PHENO3D

Performance monitoring in the cattle sector innovates with 3D imagery

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Summary

1) Why such a project? → Limits in performance monitoring
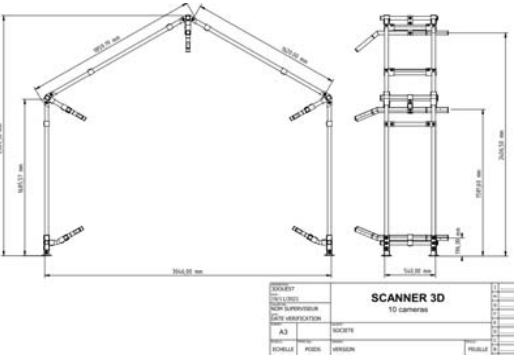
- Training system expensive
  - Initial training
  - Homogenization Sessions
  - Breed approval

- 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

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

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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 developped 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

5

2) Methodology of data collection

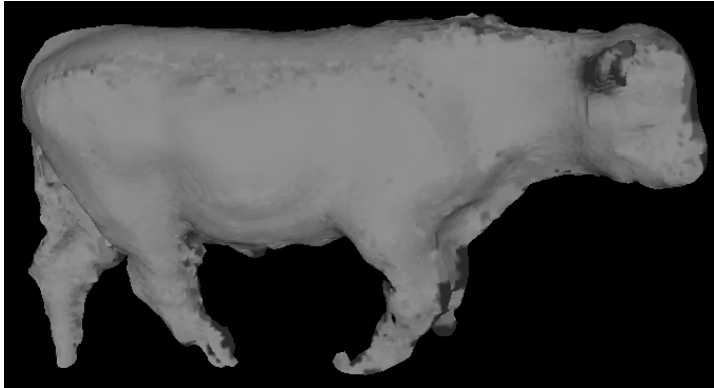32 farms (4 breeds) and

50 configurations tested

Weighing and scan

Scoring

2) Reference measurements collected on the animals

Most of them have 2
3D images &
2 weights

Breed	Number of calves
Charolaise	1 194
Limousine	327
Parthenaise	550
Blonde d'Aquitaine	500

Each calf has been scored by 3 scorers
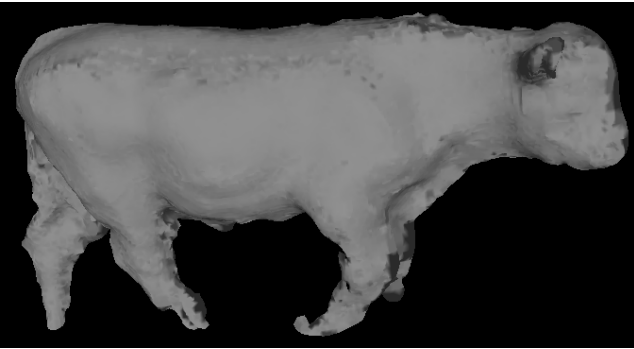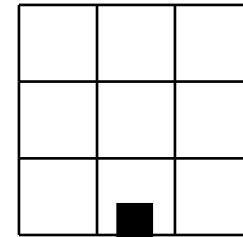
3) Preprocessing of 3D images
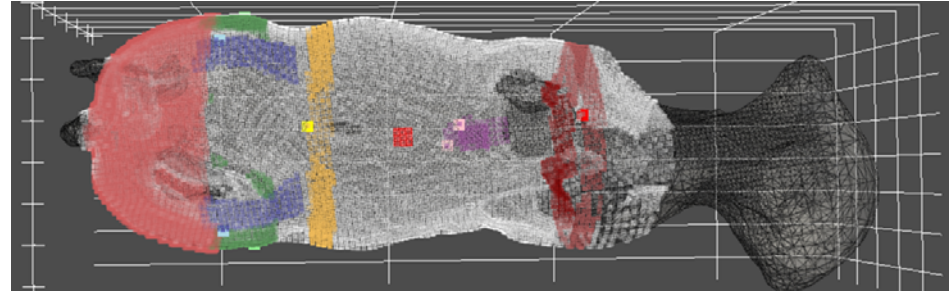
Raw 3D Image
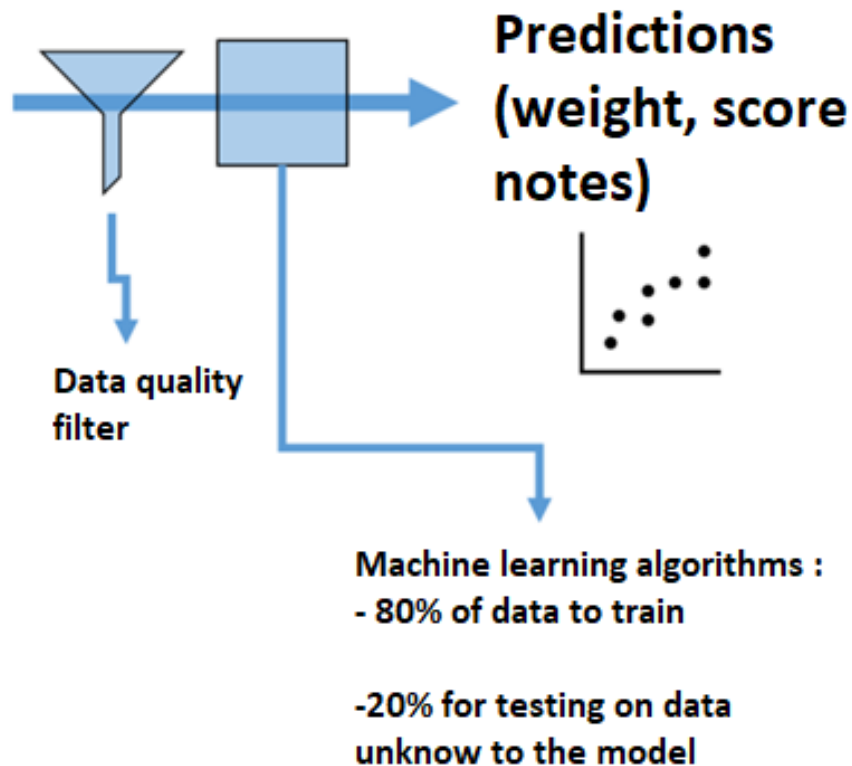
Image Indicators

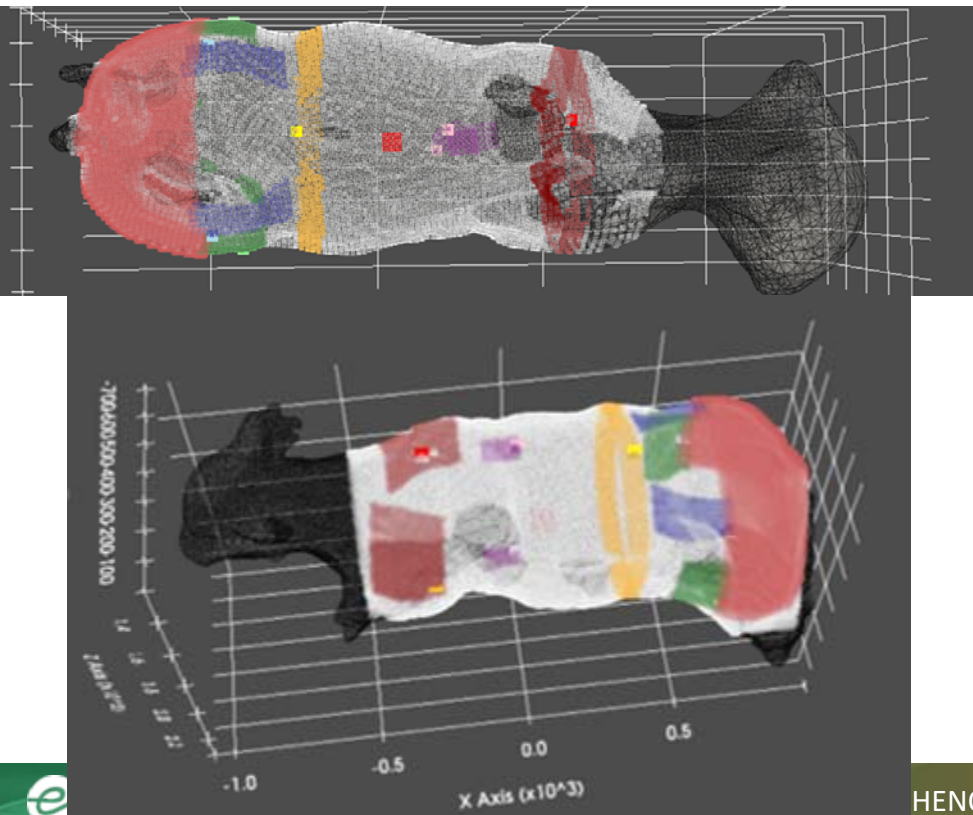- Standardization
- Targeted indicators (zootechnics)
- Cutting on 3 axes to create slices
- Indicators for each slice

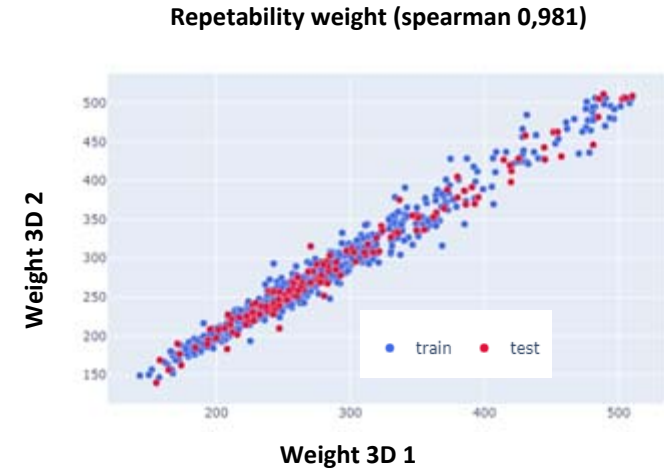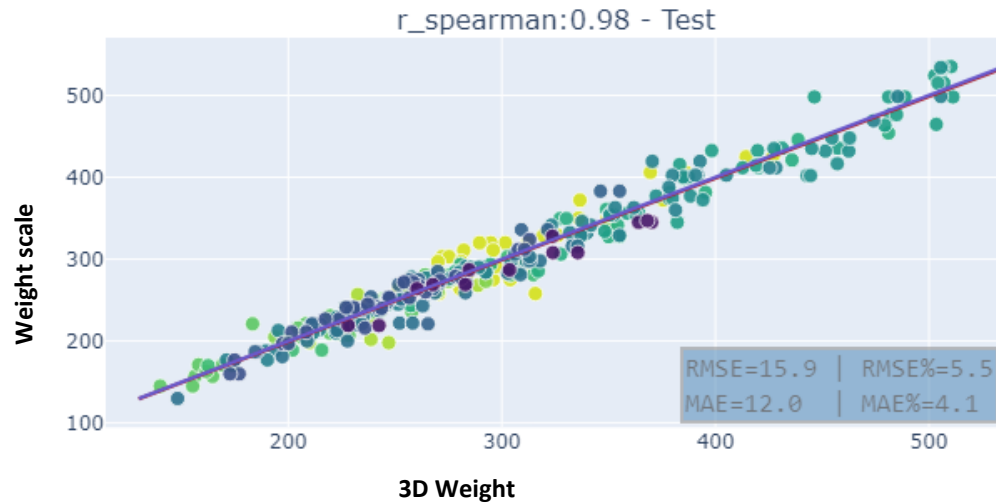Several hundred columns to describe slices and targeted indicators

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 unknow to the model

4) Results : Weight prediction performance on charolais breed

r_spearman:0.98 - Test

RMSE=15.9 | RMSE%=5.5
MAE=12.0 | MAE%=4.1

Weight scale / 3D Weight

Repetability weight (spearman 0,981)

Weight 3D 2 / Weight 3D 1

train · test

- 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

Correlation of Spearman	Repeatability		Homogeneity	
Name	Experienced scorers	PHENO3D (01/2024)	Experienced scorers	PHENO3D (01/2024)
Muscularity Shoulder	0,80	0,82	0,75	0,74
Back Width	0,77	0,86	0,72	0,72
Thigh Rounding	0,72	0,79	0,65	0,69
Thigh Width	0,81	0,82	0,75	0,73
Thickness of Loin	0,79	0,85	0,73	0,74
Thigh Lenght	0,63	0,85	0,51	0,72
Global	0,75	0,81	0,69	0,76

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4) Results : Skeletal Development Prediction Performance on charolais breed

Correlation of Spearman	Repeatability		Homogeneity	
Nom	**Experienced scorers**	**PHENO3D (01/2024)**	**Experienced scorers**	**PHENO3D (01/2024)**
Back Lenght	0,76	0,90	0,70	0,77
Length of Rump	0,78	0,87	0,73	0,75
Width at Hips	0,75	0,85	0,62	0,74
Developpment	0,83	0,87	0,76	0,76
Global	0,78	0,87	0,70	0,78

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)

Charolaise   Limousine   Blonde d'Aquitaine   Aubrac   Salers   Rouge des Près   Parthenaise   Gasconne   Blanc bleu   Bazadaise
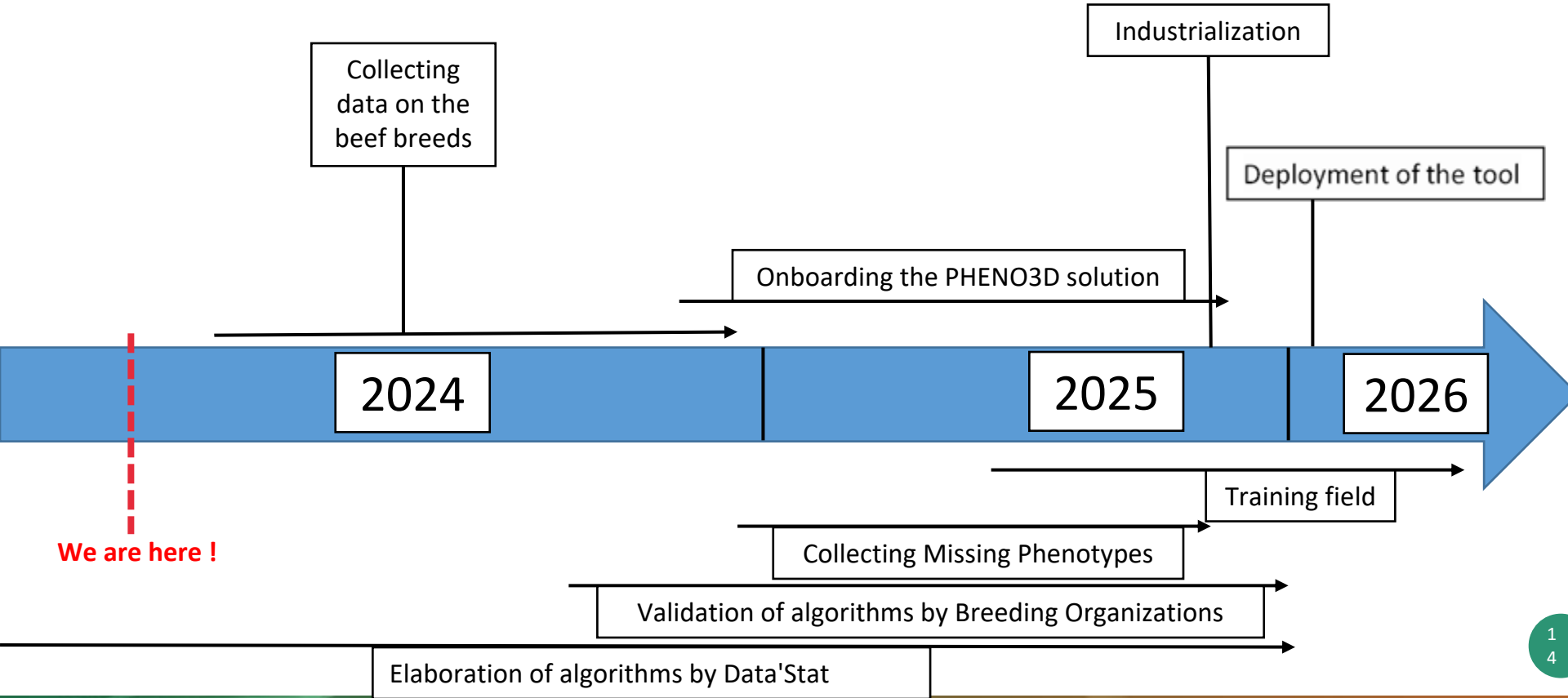
- Tomorrow, predictions must be instantaneous → algorithms of prediction must be integrated in the 3D scanner

5) Upcoming planning

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Thank you for your attention !

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Des éleveurs. Une ambition.

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