Characterization of milk composition and somatic cell count estimates from automatic milking systems sensors

Liliana Fadul-Pacheco, Mario Séguin, René Lacroix, Michel Grisé, Daniel Lefebvre

February 2018

Introduction

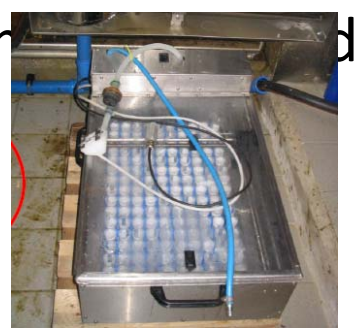
- >11% of milk recorded herds in Canada use AMS
- Increasing rapidly
- Many new installations include sensors for components and/or SCC
- Sampling for MR in AMS can be challenging
- Farmers are requesting that sensor data be considered
- Accuracy needs needs to be characterised for adequate use for
  - Management
  - Performance recognition programs/awards
  - Genetic evaluation

Objective

- The aim of this study was to characterise and compare the results from the AMS sensors and the milk-recording laboratory.

Protocol

- 10 herds with Lely AMS (MQC sensors)
  - Samples taken over a 24-h period
  - Laboratory samples :24-hr weighted average
  - Comparisons of fat, protein, lactose and SCC from the AMS and the laboratory
- 4 herds with DeLaval AMS (OCC sensors)
  - 1 sample per cow was taken over a 12-h period
  - Comparisons of SCC from the AMS estimation and laboratory
- Samples were analysed in the Valacta laboratory f m d SCC (CombiFoss FT+, Foss, Hillerod, DK)



Materials and methods

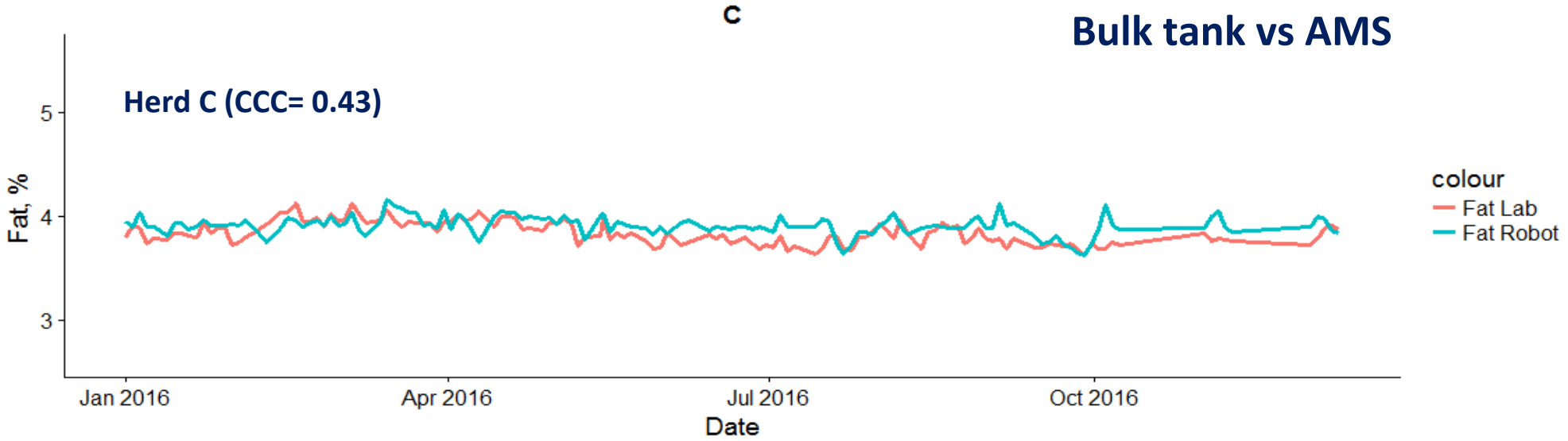
- Data from the AMS was exported in Microsoft Excel
- Differences were calculated as: **AMS - laboratory results**
- Mean absolute error (MAE)
- Concordance correlation coefficient (CCC)
- Bland Altman analysis

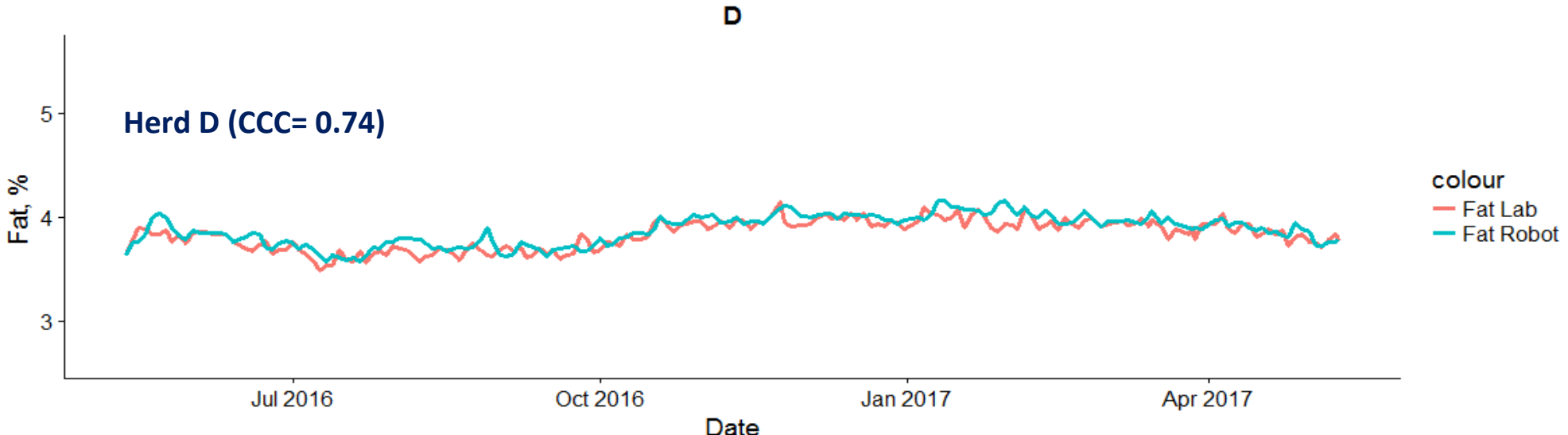
R program version 3.4.1
(R Development Core Team, 2017)

•The CCC and theBl and Altman analyses quantify the agreement and the reliability between two quantitative measurements, and help establishing the validity of a new technique (Kwiecien et al., 2011; Giavarina, 2015).

Results

Bulk tank vs AMS





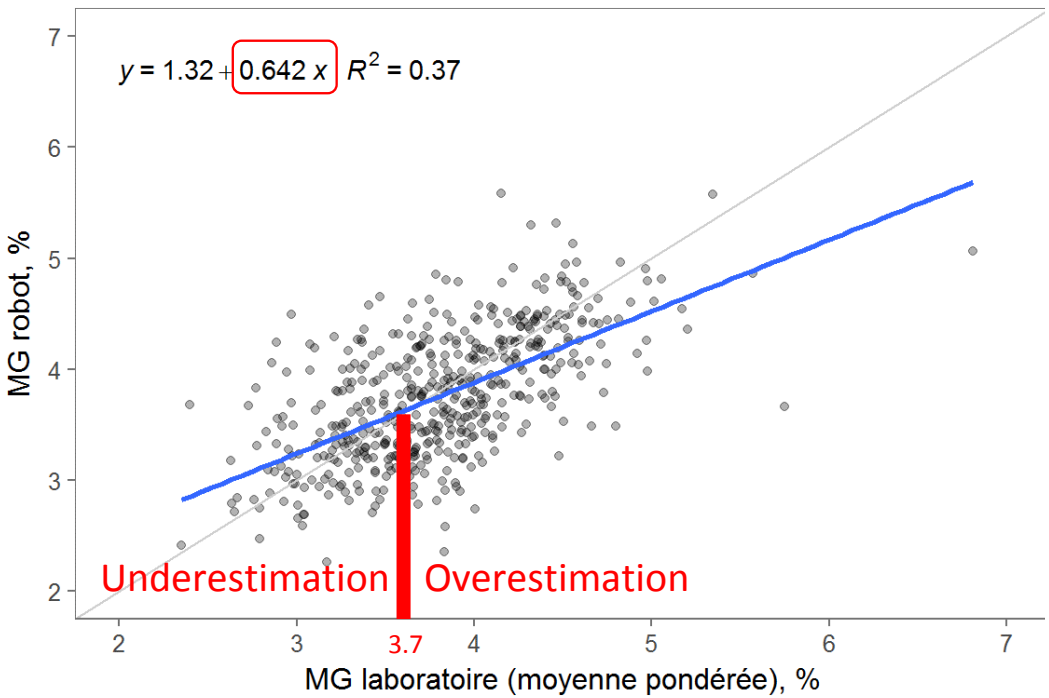
Results

Mean differences and SD of milk components generated for the ten herds by the Lely AMS and the milk recording laboratory

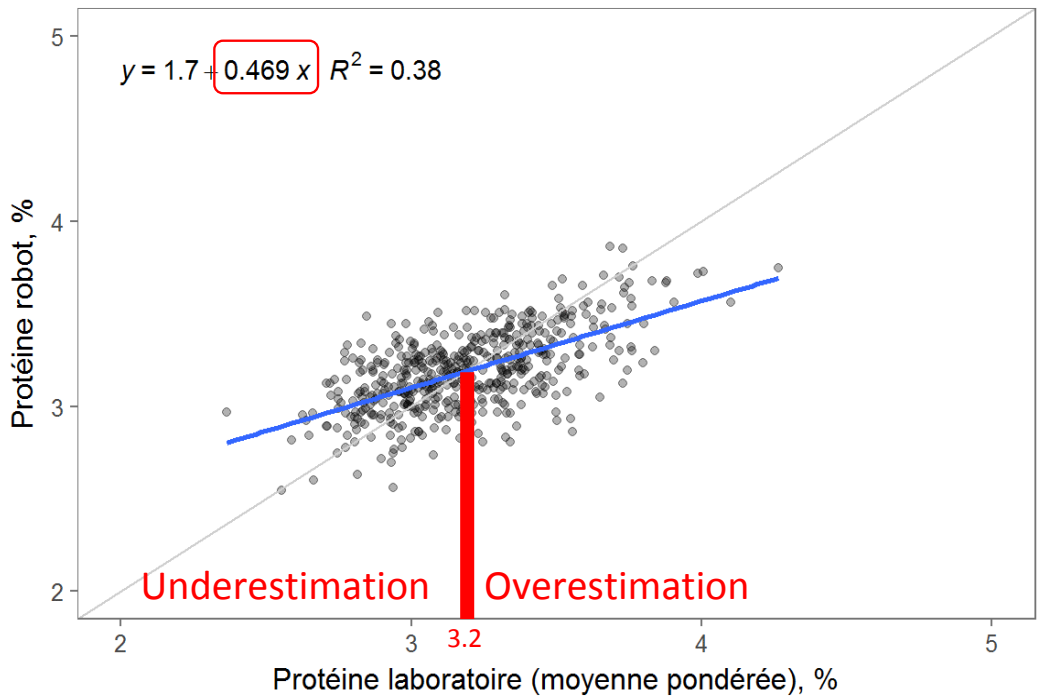
Item	% Fat	% Protein	% Lactose	Fat yield (kg/d)	Protein yield (kg/d)	SCC (cells/mL)[1]	Linear score
AMS	3.76 (0.57)	3.19 (0.21)	4.65[2] (0.11)	1.63 (0.40)	1.40 (0.33)	71[3] (145)	2.11 (0.87)
Laboratory	3.81 (0.55)	3.19 (0.28)	4.68 (0.16)	1.67 (0.40)	1.39 (0.30)	133 (340)	2.11 (1.68)
Differences	-0.05 (0.50)	-0.001 (0.23)	-0.04 (0.1)	-0.04 (0.23)	0.01 (0.10)	-61 (255)	0.01 (1.56)
MAE[4]	0.38	0.18	0.09	0.17	0.08	99	1.31

[1]Geometric mean of the last three milkings (x1000)
[2]Data available only for seven farms
[3]Data available only for six farms
[4]Means absolute error

Results - Components



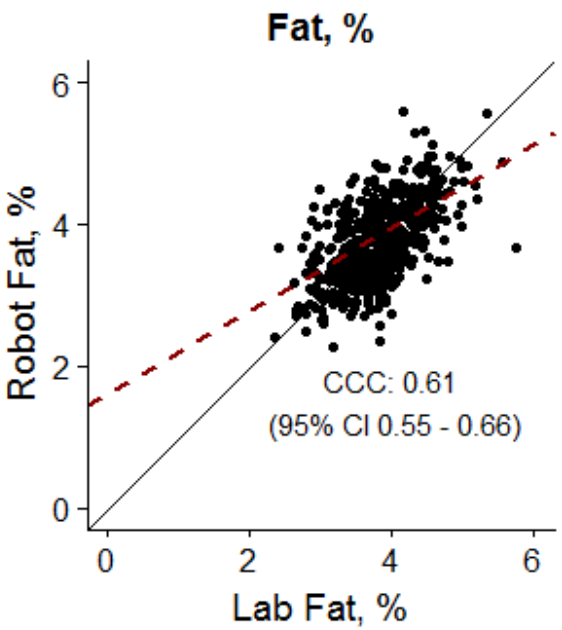
Mean absolute difference: 0.50%

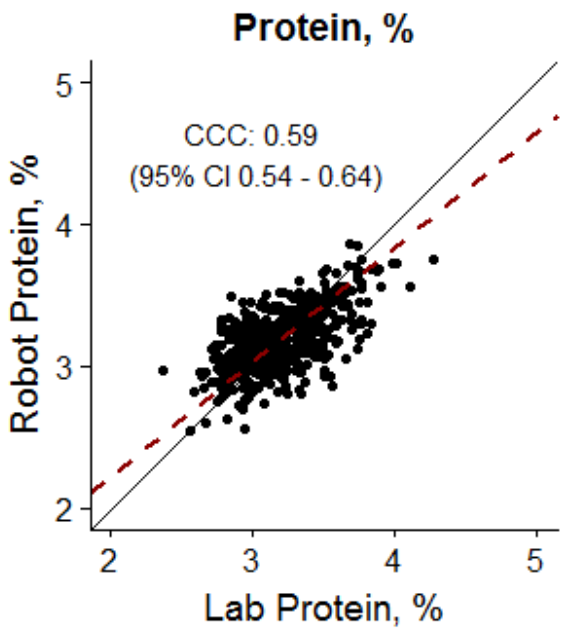


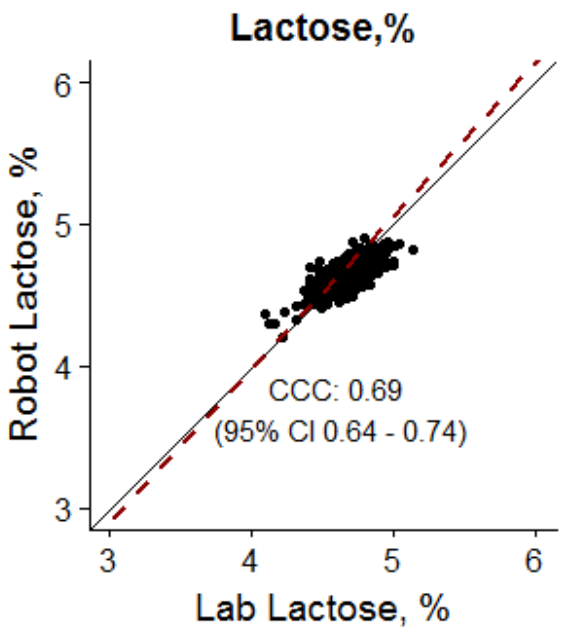
Mean absolute difference : 0.23%

Results - Components

CCC (average 10 herds)







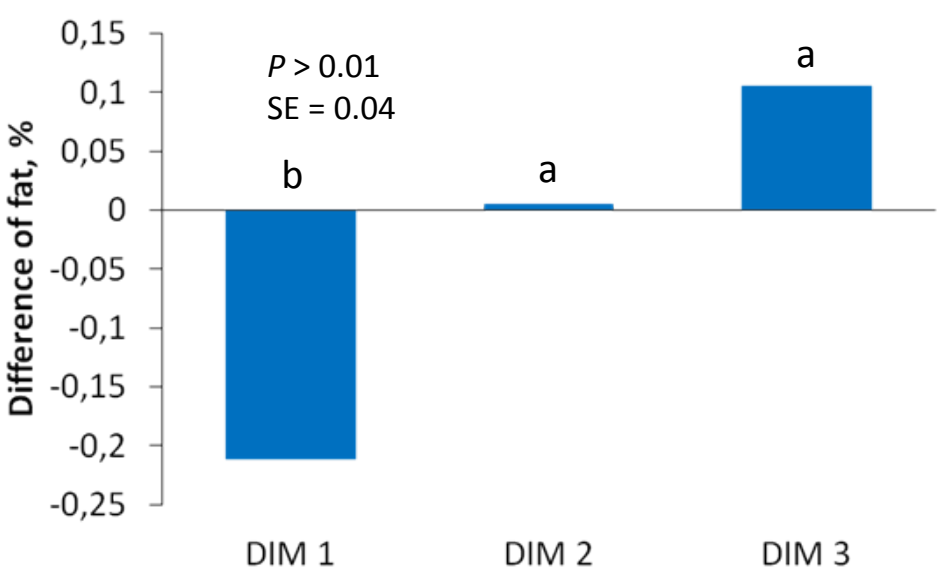
Results by DIM Categories

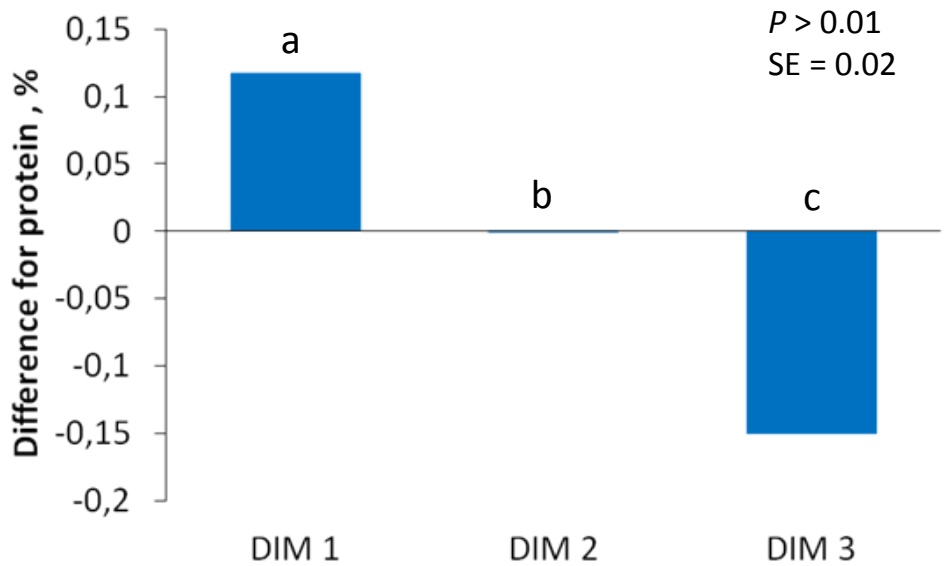
Categories of DIM:

DIM 1 : DIM <=100

DIM 2 : DIM between 101 and 200

DIM 3: >201 DIM

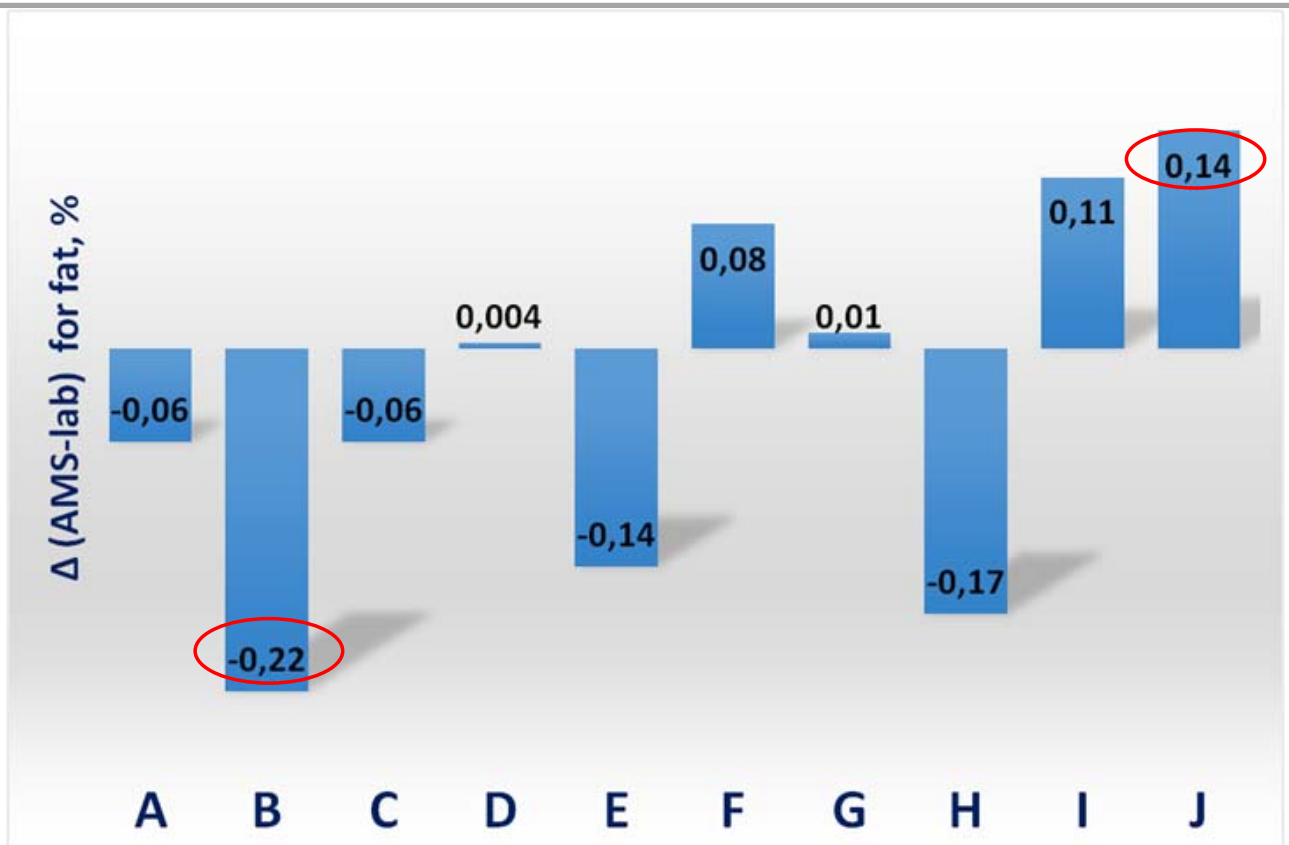




Results

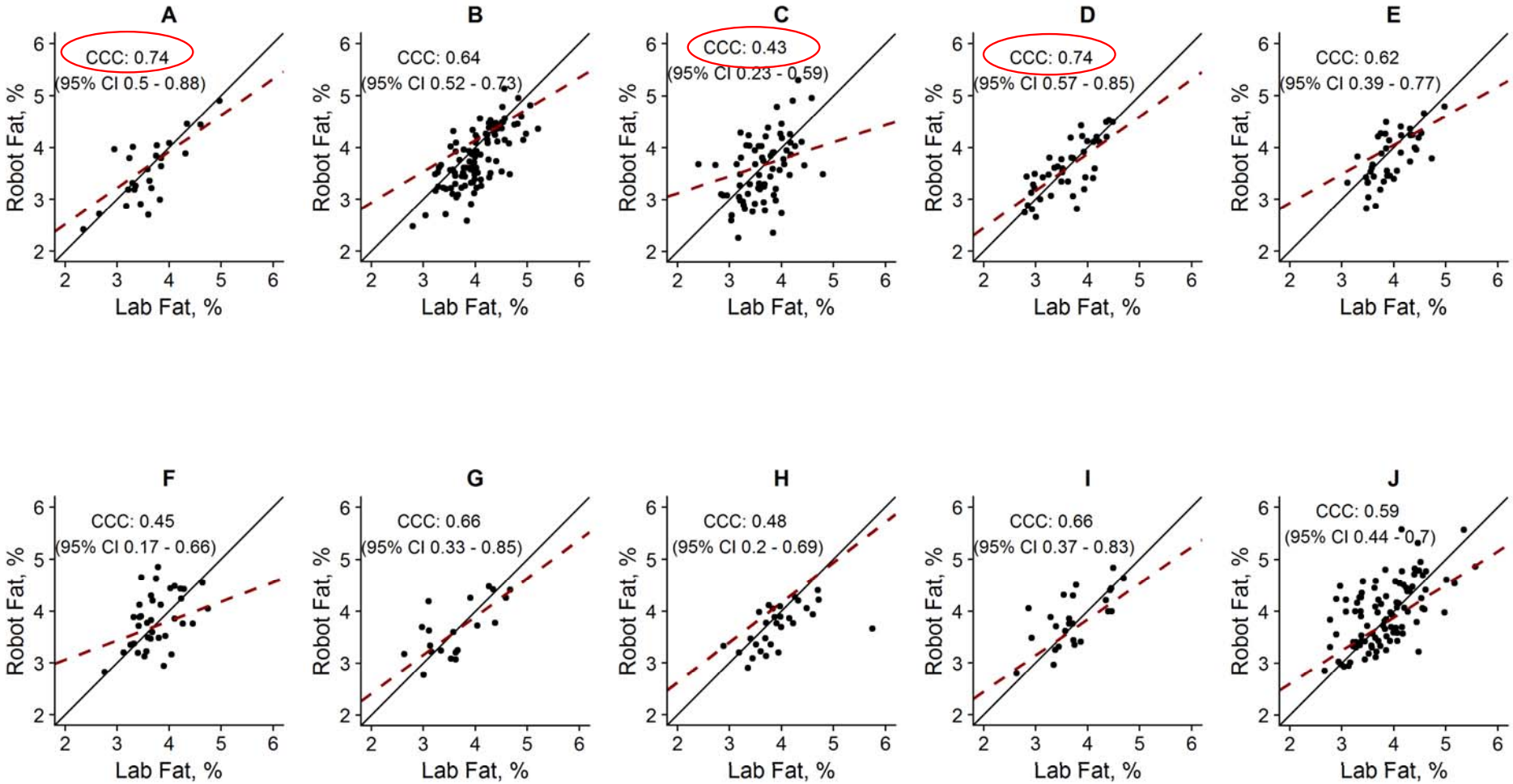
By herd

Differences among herds were larger for fat than for protein percentage (MAE = 0.47 to 0.28%)

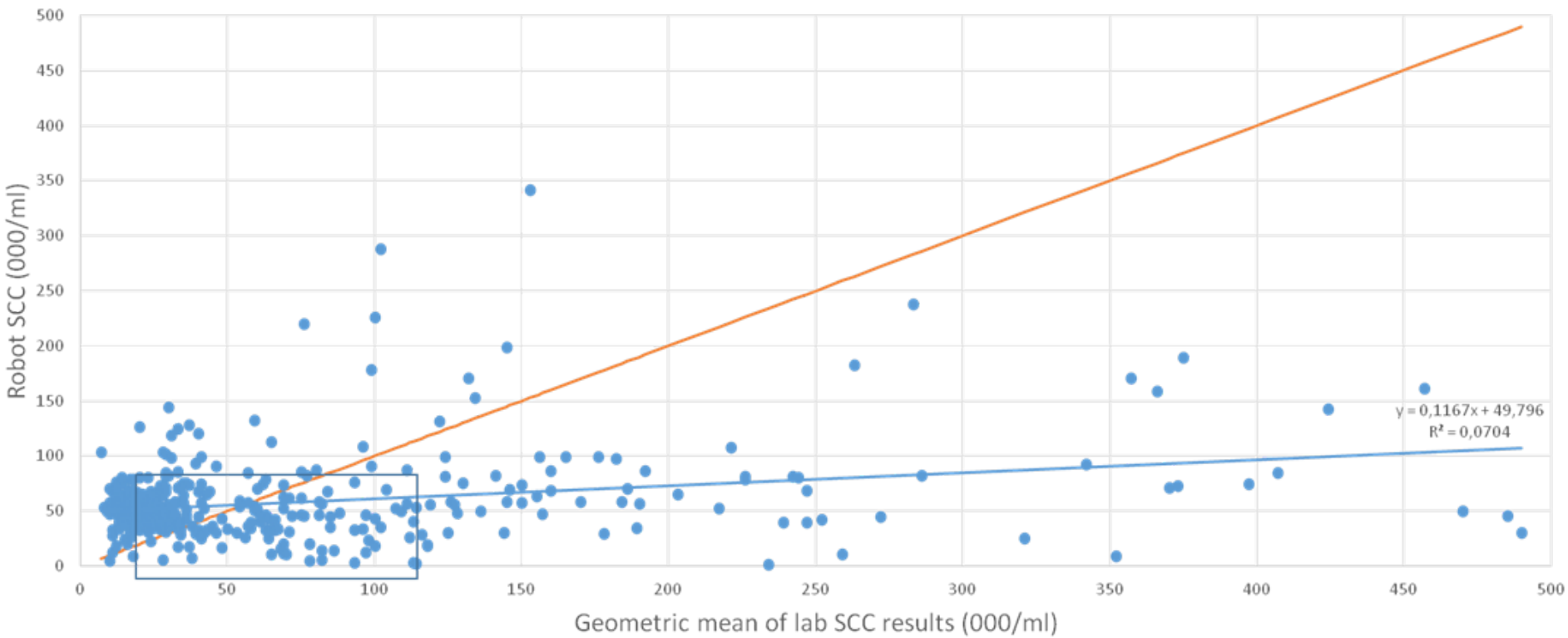


Results

CCC between milk fat percentages from the AMS sensors and the laboratory analysis of the 10 farms

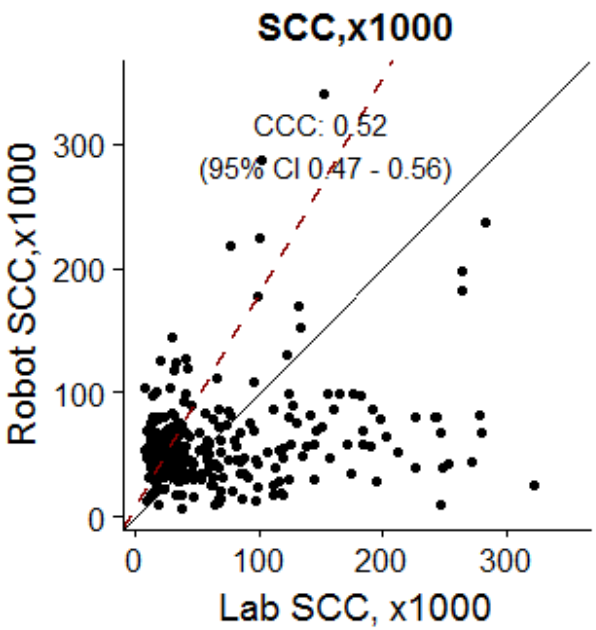


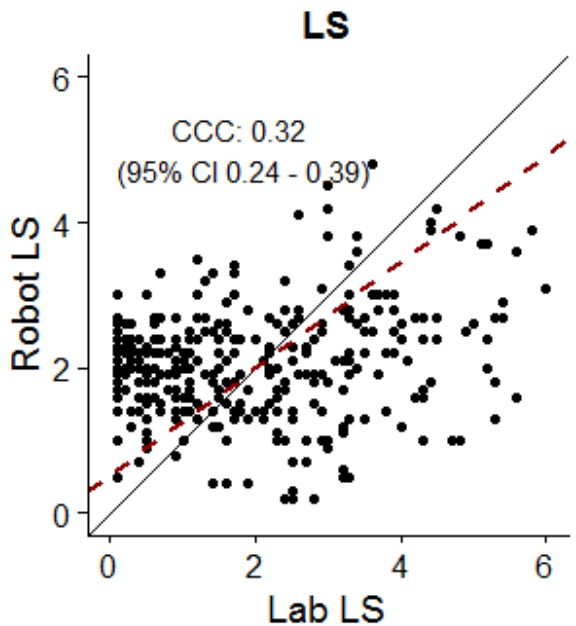
Results - SCC


Robot SCC (000/ml)
Geometric mean of lab SCC results (000/ml)
y = 0,1167x + 49,796
R² = 0,0704
0
50
100
150
200
250
300
350
400
450
500

Results - SCC

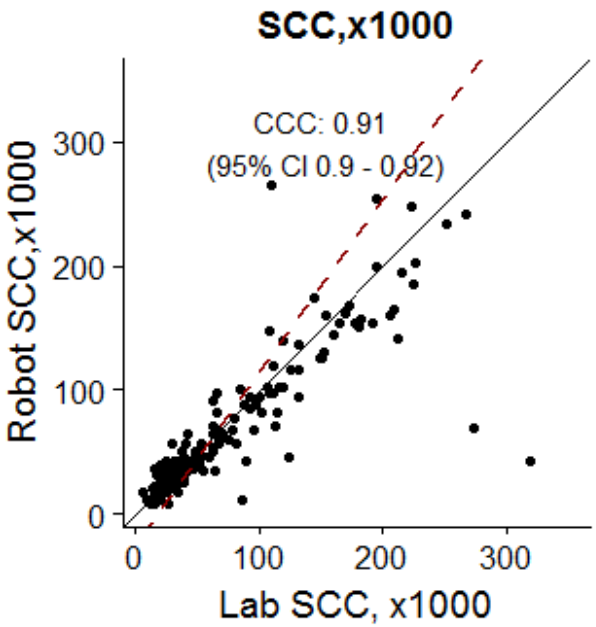
CCC (average 10 farms)

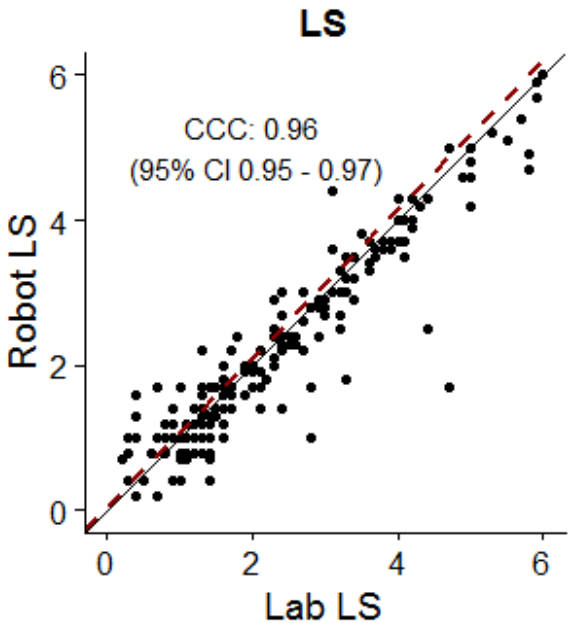




Results

CCC (average 4 herds) DeLaval SCC

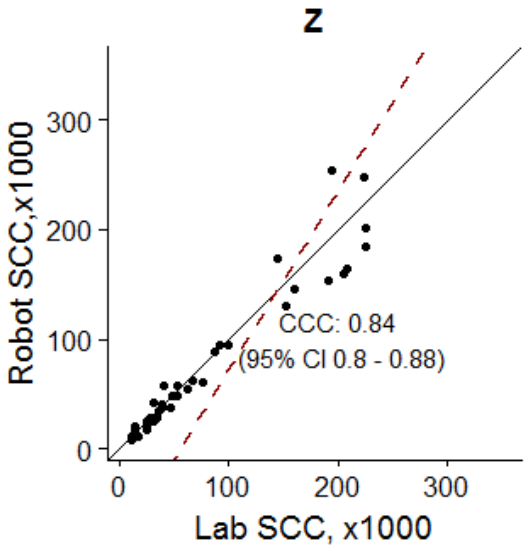


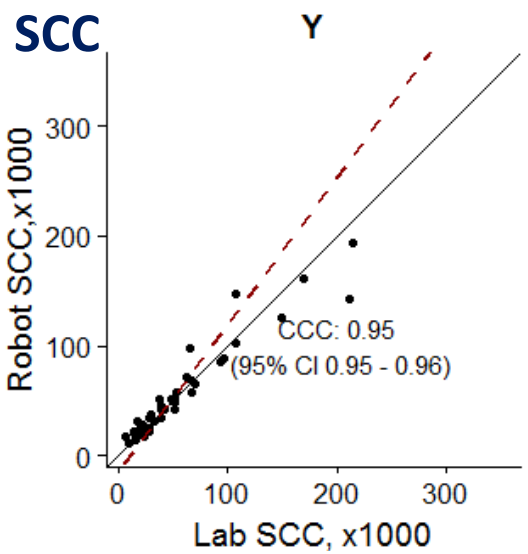


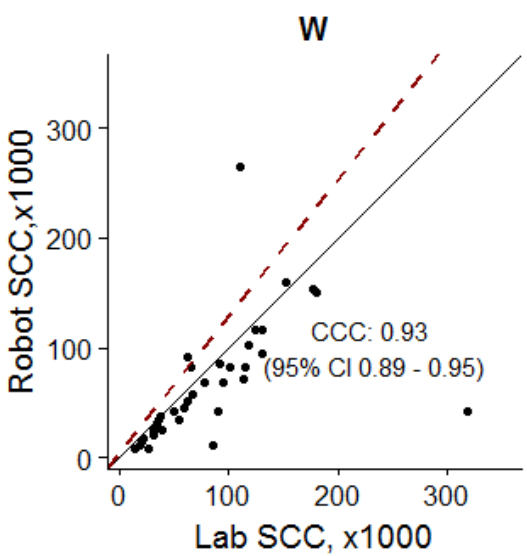
Differences between the SCC (x1000) were -66 ± 364 (MAE = 101)

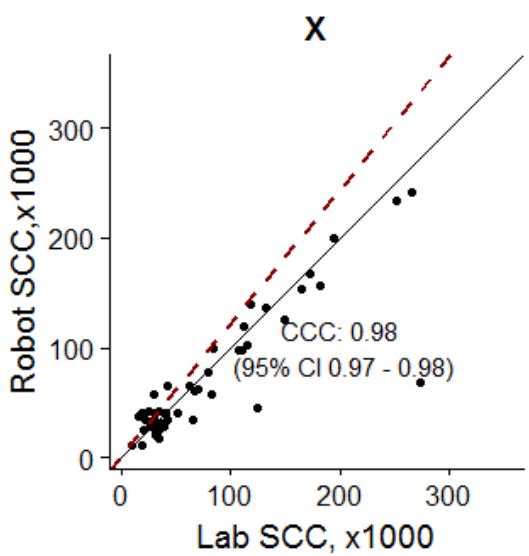
Results

CCC (by herd) DeLaval SCC



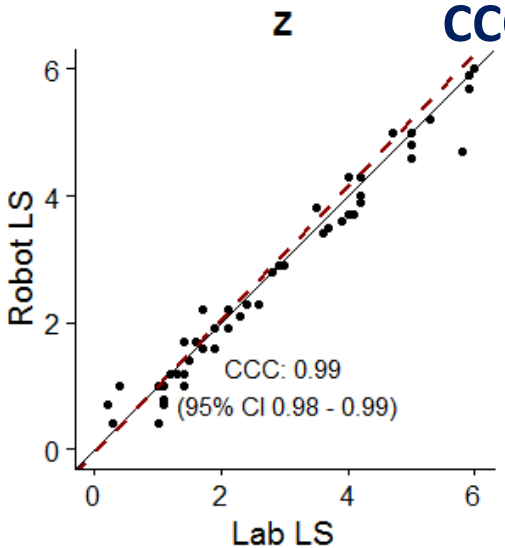


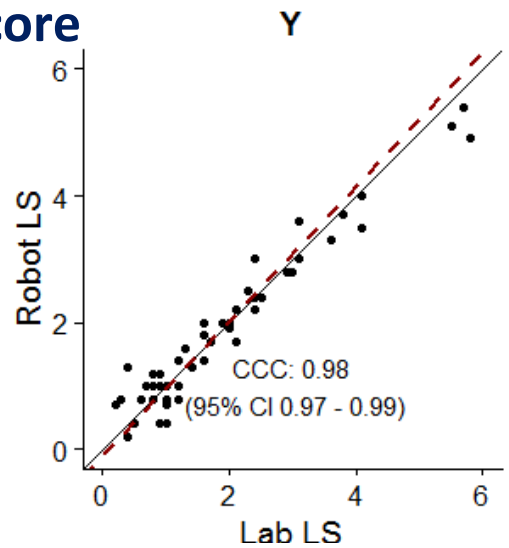


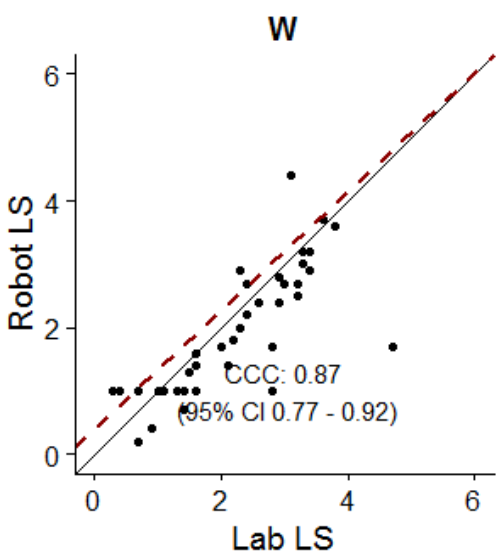


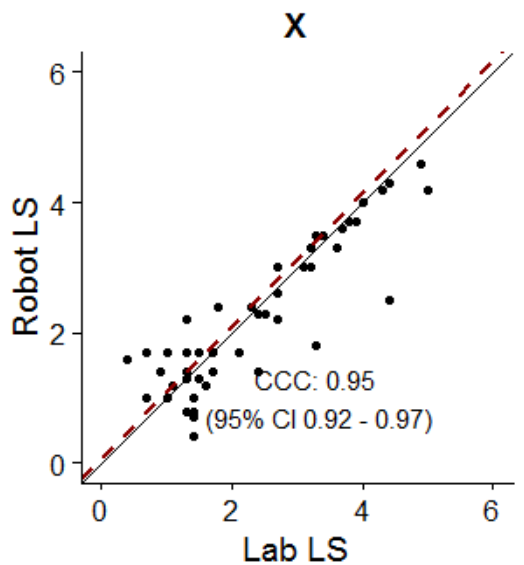
Results

CCC (by herd) DeLaval Linear Score









Discussion

Calibration

•One hypothesis to explain the large inter-herd variations may be the way producers calibrate the sensors.

- Calibration of the Lely AMS sensors can be done in two ways:
  1) At the cow level: using the results of the DHI
  2) At the herd level: using the results of the bulk tank

•Units of the two methods are different in Canada

- DHI is in kg/100kg or percentage
- Bulk tank is in kg/hl or kg/100 litres.
  - Systematic bias of approx. 3% (kg/hl ≈ kg/100 kg x 1.03)
  - Plus, an additional bias of approx. 0.98 % for lactose (bulk tank include lactose and other solids.

•Frequency at which the calibration is made ????

Outlook

- Further work to understand the impact of the calibration frequency and protocol
- Need to identify source of sensor data in central databases
- Evaluate value for genetic evaluation and other usages
- Establish routine data quality checks

This project was funded through the Programme de développement sectoriel, from the agreement, Cultivons l'avenir 2 between the Ministère de l'Agriculture, des Pêcheries et de l'Alimentation du Québec, and Agriculture and Agri-Food Canada.