Performance monitoring in the cattle sector innovates with 3D imagery

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Summary

1) Project goals and context
2) Data collection
3) Data processing
4) Results
5) Discussion & Conclusion
6) Questions and answers
1) Why such a project?  → Limits in performance monitoring

- Training system expensive
  - Initial training
  - Homogenization Sessions
  - Breed approval

- High turnover in structures & difficulty in recruitment

- Scorer effect (+ farm effect, region, etc.)
  - Notation differences between 2 scorers
  - Over/undervaluing an animal compared to a previous one

26/05/2024
1) Project goal

**Goal**: Automate the collection of live weight and the 19 note of scoring (4-12 months) on the 10 beef breeds

**3 bricks of project deliverables**: 

- **A 3D scanner** for high-throughput phenotyping in farm
- **Prediction algorithms**
- **Service for breeders**
- **Consortium Animal 3D**
2) Data collection : the 3D scanner

Hardwares :
• A demountable and movable gantry
• 5 « bars » of 2 Intel Realsense depth cameras
• A laser barrier to trigger the shot

A software developed by 3D Ouest:
• Time and space synchronization of the cameras
• Merging all data to provide a complete 3D animal image

A restraining system to:
• Let the animal pass one at a time
• Identify the animal
2) Methodology of data collection

32 farms (4 breeds) and 50 configurations tested

Scoring

Weighing and scan
2) Reference measurements collected on the animals

Most of them have 2 3D images & 2 weights

Each calf has been scored by 3 scorers

<table>
<thead>
<tr>
<th>Breed</th>
<th>Number of calves</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charolaise</td>
<td>1,194</td>
</tr>
<tr>
<td>Limousine</td>
<td>327</td>
</tr>
<tr>
<td>Parthenaise</td>
<td>550</td>
</tr>
<tr>
<td>Blonde d’Aquitaine</td>
<td>500</td>
</tr>
</tbody>
</table>
3) Preprocessing of 3D images

- Standardization
- Targeted indicators (zoo technics)
- Cutting on 3 axes to create slices
- Indicators for each slice

Several hundred columns to describe slices and targeted indicators
3) Preprocessing of 3D images

Image Indicators

Predictions (weight, score notes)

Data quality filter

Machine learning algorithms:
- 80% of data to train
- 20% for testing on data unknown to the model
4) Results : Weight prediction performance on charolais breed

- Generalizing weight prediction to larger animals with stable performance, **Average Prediction Error:** 4.1%
  - The weight is repeatable, but variability persists
- Work in progress to improve these weight prediction algorithms!
4) Results: Muscle Development Prediction Performance on charolais breed

<table>
<thead>
<tr>
<th>Name</th>
<th>Correlation of Spearman</th>
<th>Repeatability</th>
<th>Homogeneity</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Experienced scorers</td>
<td>PHENO3D (01/2024)</td>
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<tr>
<td>Muscularity Shoulder</td>
<td>0.80</td>
<td>0.82</td>
<td>0.75</td>
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<tr>
<td>Back Width</td>
<td>0.77</td>
<td>0.86</td>
<td>0.72</td>
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<tr>
<td>Thigh Rounding</td>
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<td>0.79</td>
<td>0.65</td>
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<tr>
<td>Thigh Width</td>
<td>0.81</td>
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<td>0.75</td>
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<tr>
<td>Thickness of Loin</td>
<td>0.79</td>
<td>0.85</td>
<td>0.73</td>
</tr>
<tr>
<td>Thigh Length</td>
<td>0.63</td>
<td>0.85</td>
<td>0.51</td>
</tr>
<tr>
<td>Global</td>
<td>0.75</td>
<td>0.81</td>
<td>0.69</td>
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</table>
4) Results : Skeletal Development Prediction Performance on charolais breed

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<td></td>
</tr>
<tr>
<td>Back Length</td>
<td>0.76</td>
<td>0.90</td>
</tr>
<tr>
<td>Length of Rump</td>
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<td>0.87</td>
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<tr>
<td>Width at Hips</td>
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<tr>
<td>Development</td>
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<td>0.87</td>
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<tr>
<td>Global</td>
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5) Discussion and conclusion

- The results are very encouraging!

- The weight needs to be made reliable, especially for the approach to sales

- It must work on all breeds (10 beef breeds currently)

- Tomorrow, predictions must be instantaneous → algorithms of prediction must be integrated in the 3D scanner
5) Upcoming planning

- **2024**
  - Collecting data on the beef breeds
  - We are here!

- **2025**
  - Elaboration of algorithms by Data'Stat
  - Collecting Missing Phenotypes
  - Validation of algorithms by Breeding Organizations

- **2026**
  - Industrialization
  - Deployment of the tool
  - Training field

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**PHENO3D**

**26/05/2024**
Thank you for your attention!

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