MORPHO 3D

A new device to register and analyze 3D shapes of animals

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Presented by L. Journaux
Background

• Fischer A. et al. 2015. Rear shape in 3 dimensions summarized by principal component analysis is a good predictor of body condition score in Holstein dairy cows. Journal of dairy science, 98(7), 4465-4476.

• New idea: is it possible to get a 3D image of the whole animal to assess new parameters like volume, surface and other morphological traits?

« Fat cows have rounder shapes than thin cows. »

sharp 0 3D shape BCS flat

1 3 4.75
Morpho 3D Project

• Objective: build a device able to scan the whole animal

• Hypothesis: 3D imaging allow
  ➢ A fine, precise, non-subjective analysis of body condition and animal morphology, at high speed, while working safely
  ➢ Identify and use new morphological traits: surface, volume

• Partners: 3D Ouest (SME), Idele, INRA, AgroCampus Ouest
The Morpho 3D scanner

- Laser (\(\lambda = 650\,\text{nm}\))
- Camera
- 5 recording systems
- 0.5 m.s\(^{-1}\)
Morpho 3D, A new device to register and analyze 3D shapes of animals
Image processing

3D raw cloud → Smoothing and shape reconstruction on Meshlab® → Measures on Metrux2®

- Linear measures
- Circumferences
- Surfaces
- Volumes
Evaluation of the system performance

- Comparison of the scanner with manual measurements for withers height (WHG), hip width (HW), hearth girth (HG)
- Accuracy: 30 cows measured 1 time with each method
- Reproducibility: 6 different cows scanned and measured 4 times with each method
- Repeatability: 1 model plastic cow measured 6 times by 2 different operators with each method
Results

- High correlations between Manual and Morpho3D values (0.94 for hips width, 0.89 for chest depth, 0.78 for hearth girth, 0.62 for withers height)
- Slight and constant over estimation of Morpho3D measurements (around 3%)
Results:

<table>
<thead>
<tr>
<th></th>
<th>Repeatability</th>
<th>Reproductibility</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\mu_r$ (cm)</td>
<td>$\sigma_r$</td>
</tr>
<tr>
<td><strong>HG</strong> Hearth Girth</td>
<td>Manual</td>
<td>194.2</td>
</tr>
<tr>
<td></td>
<td>Morpho3D</td>
<td>195.8</td>
</tr>
<tr>
<td><strong>WHG</strong> Withers Height</td>
<td>Manual</td>
<td>129.1</td>
</tr>
<tr>
<td></td>
<td>Morpho3D</td>
<td>131.1</td>
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<tr>
<td><strong>HW</strong> Hips Width</td>
<td>Manual</td>
<td>39.8</td>
</tr>
<tr>
<td></td>
<td>Morpho3D</td>
<td>39.9</td>
</tr>
</tbody>
</table>

- CVr & CVR values < 3 %: repeatability and reproductibility are (very) good
- Reliable technology for R&D uses
First data on surface and volume

Half back surface

Body volume (without head)
What’s next?

- Automated morphological scoring
- Volume: ingestion capacity, muscle volumes, pregnancy diagnosis,…
- Surface: weight estimation, energy expenditure,…
- Other species:

  - Clément Allain
  - Goats
  - Calves
Thanks !