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Can a virtual cow model help precision feeding?

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Introduction

Feed

Production

Environnent

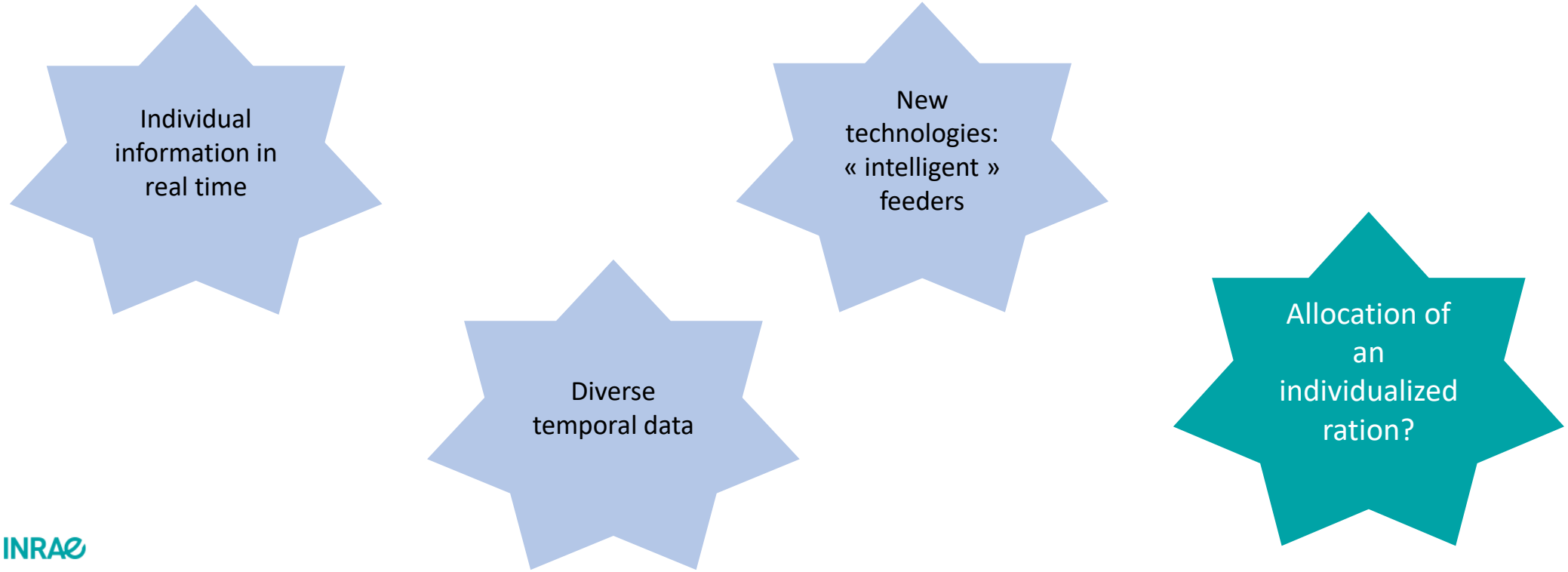
Economy

Product quality

The estimation of the animals requirements allow to optimize their performances and feed costs

Introduction

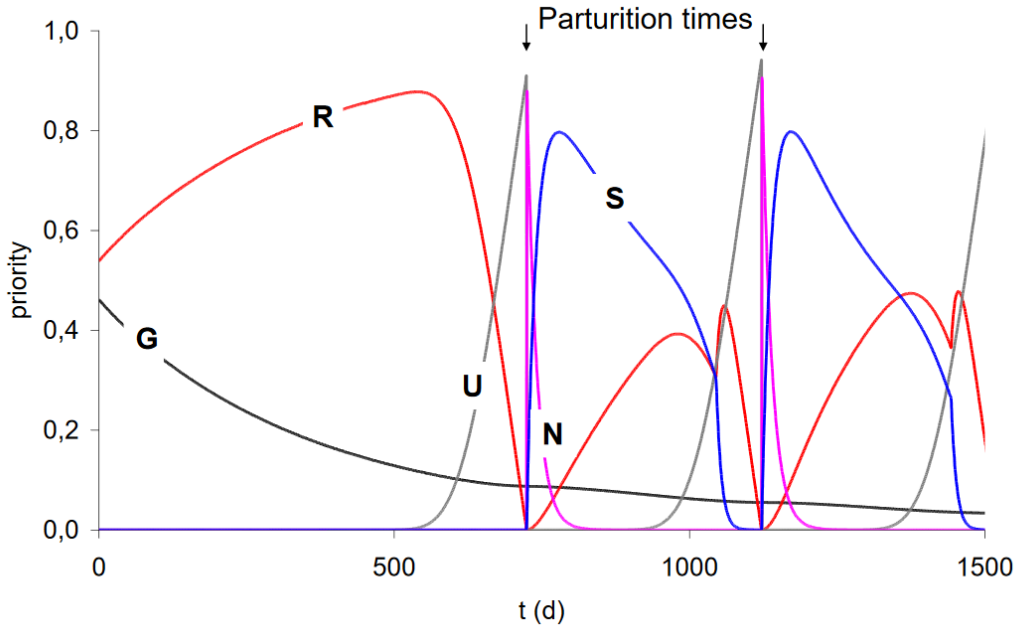
- Precision farming allows automatic and massive data collection
- Animal models are needed to interpret these data and individual variability in order to better adjust management strategies (i.e. feeding strategies).

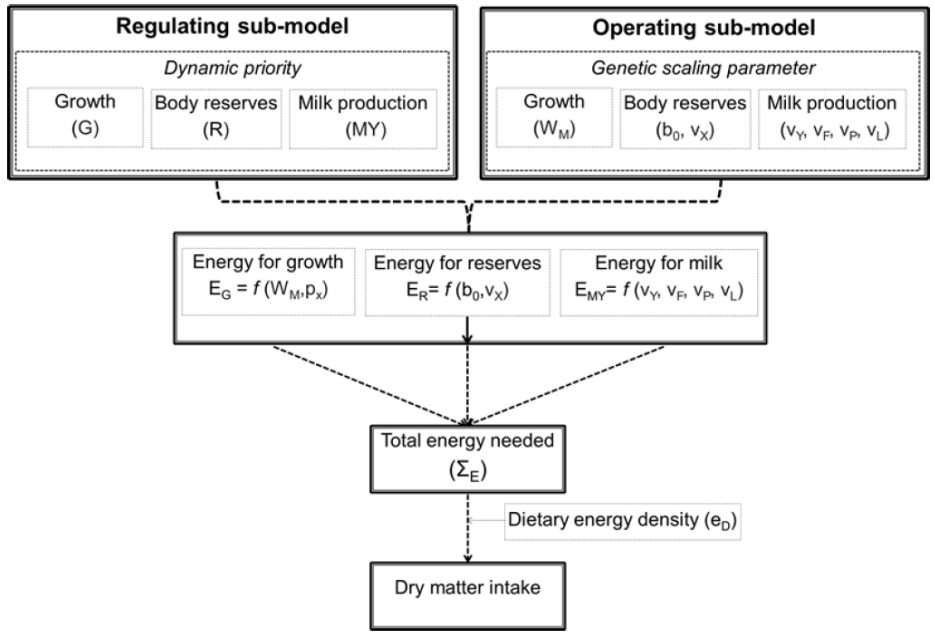


Introduction

GARUNS model : lifetime performance model taking into account the changing physiological priorities of an animal during its life and through repeated reproduction cycles (Martin and Sauvant, 2010).

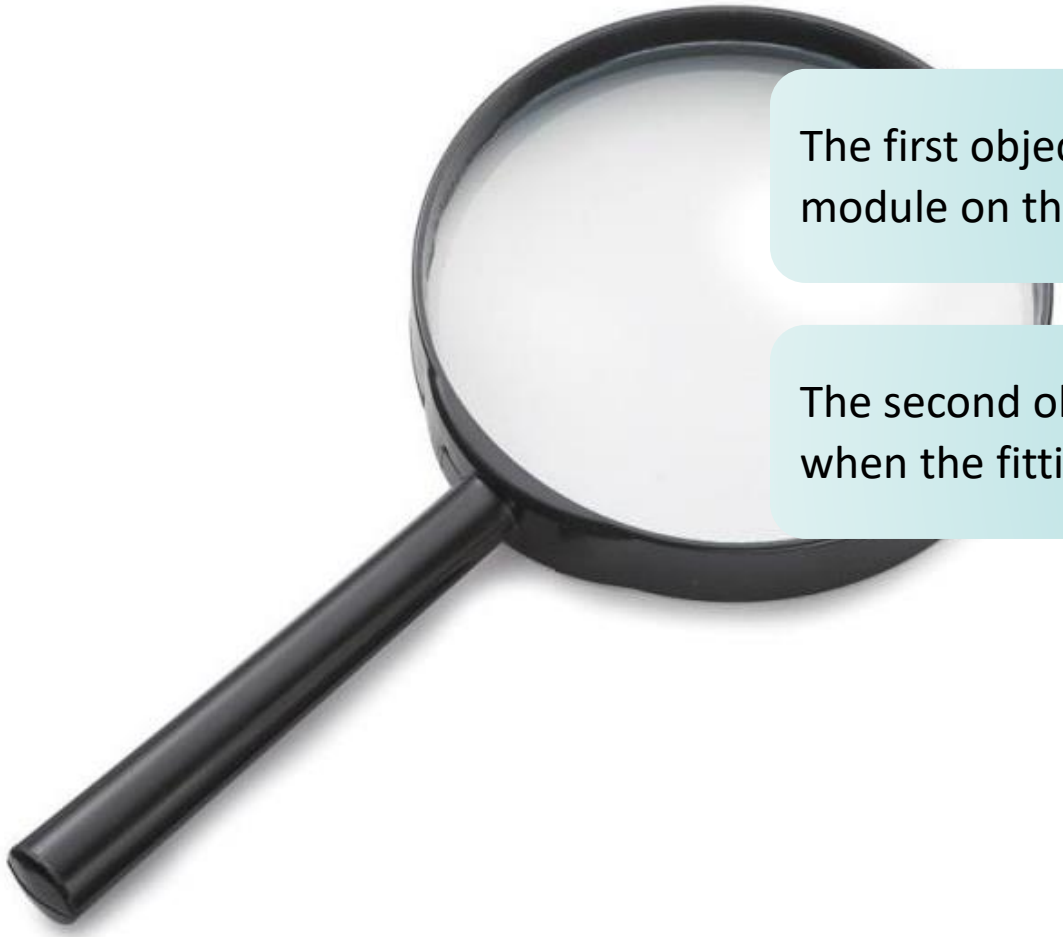
Dynamic and stochastic model, previously used to predict the productive and reproductive performance of various genotypes of cows across feeding systems.





Recent evolution of the GARUNS model of dairy cow lifetime performance : “feed plan” module taking into account the composition of the ration distributed to the cow during its life

Objectives



The first objective of this study was to quantify the effect of this “feed plan” module on the fitting accuracy of production variables.

The second objective was to evaluate the fitting quality of the second lactation when the fitting was done on first lactation data only.

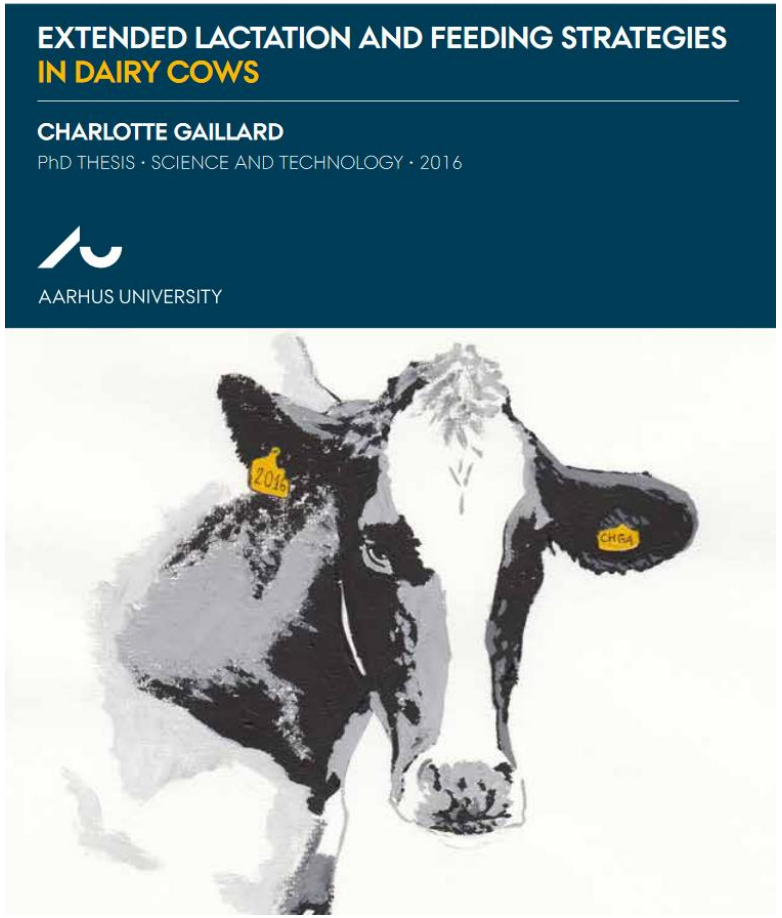
Material & Methods

Origin: data from a trial on extended lactation (2012-2015) at the Danish Cattle Centre in Aarhus University (Denmark).

Data used: dry matter intake, milk yield, body weight, body condition score, milk components, insemination and parturition times, rations' composition on first lactation

Animals: 16 primiparous cows

Feeding treatments: 7 primiparous with a diet enriched in energy (EXP) in early lactation (mobilization period) followed by a standard diet lower in energy (STD); vs. 9 primiparous fed STD during all the lactation. Only a 4%-units energy difference between EXP and STD

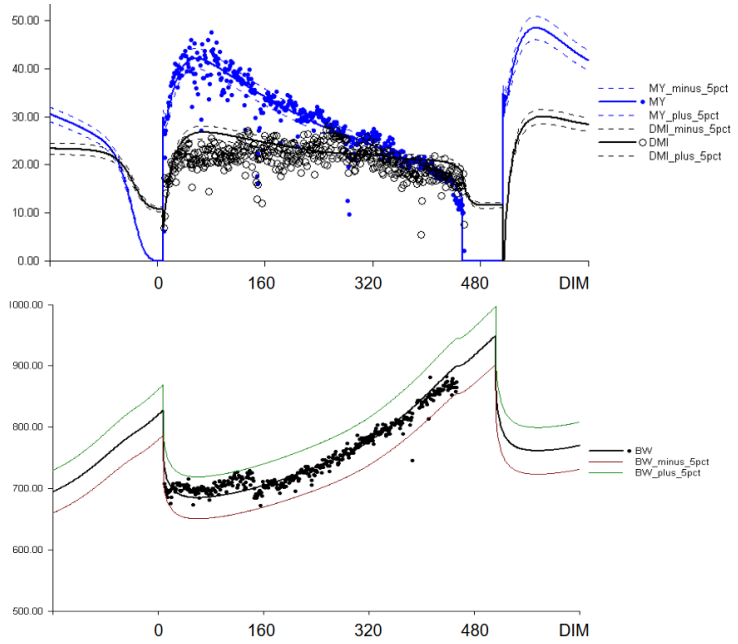


Material & Methods

The new model with the “feed plan” module, was fitted on each of the of 16 primiparous Holstein cows data with a step-by-step fitting procedure

Each cow was characterized by an adjusted version of the model with a specific set of 12 parameters

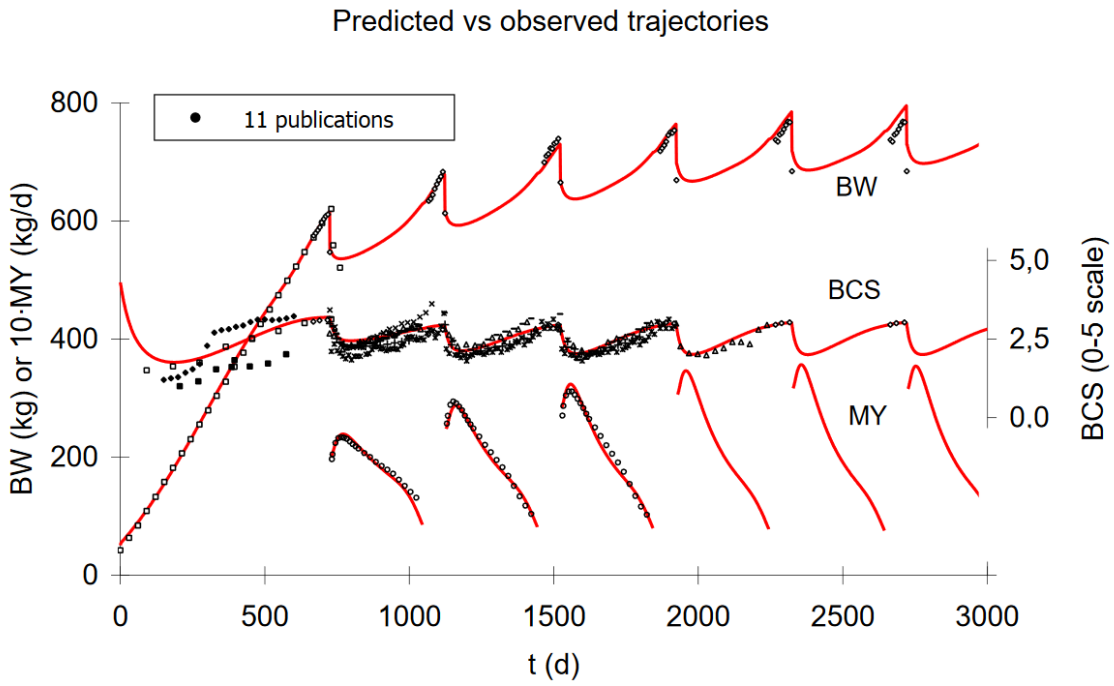
Parameter	Description
w_M	Mature size
μ_Y	Level of production
λ_0	Persistency
y_N	Start of the lactation
Uwea	End of the lactation
γ	End of the lactation
v_L	Milk lactose secretion
v_F	Milk fat secretion
v_P	Milk protein secretion
v_X	Ability of mobilizing
ϕ	Weight of uterus/fetus



Material & Methods

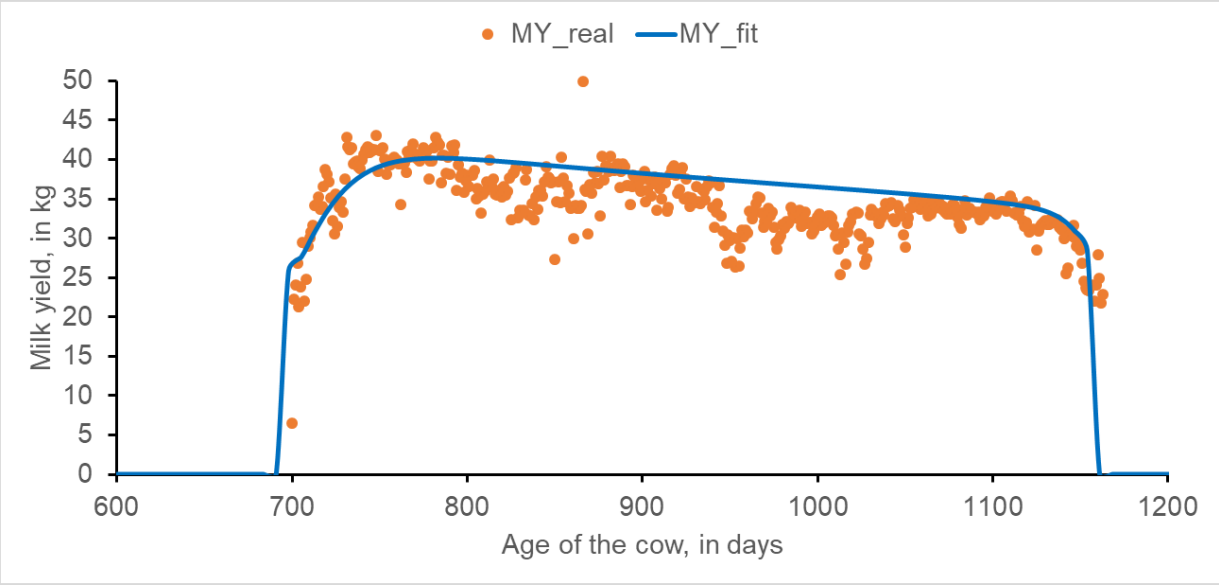
- Statistical analysis :

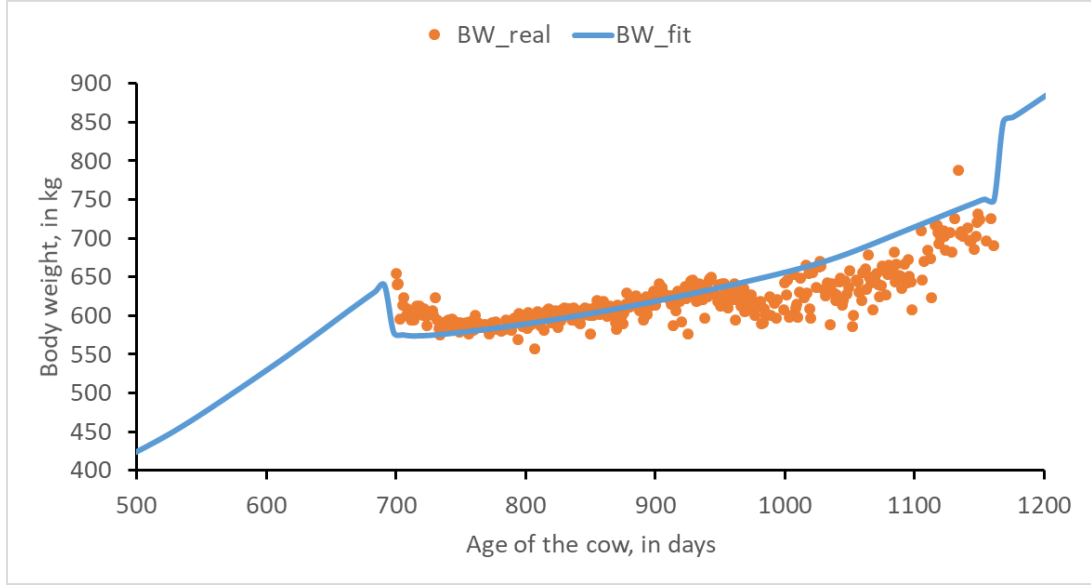
The relative prediction errors (RPE) were calculated to evaluate the ability of the GARUNS model to fit the observed data of the first and second lactation of each cow.



Results

Adjustment on the first lactation, example of one cow for milk yield (MY) and body weight (BW):





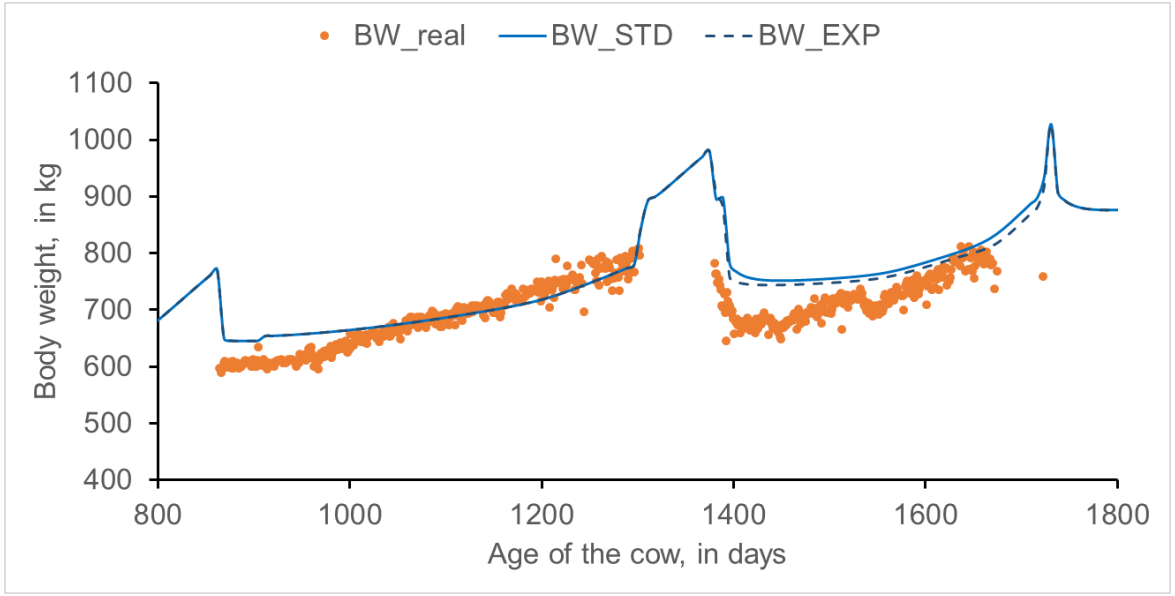
Results

Adjustments with the model including the feed module (model 2) were more accurate for the three production variables studied (dry matter intake, milk yield and body weight) during the first lactation than the one with the model without feed module (model 1, Gaillard et al., 2016).

Variable	RPE (%) model 1 (Gaillard et al., 2016)	RPE (%) model 2
DMI	22.65	**11.2**
BW	3.28	**2.75**
MY	13.0	**11.4**

Results

Based on the first lactation fitting, the new model was also able to fit the second lactation data to a certain extend.



RPE results with an hypothesis on the ration of lactation 2 (STD diet) :

Variable	RPE (%) – Lactation 1	RPE (%) – Lactation 2
DMI	11.2	25.9
BW	2.75	6.04
MY	11.4	46.5

Problem with the current milk dataset

Conclusion

To conclude, this first approach indicated the relevance of the feed module to improve the accuracy of the fitting of the model. This updated model could therefore serve as management tool and help predicting the individual productivity of the next lactation.

➢ Further work :

- Include more cows
- Include perturbations (i.e. health incidents) while fitting to be more accurate
- Develop a decision system tool in real-time for a precision feeding strategy (diet adjusted individually and regularly) able to function with a large range of equipment and sensors

Thank you for your attention !