Turkey gait score measured with sensors

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WAGENINGEN
UNIVERSITY & RESEARCH

100years
1918 — 2018

Acknowledgement

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Importance locomotion

- Good locomotion is important for
  - Performance
  - Longevity
  - Welfare
- Improve locomotion
  - Through breeding & herd management
  - Using sensor technology

Hypotheses

Sensor data can be used to estimate locomotion phenotypes with high accuracy

Sensors can provide low cost, high quality and scalable locomotion phenotypes

Questions

- Which sensors?
- Accuracies?
- Costs?
- Practical feasibility?

Pilot in turkey

- Good routine gait scoring in place
- Selection candidates
- Scored one-by-one

Turkey gait scoring

- Human observer
- Labour intensive
- Subjective
- Once in a life-time / temporal

Turkey gait scoring

- Human observer
- Labour intensive
- Subjective
- Once in a life-time / temporal
  - Repeatable
  - Heritable
  - Golden standard
  - Selection

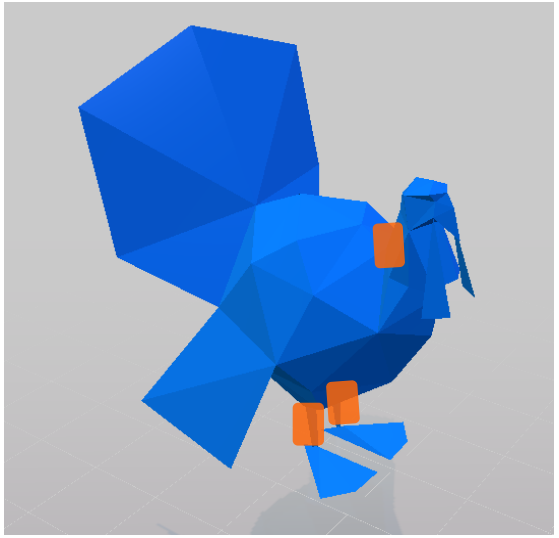
Pilot study

- 2 days
- 100 birds/day
- During routine locomotion scoring
- 3 different types of sensors at same time
- Different sensor placement on each day
- Human score as golden standard

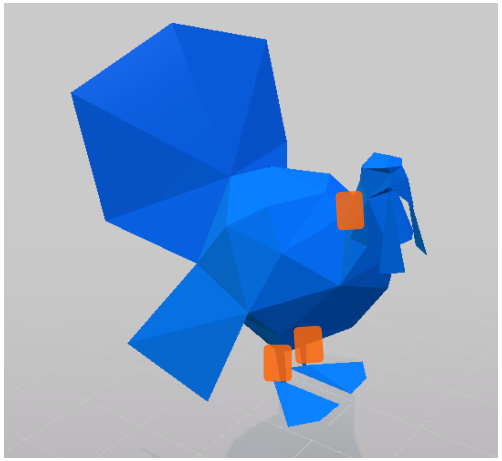
IMU

- 3 Inertial Measurement Units per bird
- One on neck, one on each leg
- 9 variables per IMU
  - Acceleration X, Y, Z
  - Angle X, Y, Z
  - Magnetic X, Y, Z

Size: 47 mm × 30 mm × 13 mm
Weight: 16 gram



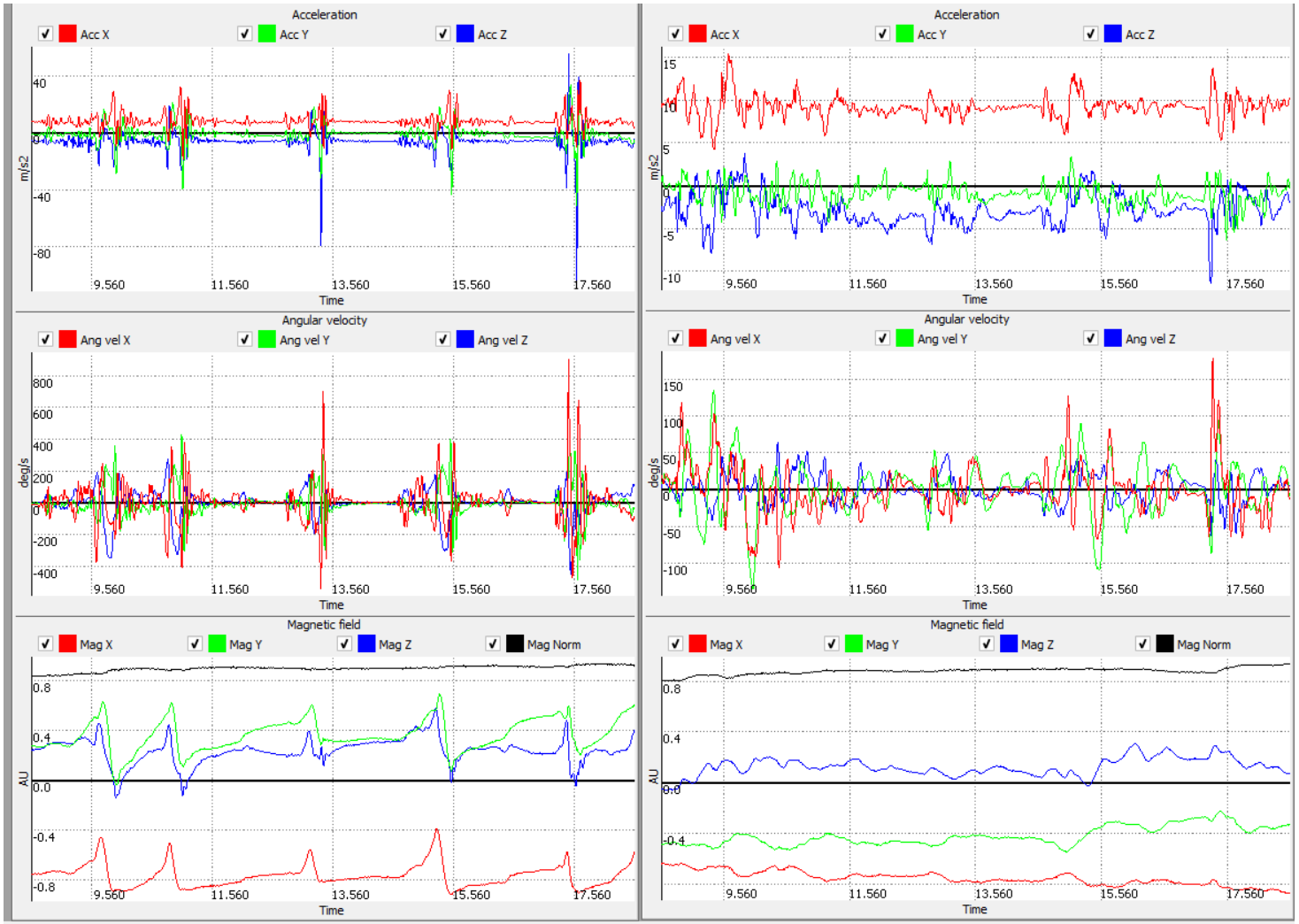
IMU



- Attachment with velcro band
- IMU on legs influence walking
- Place IMU in same direction on animal
- Potential to predict other traits
- Potential to be incorporated in ID tag

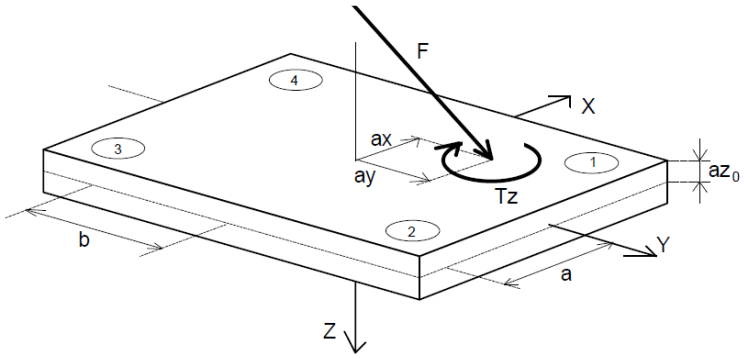
- Costs: receiver ~€1000, IMU ~€400 (20 IMUs/receiver)

IMU

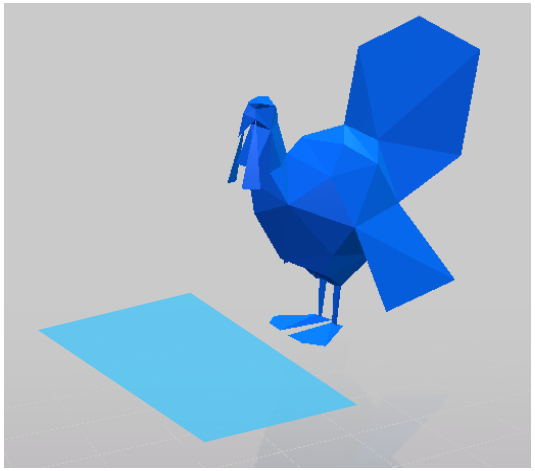

Acceleration
Acc X
Acc Y
Acc Z
m/s2
Time
Angular velocity
Ang vel X
Ang vel Y
Ang vel Z
deg/s
Time
Magnetic field
Mag X
Mag Y
Mag Z
Mag Norm
AU
Time

Force plate

- In floor covered with bedding
- 4 load cells
- 8 variables
  - 1) Force X cell 1+2
  - 2) Force X cell 3+4
  - 3) Force Y cell 1+4
  - 4) Force Y cell 2+3
  - 5-8) Force Z cell 1-4



Weight: ~40kg
Size: 60cm x 40cm x 10cm

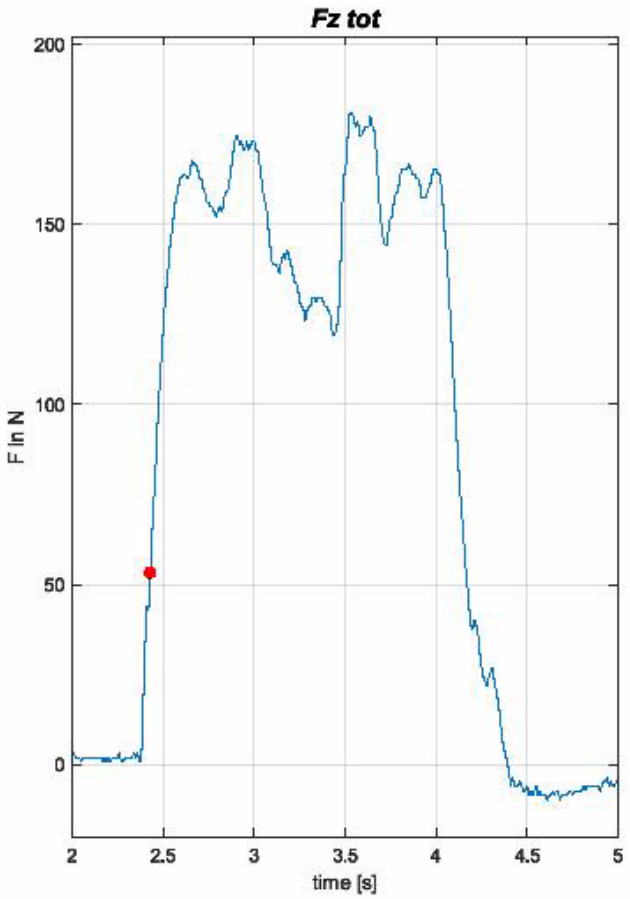


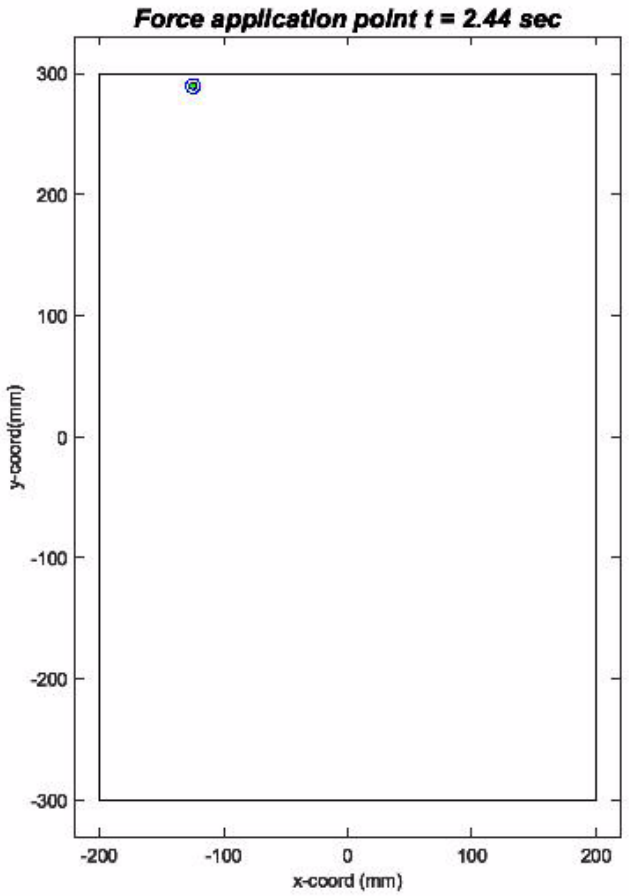
Force plate

- Placement in floor
- Robust for poultry
- Recalibrate/correct for drift
- Walk over it correctly
- Potential to predict body weight

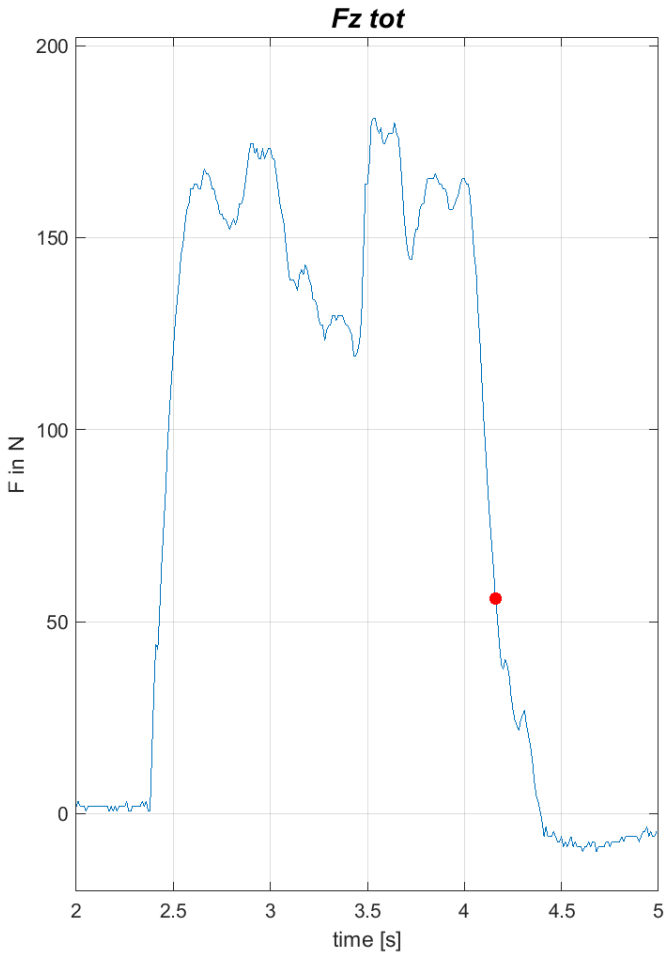
- Costs: ~€25,000-40,000

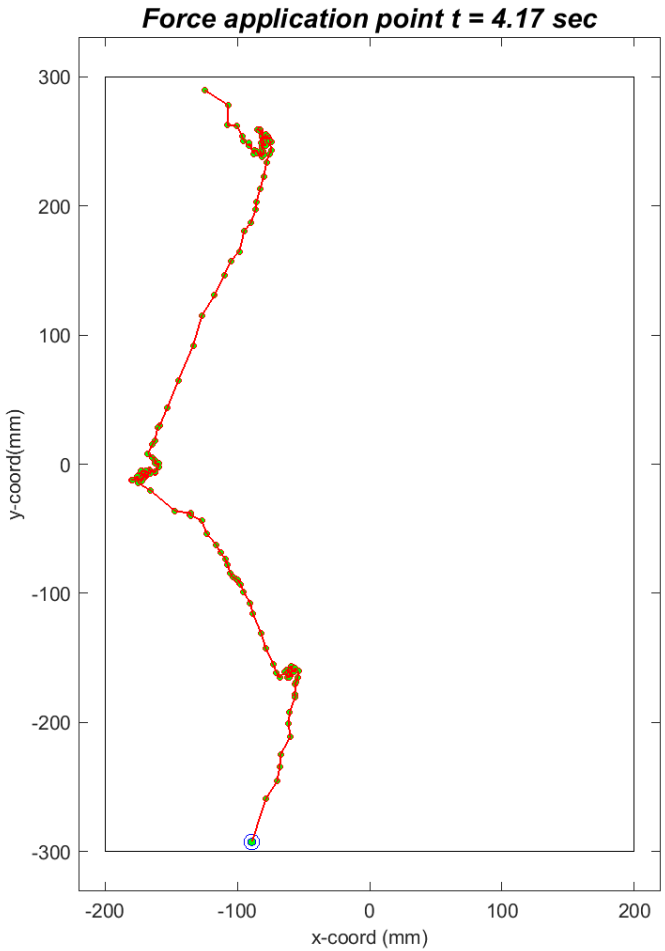
Force plate


Fz tot
F in N
time [s]
200
150
100
50
0
2
2.5
3
3.5
4
4.5
5


Force application point t = 2.44 sec
y-coord(mm)
x-coord (mm)
300
200
100
0
-100
-200
-300
-200
-100
0
100
200

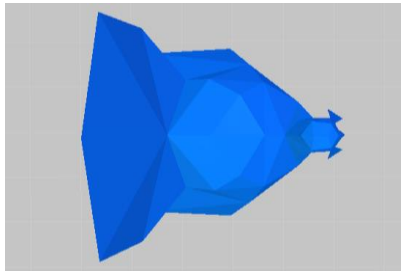
Force plate

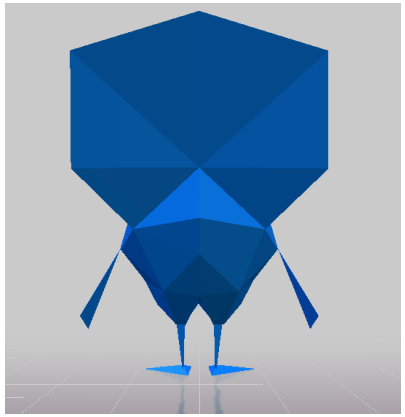

Fz tot
F in N
time [s]
200
150
100
50
0
2
2.5
3
3.5
4
4.5
5


Force application point t = 4.17 sec
y-coord(mm)
x-coord (mm)
300
200
100
0
-100
-200
-300
-200
-100
0
100
200

3D camera

- From behind, from top
- 3 images
  - Infrared
  - Depth
  - colour





3D camera

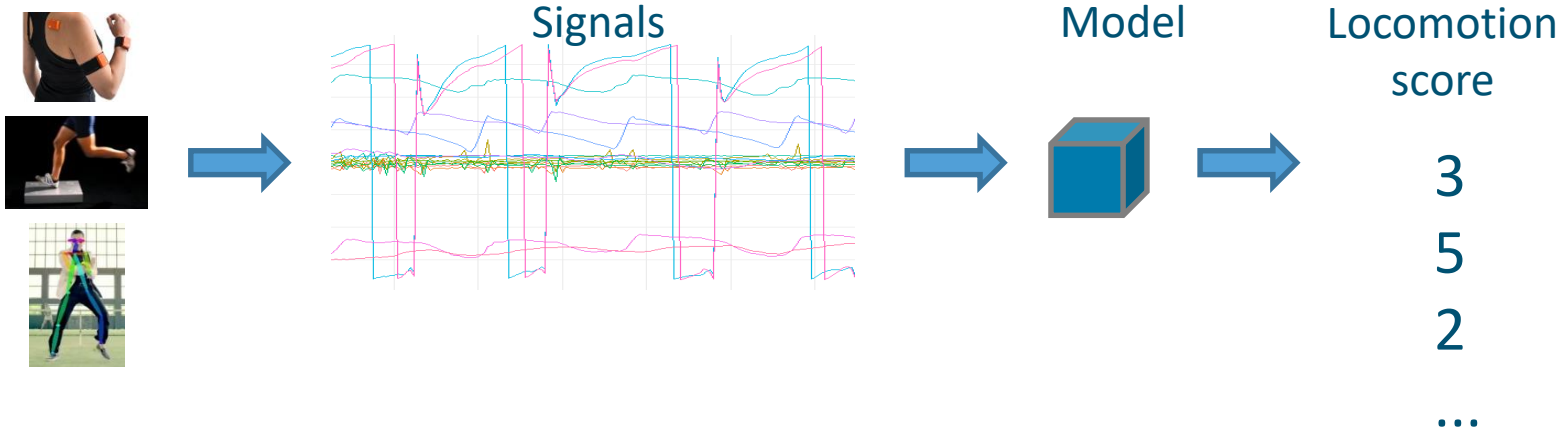
- Camera placement
- File storage: 1-1.5GB for 40s/bird
- Image=what we see
- Automation needed
- Potential to predict other traits

- Costs: ~€150/camera

3D camera

Locomotion prediction

- gait score = “gold standard”
- Sensor signals as predictor variables



Locomotion prediction

- Raw or derived features?
- Which derived features are informative?
  - Scoring protocol
  - Any sensor that can capture them suited
- Combination of sensors?

Gait score

- Motion
- Pitch
- Balance

Motion

- Leg angulation
- Hock strength
- Hip strength
- Leg structure

Morphology

After pilot

- Optimize sensor settings/placement
- Larger experiment
- Try in group housing

Take home message

- Get experience!
  - Start applying sensors
  - Small trails first
  - “golden standard”
  - Most sensors produce “just” variables