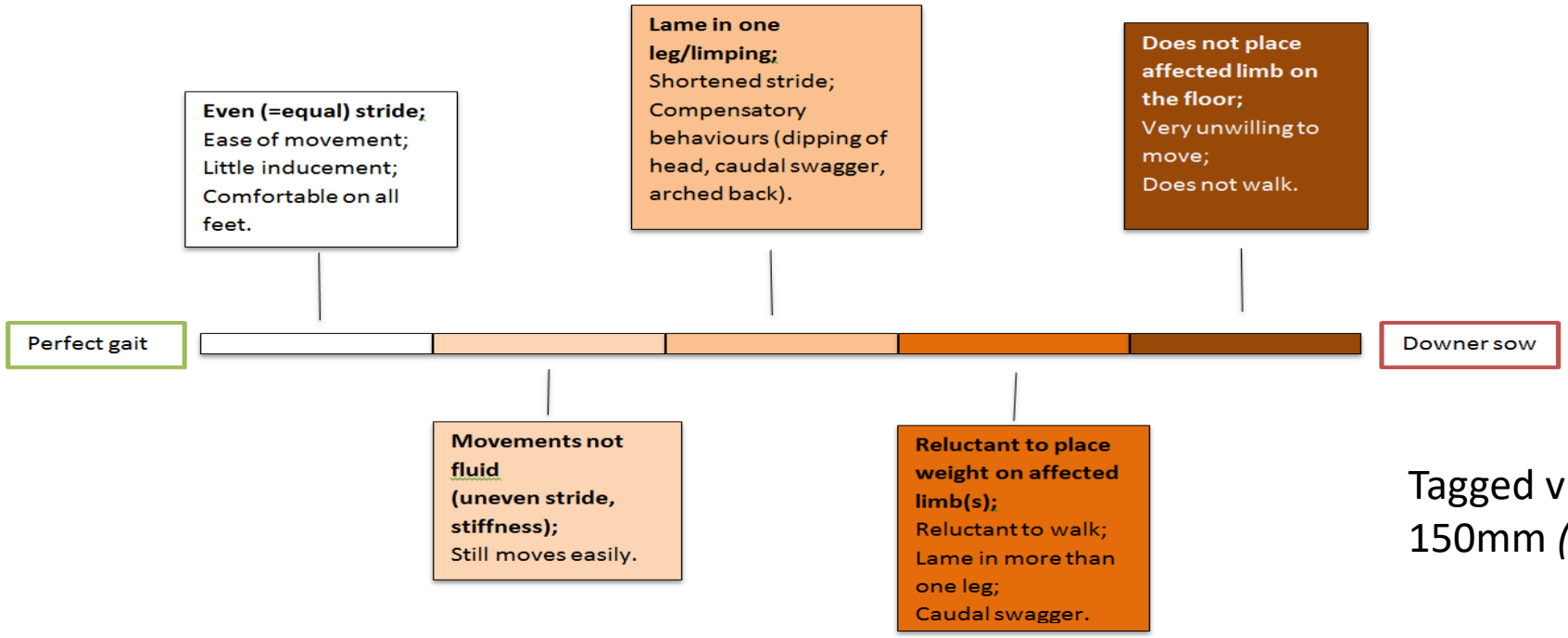
Reference data: visual gait score



Tagged visual analog scale 150mm *(Nalon et al. 2013)*

- Standard for lameness: >60 mm is lame
- Gait scores obtained 2x/week by trained observer (sows walk freely in corridor)
- Period December 2017 – May 2018, 3 groups, 53 sows

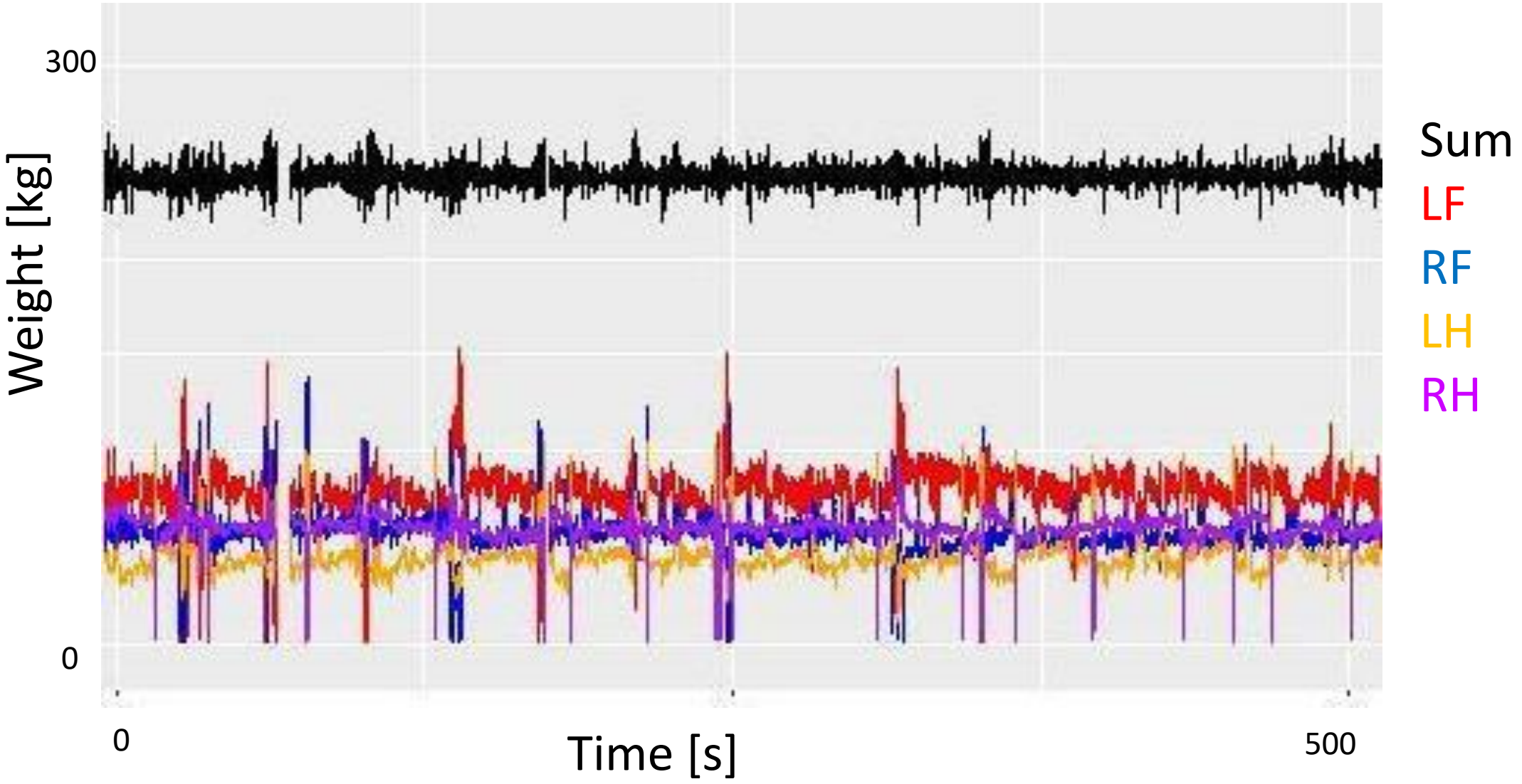
Data processing

- 1) Link ESF data to SowSIS data → obtain Sow IDs
- 2) Filter data
  - Remove errors
    - Remove data where a leg < than 10 kg for >10 sec
  - Remove non-feeding visits (< 5 min)
  - Clean data of small loose chunks
- 3) Calculate variables

Variables (> 200 options)

Variable	Description	Parameters
Absolute weight (kg)	Absolute weight per leg and the sum of all legs	Mean, min, max, SD, CV
Relative weight (%)	Weight of leg/sum of all legs*100	Mean, min, max, SD, CV
Leg weight ratio	Measurement of assymmetry of weight distribution. Lightest leg/heaviest leg for each pair of legs (Left, Right, Front, Hind, Diagonal left and Diagonal right)	Mean, min, max, SD, CV
Number of kicks	Number of times a sow lifts her leg and weight falls below 10 kg, if duration <3 seconds	Total per leg and sum of all legs
Frequency of kicks (kicks/min)	Number of kicks/duration of visit*60	Total per leg and sum of all legs
Duration of kicks (s)	Amount of time a kick lasts	Mean, min, max, SD, CV
Number of WS (weight shifts)	Number of times the weight of two legs deviate >10 kg from the mean of the leg, moving in opposite directions, if duration >1 second	Total per pair of legs and sum of all pairs
Frequency of WS (shifts/min)	Number of WS/duration of visit*60	Total per pair of legs and sum of all pairs
Duration of WS	Amount of time a WS lasts	Mean, min, max, SD, CV
Magnitude of WS	Sum of the mean difference per leg from the mean of each leg For all pairs of legs	Mean, min, max, SD, CV

Measurement of a sound sow



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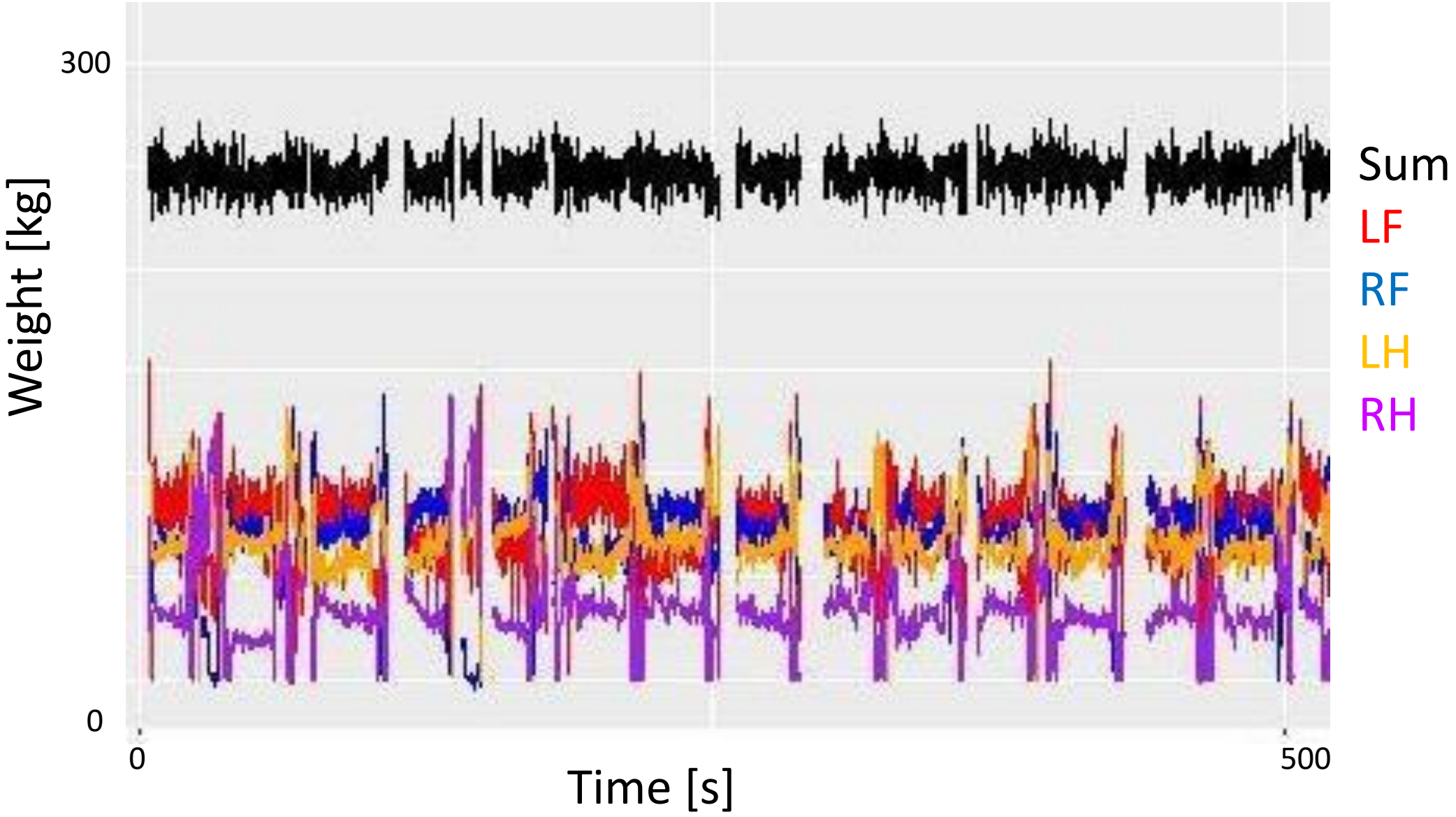
Measurement of a lame sow RH



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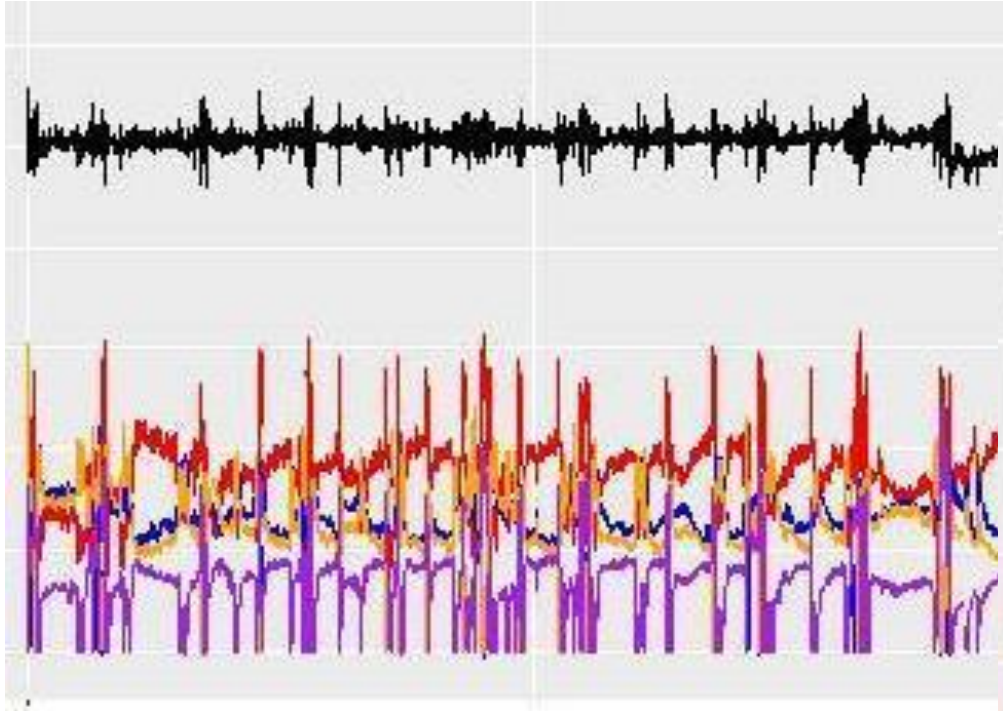
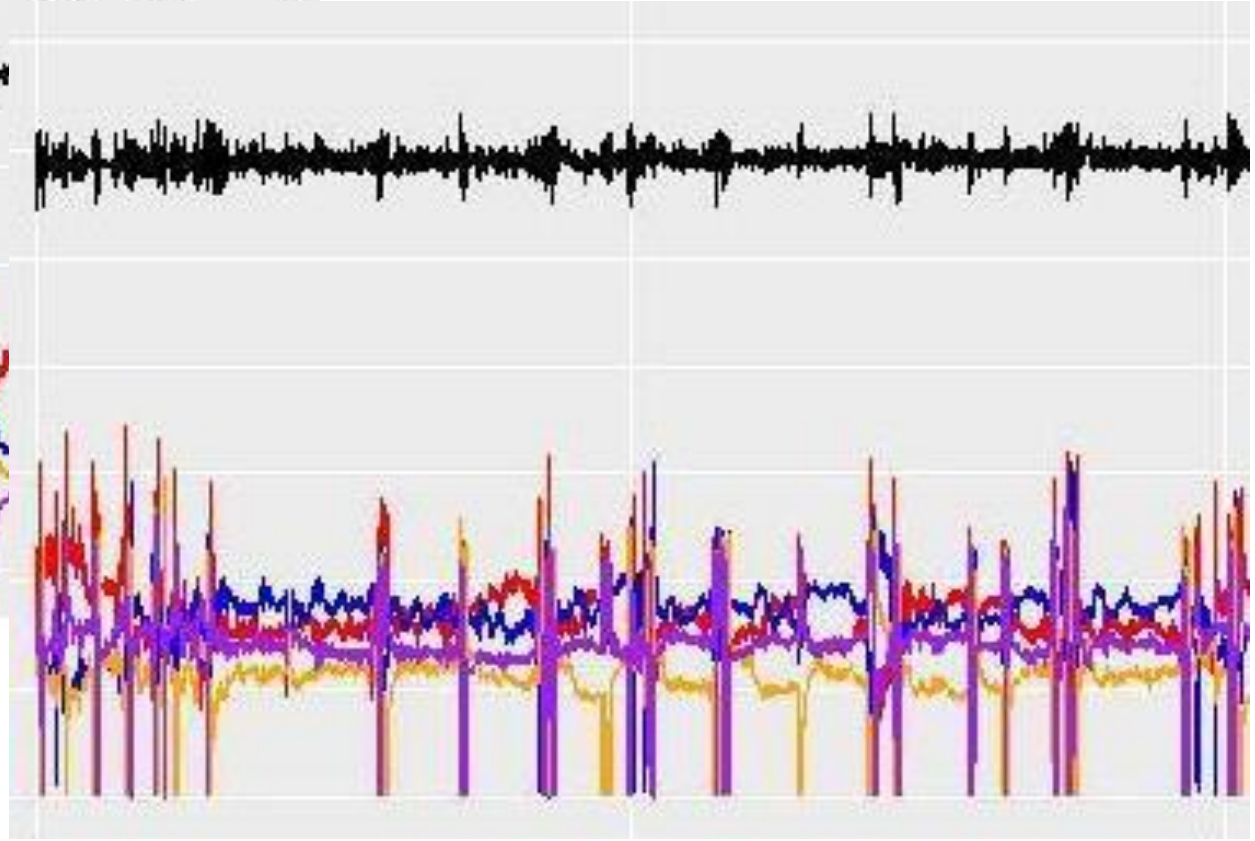
Measurement of a “mix” sow

- When lame on RH



- When sound



Analysis

- To test if the SowSIS can correctly identify lame sows
- Test **leg-independent** variables (36) of gait scoring days
- Multilevel linear regression
  - 1) univariably testing the influence of variables on Gait Score (GS)
  - 2) use significant variables in multivariable model to determine which variables to use in the final prediction model
  - Sow as random factor to correct for repeated measurements

Results

Variable	P-value univariable
Relative weight Left mean	0.005
Relative weight Left min	0.042
Relative weight Front max	0.021
Leg weight ratio all mean	0.0001
Kicks per minute all	0.002
Duration kicks all mean	0.021
Duration kicks all min	0.058
Duration kicks all CV	0.028
Shifts per minute all	0.002

Multivariable model

Variable	P	Effect
Relweight L mean	0.0061	+
Relweight L min	0.0099	+
LWR all mean	0.0019	-
Kicks per min all	0.0231	+

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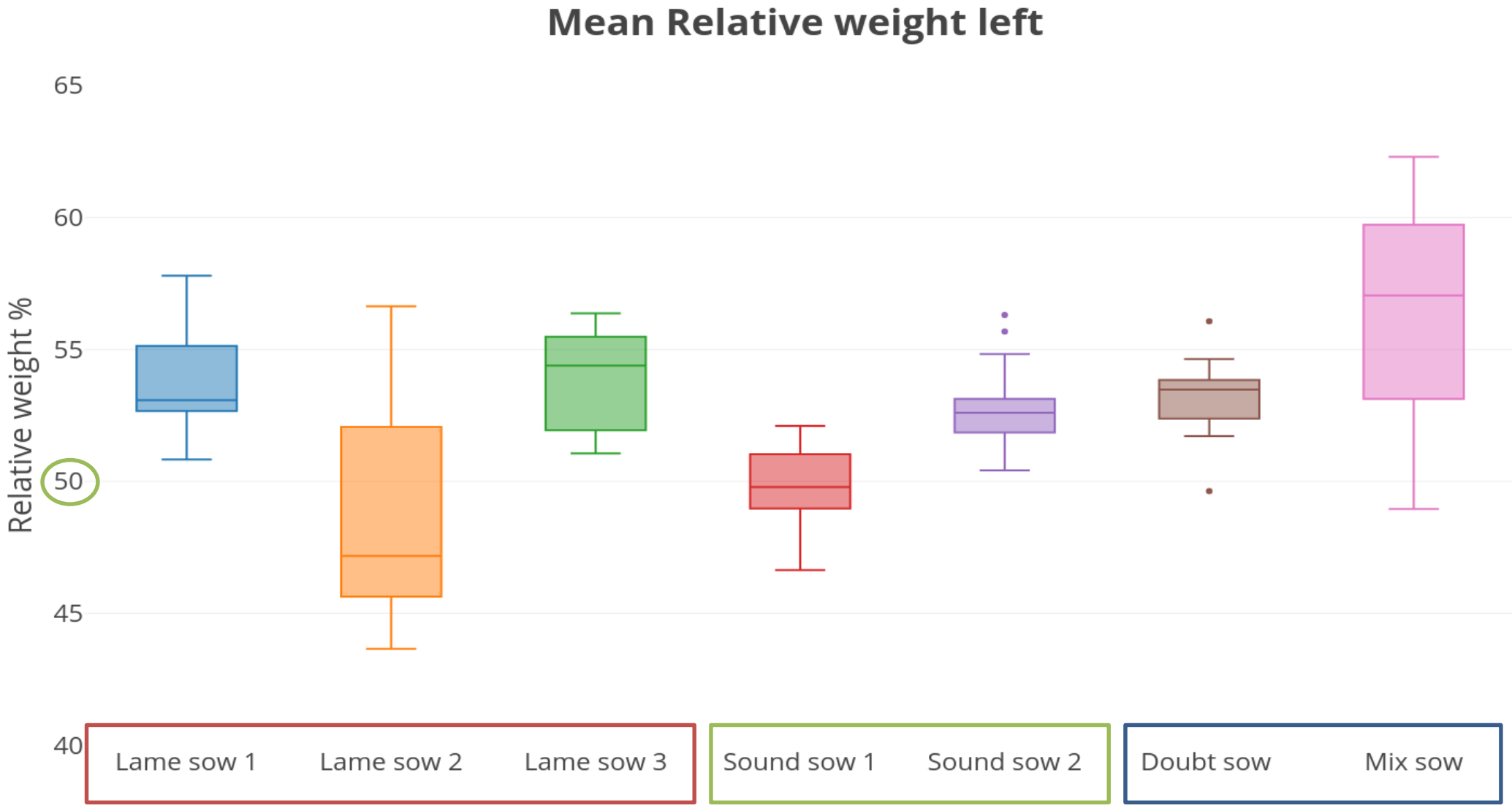
Individual variables



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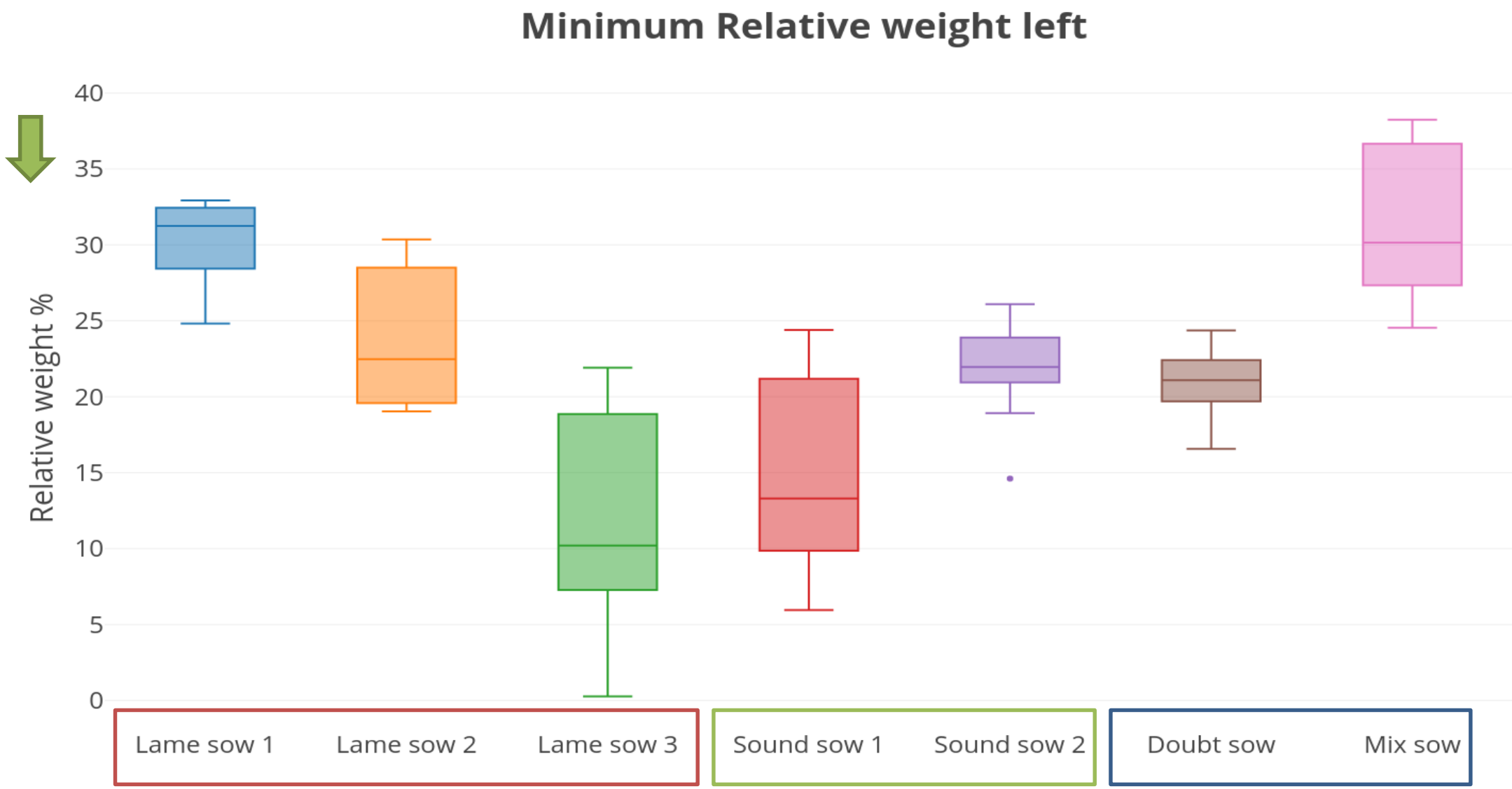
Results



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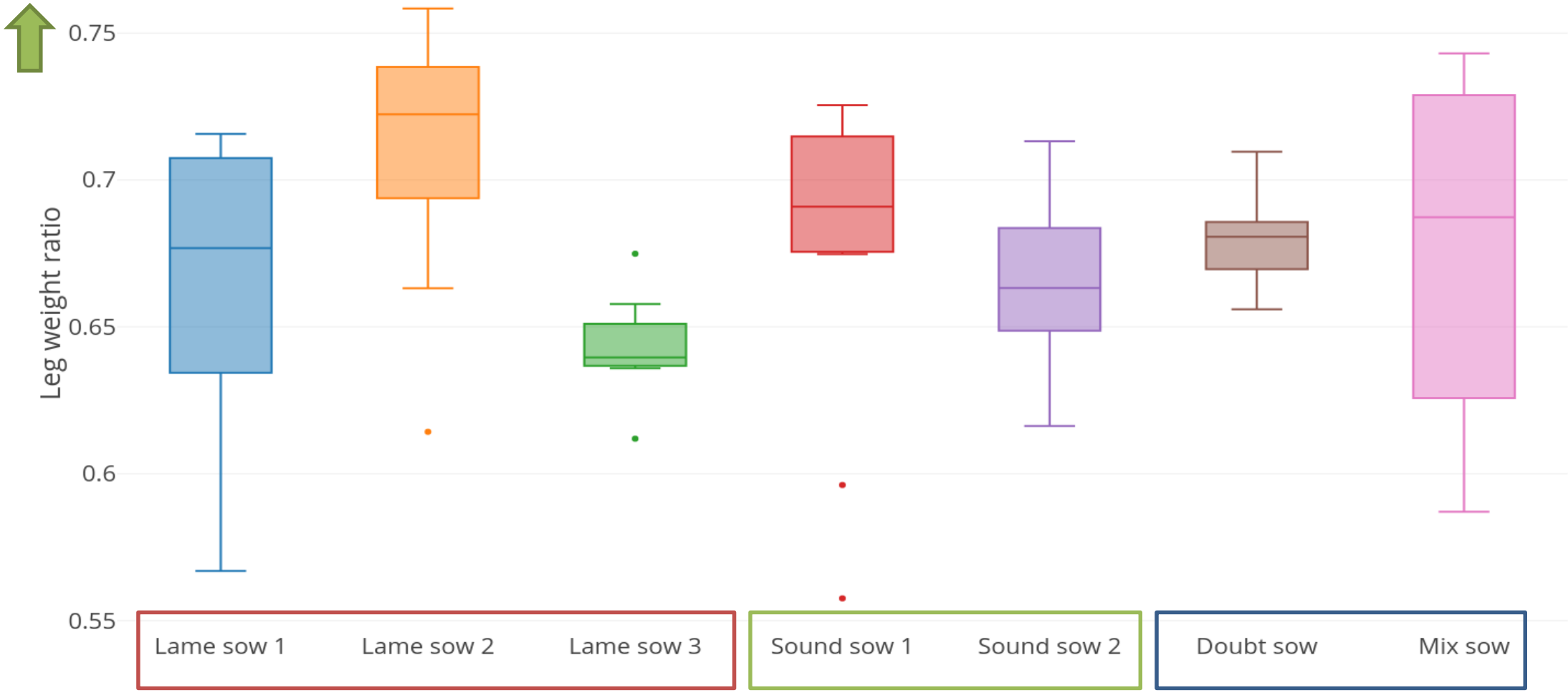
Results

Mean Leg Weight Ratio all legs



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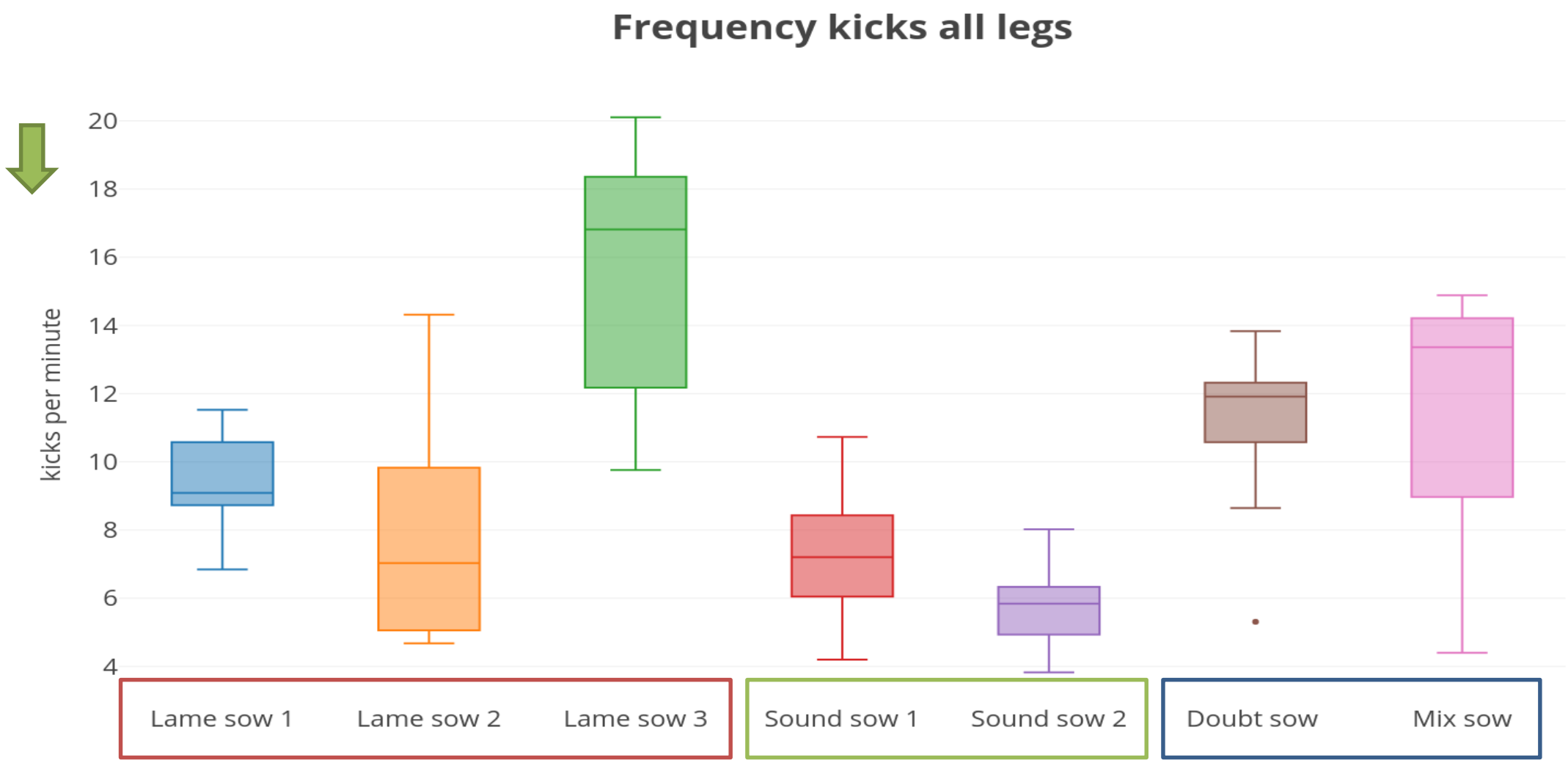
Results



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Discussion

- Individual variables don’t explain all lame individuals
  - Multi-variable model needed to classify lameness correctly
- Differences between and within lameness categories
  - Need for individual monitoring
  - Lameness can have multiple causes with different effects
  - Difference between lameness in motion and lameness in stance

(*Pluym et al. 2013; Conte et al. 2014)*

Future work

- Develop and test predictive models to correctly classify lameness
  - Improving variables, determine classification accuracy
  - Improve by adding rules, decision trees
- Develop and test predictive models to classify lame leg
- Develop and test predictive models based on time series of individual sows

Thank you!

Flanders Research Institute for
Agriculture, Fisheries and Food
Burg. Van Gansberghelaan 115 box 1
9820 Merelbeke – Belgium

Petra Briene
T + 32 (0)9 272 2754
petra.briene@ilvo.vlaanderen.be
www.ilvo.vlaanderen.be

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is agriculture and fisheries

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“See you in Ghent 2019”