Body Weight Prediction of Turkeys - From Walk to Mass

Jos Hageman,

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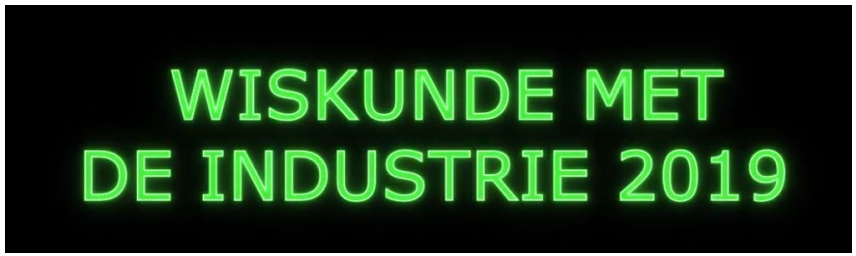
100years
1918 — 2018

Topic of SWI 2019

- **What is SWI?**
  The Study Group Mathematics with Industry (SWI) is a combined industrial–academic week-long workshop sponsored by NWO.
- Roughly seventy mathematicians work in groups on problems submitted by companies. Companies present a selection of problems on Monday.
- The participants devote the entire week to studying these problems in smaller groups, and presents their results on Friday.

SWI2019 Turkey Weight Team
Arjun Azadi
Javier Fernandez
Jos Hageman
Alexander Mey
Behrouz Raftari
Oliver Sheridan-Methven
Martin Stefanov
Yang Zhou
Elizabeth Zuniga
&
Bram Visser (HG)



Clip at: http://tiny.cc/gotoSWI

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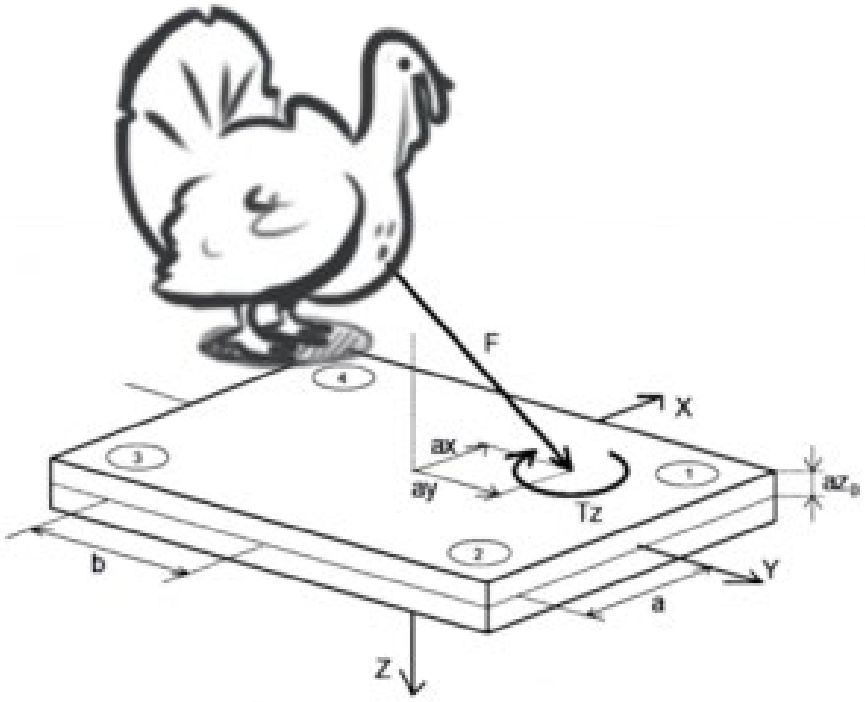
HENDRIX GENETICS

Turkey Body Weight Prediction

- Hendrix Genetics is a Dutch multi-species animal breeding, genetics and technology company
- One of the world's leading breeders and distributors of turkeys
- An important characteristic in turkey breeding is body weight.
- Interest is in a model that predicts turkey body weights using a force plate
- No more manually weighing the birds on a scale.

Challenge

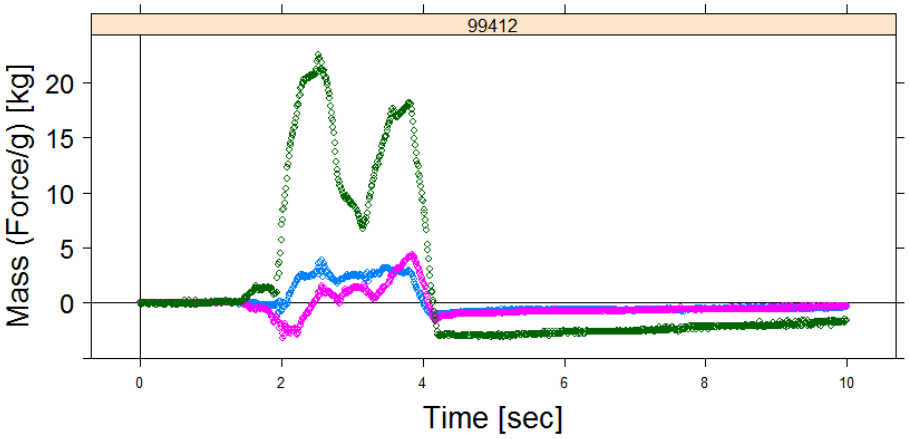
- develop an innovative model to predict body weight and maybe other features from the plate measurements

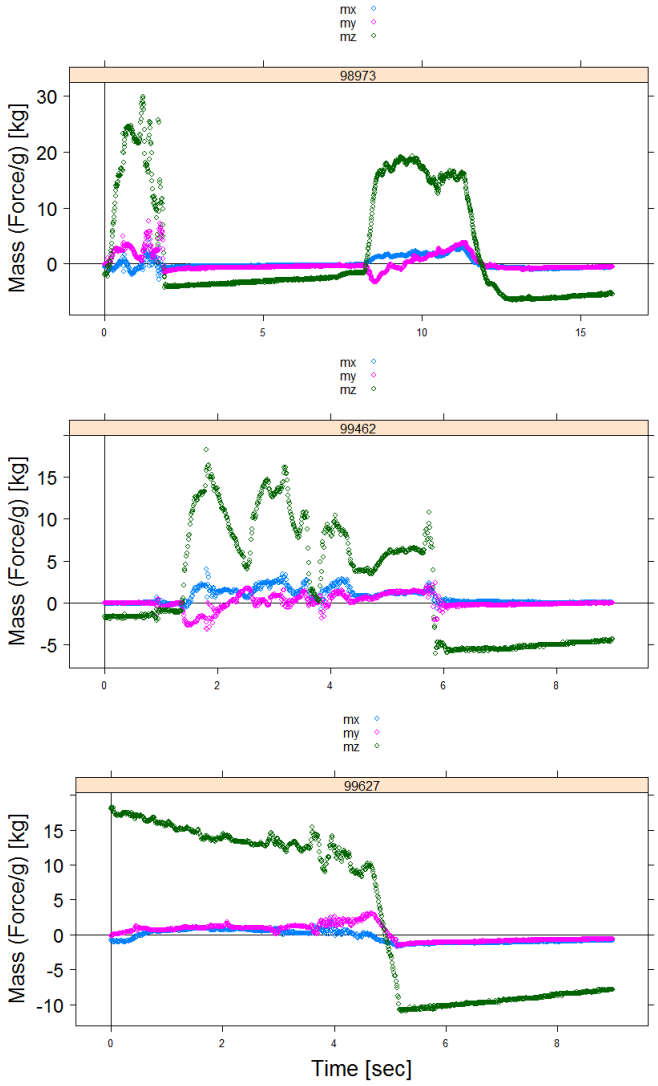


The data

- ~200 turkeys from 2 bloodlines were walked individually through a corridor in which a force plate was placed.
- 8 force plate output voltages were captured
    - ~15 seconds at 100 Hz,
- Actual body weight of the birds was measured using a scale.

The data

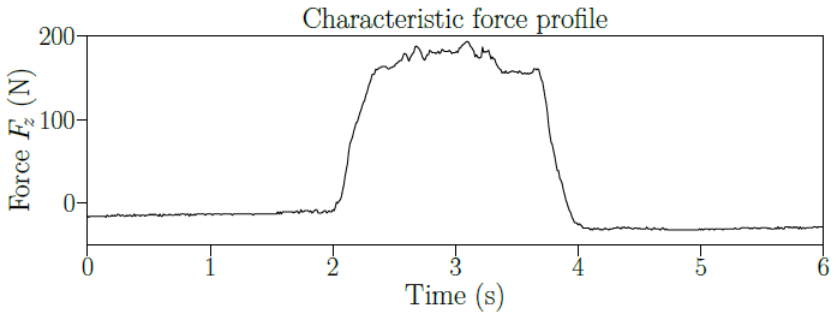




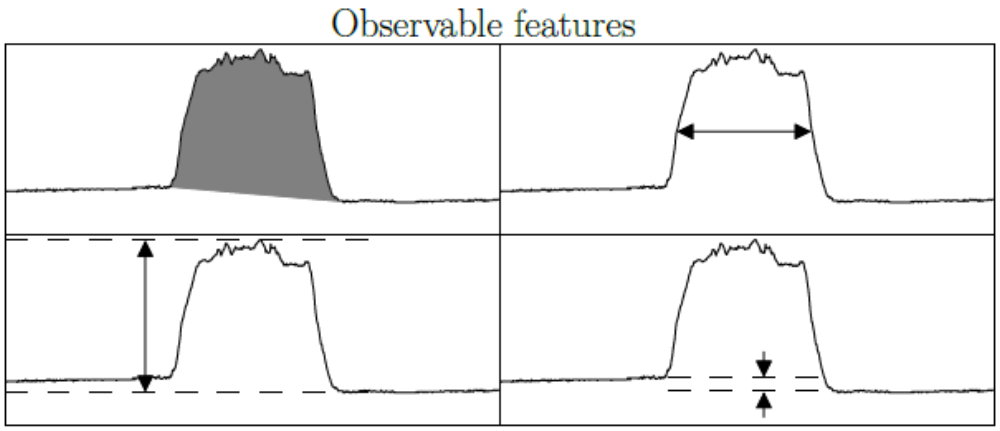
- 8 signals, line and weights of 183 turkeys
- Removed incomplete or bizarre time series
- Kept the data of 165 turkeys

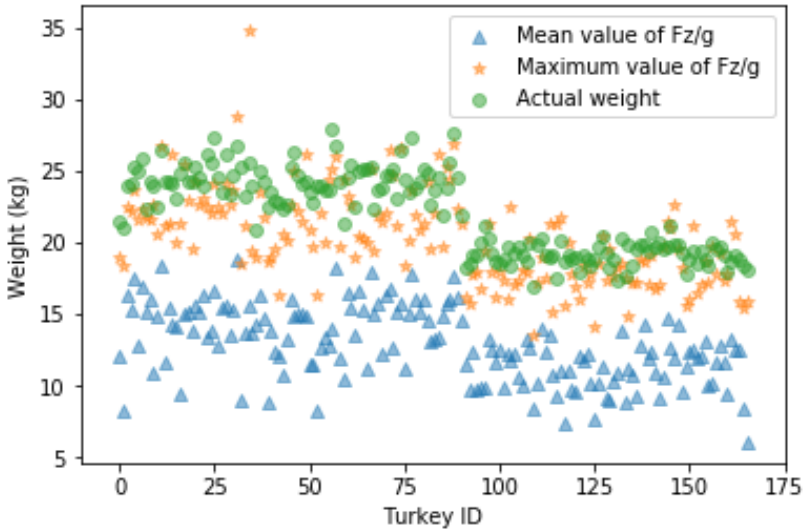
Approaches

- Forces in X, Y, Z direction
  - Mass ~ Z-Forces / g
  - Jumping?



- Feature extraction





Methods

- Statistics / Machine Learning
  - Multiple linear regression
  - Random Forests
  - Bayesian Hypothesis testing
    - Updated learning with each pass over pressure plate
  - Sparse Bayesian GLM
  - …
  - …
  - …

Conclusions

- Performance for different models comparable
  - Large error ~ RMSE 0.96 - 1.1 kg
- Preprocessing important
- Feature extraction most influential
  - Fz is most important, other features give only marginal improvements

Next steps

- Insights in use of pressure plate
  - For same animal
    - repeated walks
    - Standing still (if possible)
    - Info on walk itself (fast, slow, etc)
- Insight into signals for better feature extraction
  - Better preprocessing