Standardisation of MIR milk spectra,

a step to build an international spectral database

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PARTNERS

Investing in Opportunities

This project has received European Regional Development Funding through INTERREG IV B.

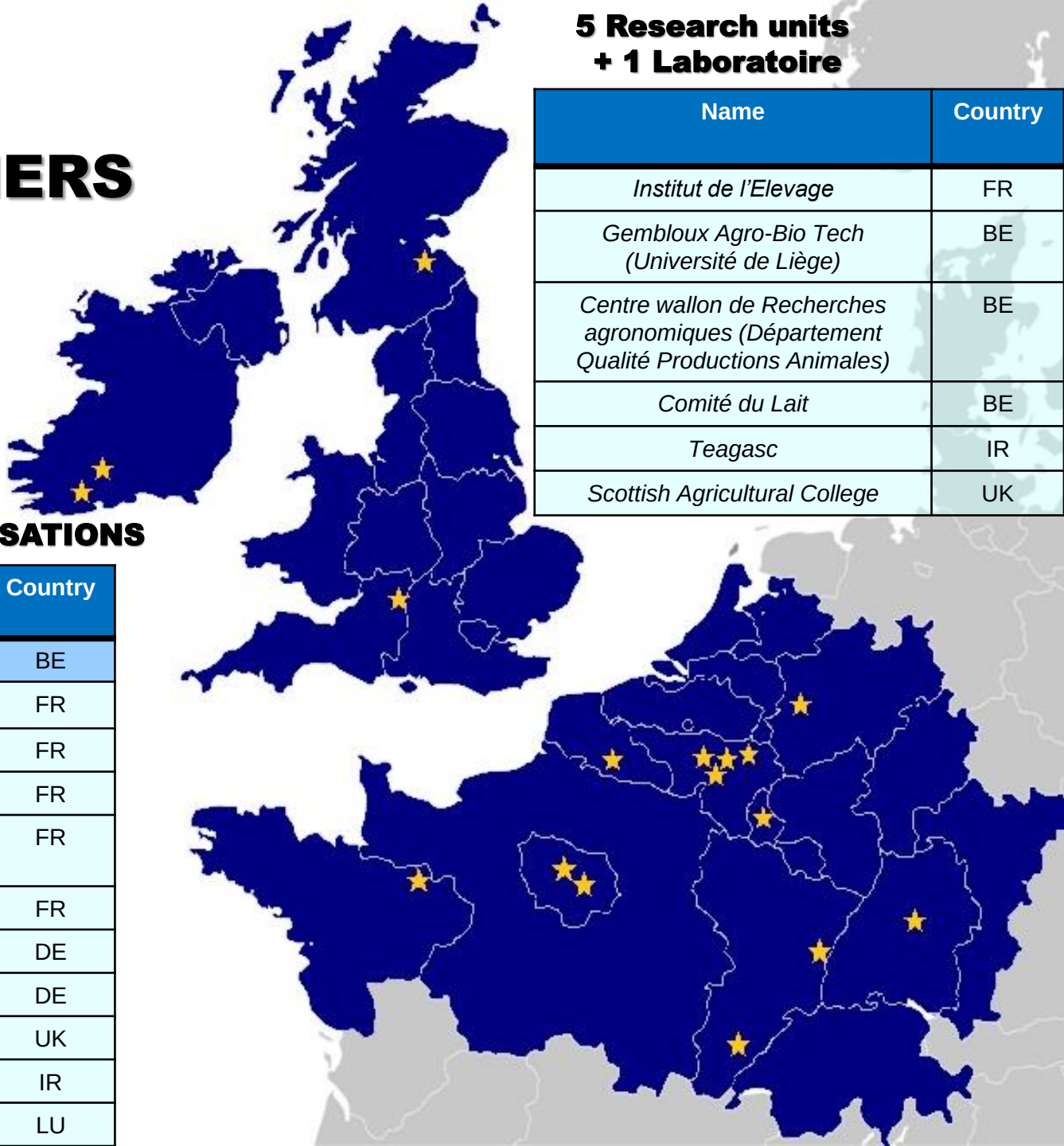
INTERREG IVB

5 Research units + 1 Laboratoire

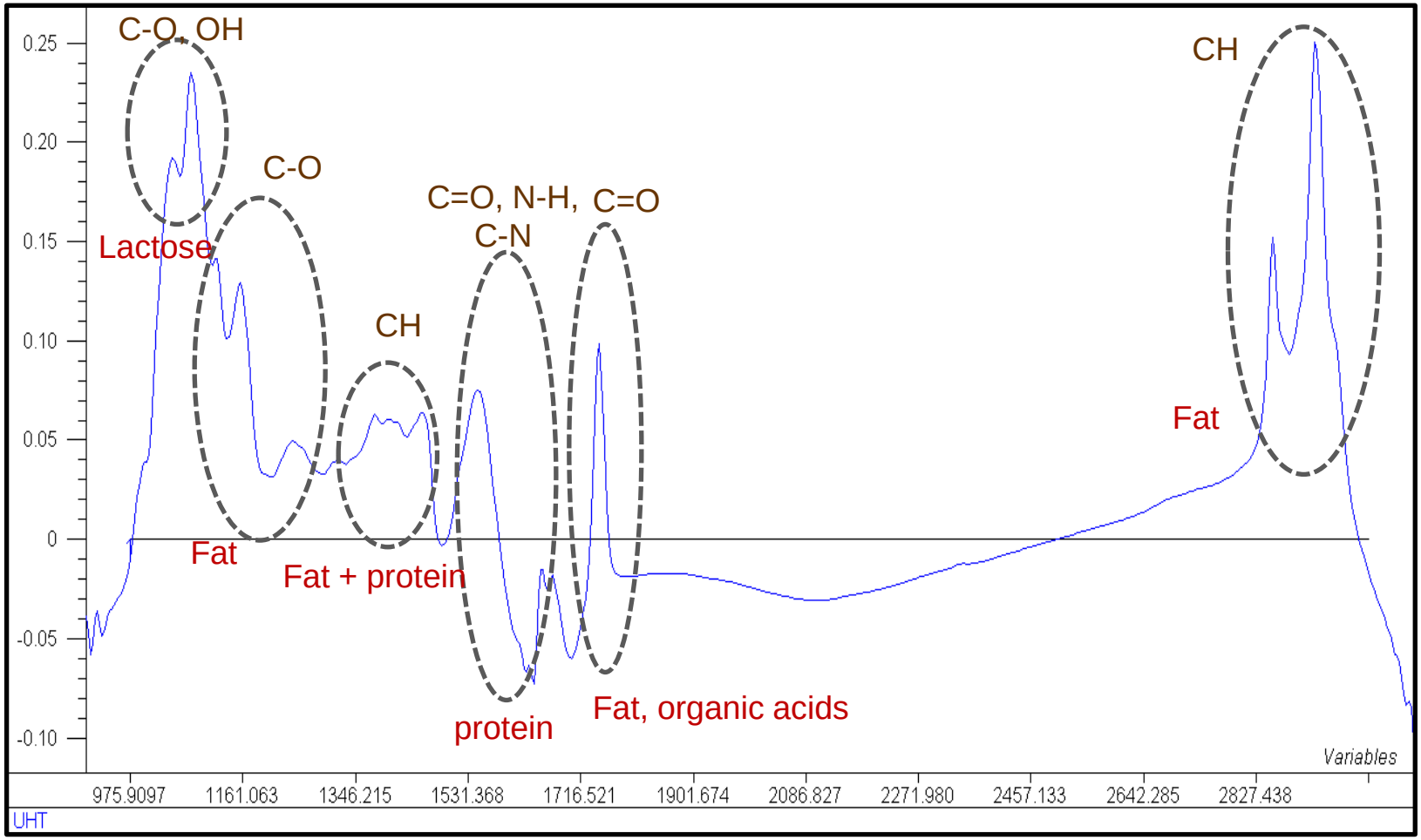
Name	Country
Institut de l'Elevage	FR
Gembloux Agro-Bio Tech (Université de Liège)	BE
Centre wallon de Recherches agronomiques (Département Qualité Productions Animales)	BE
Comité du Lait	BE
Teagasc	IR
Scottish Agricultural College	UK

11 MILK CONTROL ORGANISATIONS

Name	Country
Association Wallonne de l'Elevage	BE
Chambre régionale Agriculture Alsace	FR
ADECL62 (Pas-de-Calais)	FR
CLASEL (Sarthe & Mayenne)	FR
SCL du Doubs et du territoire de Belfort	FR
France Conseil Elevage	FR
LKV Baden-Württemberg	DE
LKV Nordrhein-Westfalen	DE
National Milk Recording	UK
Irish Cattle Breeding Federation	IR
CONVIS	LU



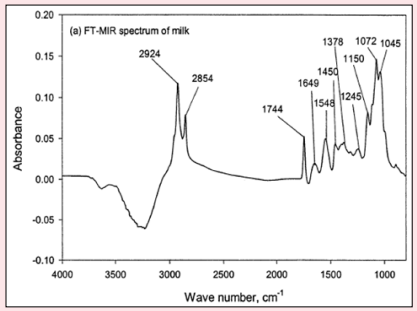
MIR technology



- **Position** of the peaks → **Qualitative** analysis
- **Intensity** of the peaks → **Quantitative** analysis

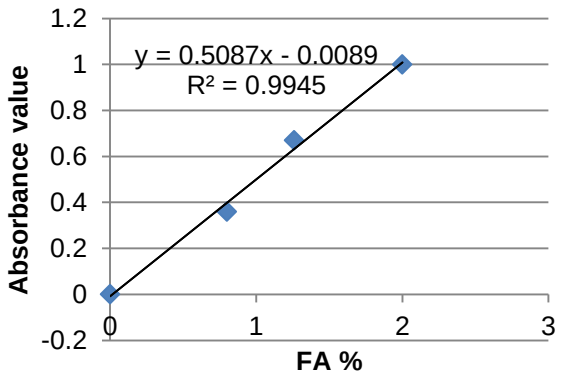
MIR predictions

MIR spectra



Reference analysis

Saturated FA (g/100ml) =ax + b



Saturated FA (g/100ml) = $0.0985 + 4.6191 *X_1 +1.1659*X_2 +1.4827*X_3 +4.1684*X_4 +7.3294*X_5 +9.8991*X_6 +11.183*X_7 +8.0711*X_8 +2.1599*X_9 -0.4619*X_{10} -1.7876*X_{11} -2.5708*X_{12} -2.8941*X_{13} - 2.9217*X1_4 -2.7392*X_{15} -2.2543*X_{16} -1.2677*X_{17} +0.0676*X_{18} +1.0762*X_{19} +1.3228*X_{20} +1.0241*X_{21} +0.536*X_{22} + 0.0177*X_{23} - 0.5265*X_{24} -1.1445*X_{25} -1.8178*X_{26} +-2.212*X_{27} -2.0766*X_{28} +- 8.3083*X_{29} -3.703*X_{30} +-1.1999*X_{31} +-0.5698*X_{32} -0.1674*X_{33} +0.246*X_{34} +0.666*X_{35} +1.2938*X_{36} +2.0946*X_{37} -0.0689*X_{38} - 1.4774*X_{39} -1.7984*X_{40} -2.0553*X_{41} -2.9338*X_{42} -4.644*X_{43} -6.764*X_{44} -8.1475*X_{45} -5.6904*X_{46} +2.6657*X_{47} +10.9883*X_{48}+14.4346*X_{49} +13.8878*X_{50} +10.2135*X_{51}+4.8464*X_{52} -1.2081*X_{53}-7.4854*X_{54}- 11.6799*X_{55} -12.6849*X_{56} -10.7724*X_{57} -4.8936*X_{58} + 0.4425*X_{59} +3.583*X_{60}+……+2 .9636*X_{310} +6.4566*X_{311}$

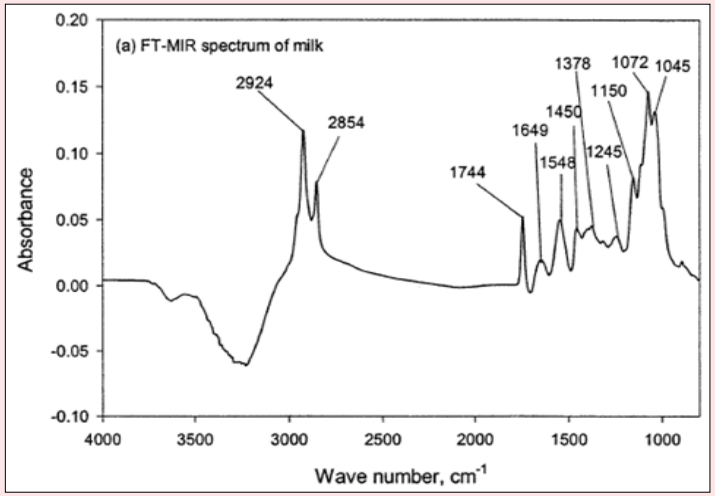
MIR technology

Classical use of MIR spectra :

Milk control

MIR

MIR spectra of each cow



Milk composition

Fat
Proteins
Urea
FA
...

Fast
Cheap

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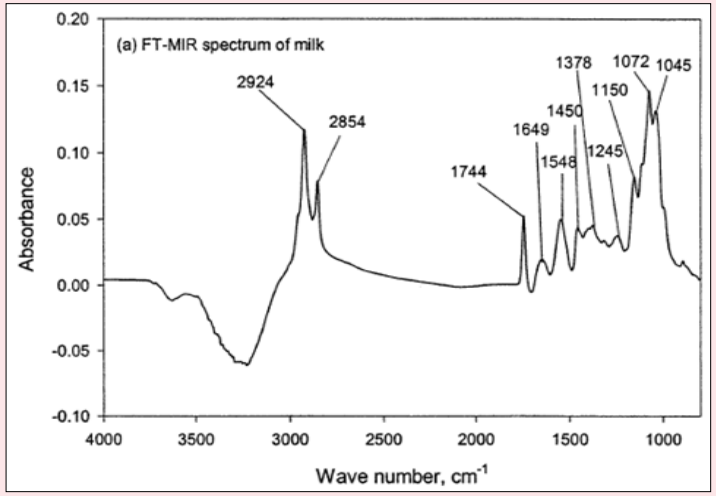
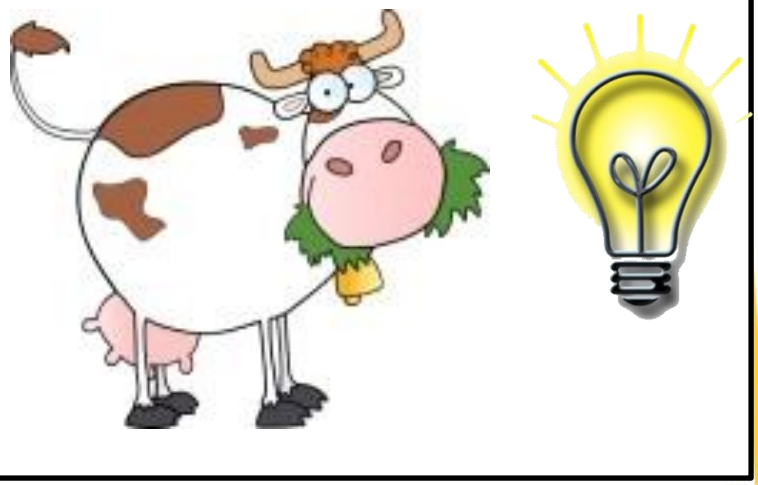
Innovative view of OptiMIR:

Spectra MIR



Cow state



Prediction tools fast, cheap, via milk control organisations

Informations on :
- **fertility**
- **feeding**
- **health**
- **environmental impact**

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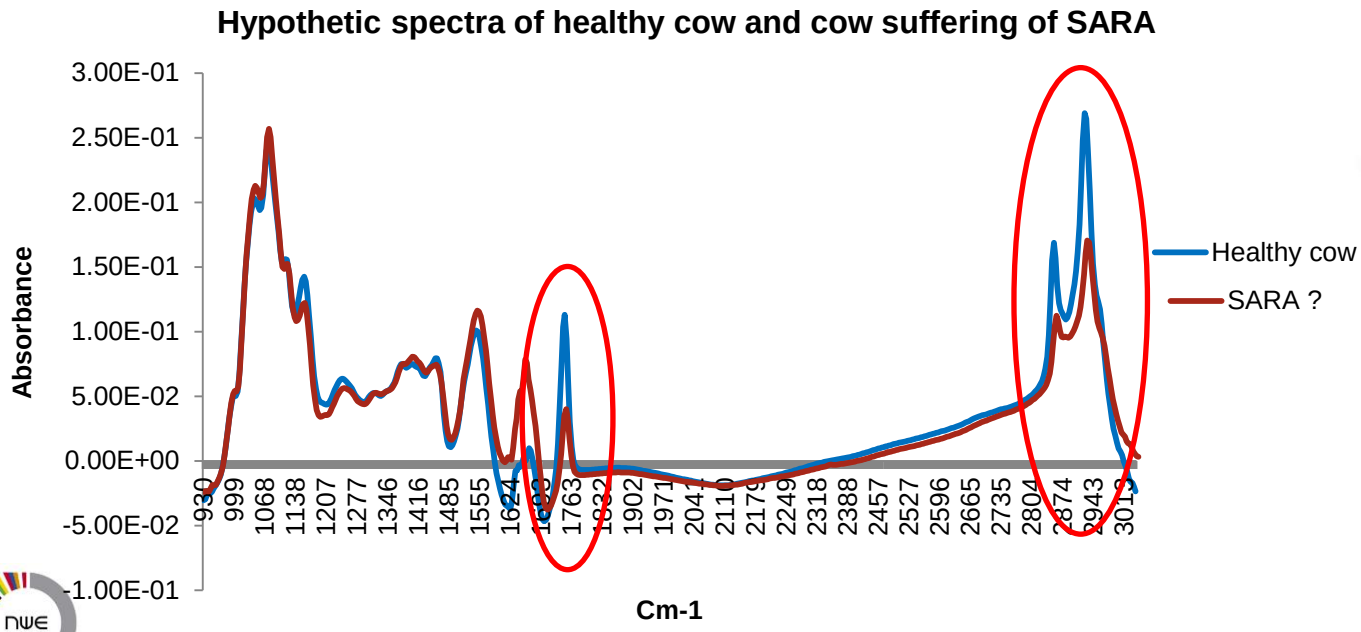
Concrete example: SARA

Impact of SARA on fat rate, fatty acid profile… (Sauvant et al., 1999; Colman et al,, 2010)



STEP N°1

Combine data from each MRO :

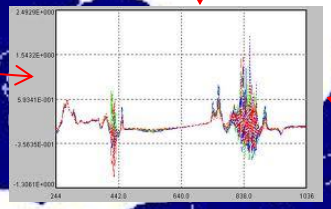
Spectra MIR + Fertility, health, feeding and environmental data

Transnational database

Prediction tools of cows states

Issue

No standard format !!



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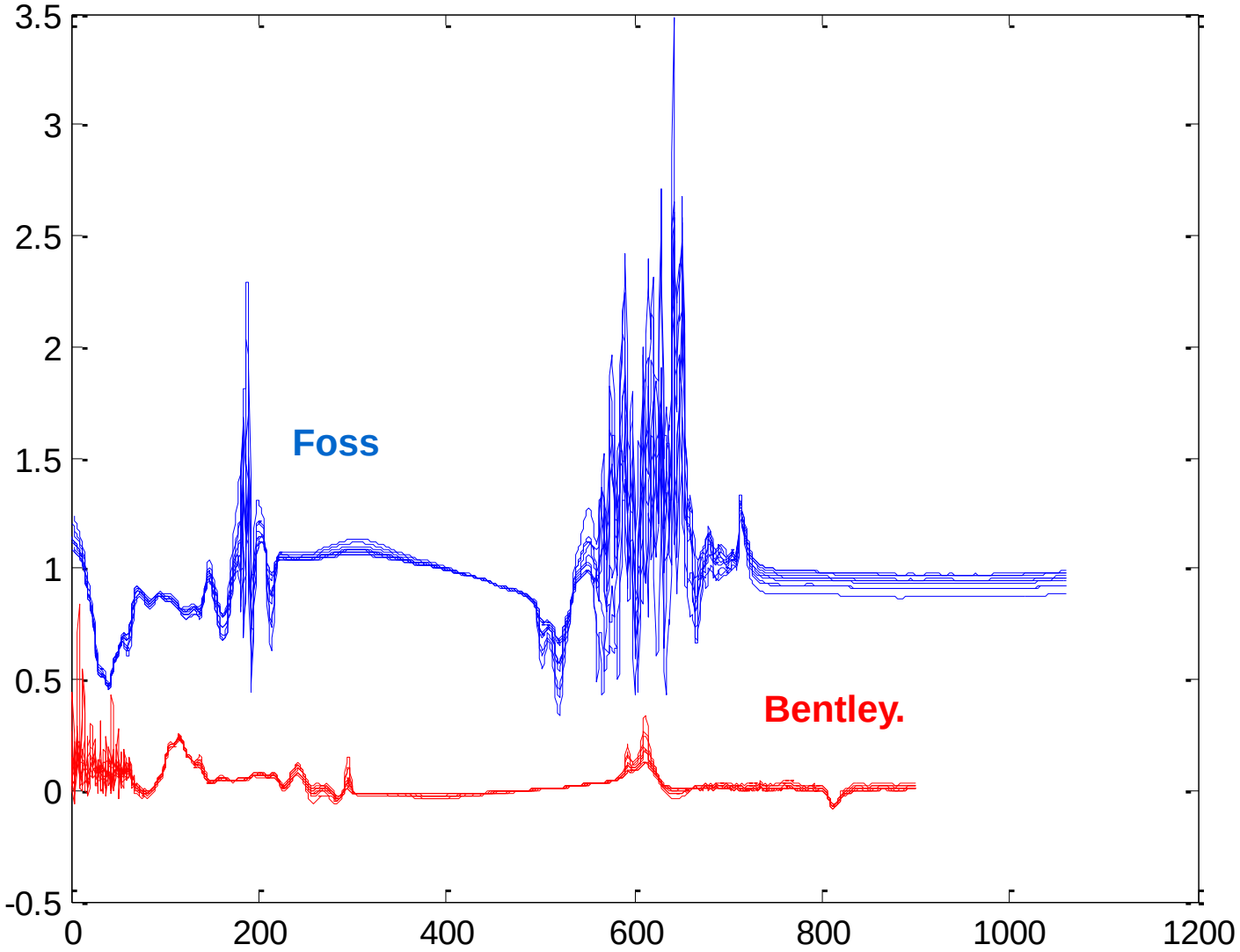
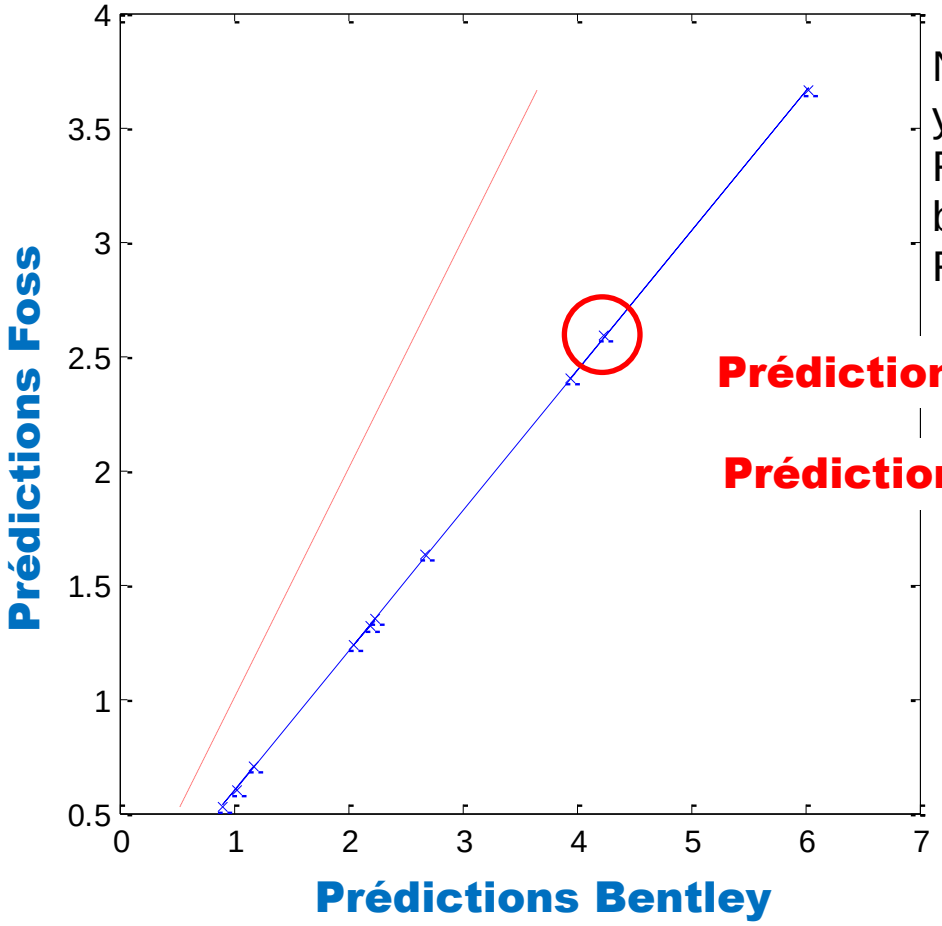
10 spectra from identical milks :



Predictions fat with raw spectra :



N= 10
y= -0.019098+0.612
R square= 0.99995
biais= 1.0452
RMSE= 1.2073

Prédiction Foss : 2.6%

Prédiction Bentley : 4.3%

Need of spectral standardisation

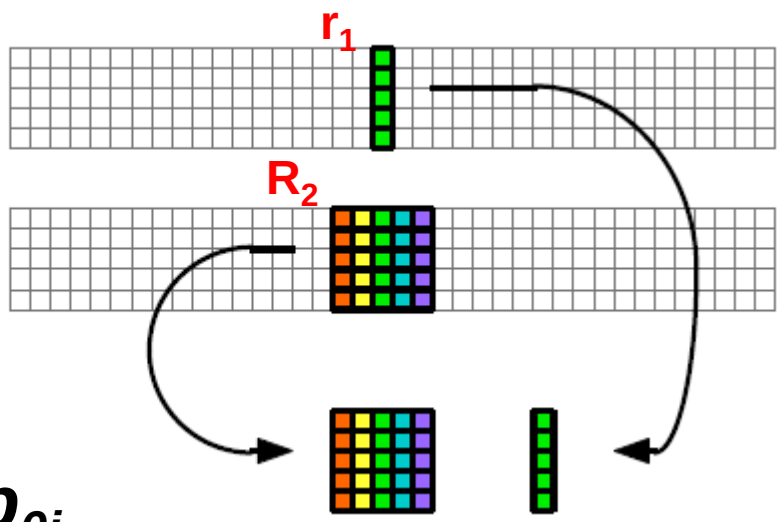
PIECE-WISE DIRECT STANDARDIZATION (PDS)

Absorbance in the area of r_1 (master)

→ correlated to R_2 (slaves)

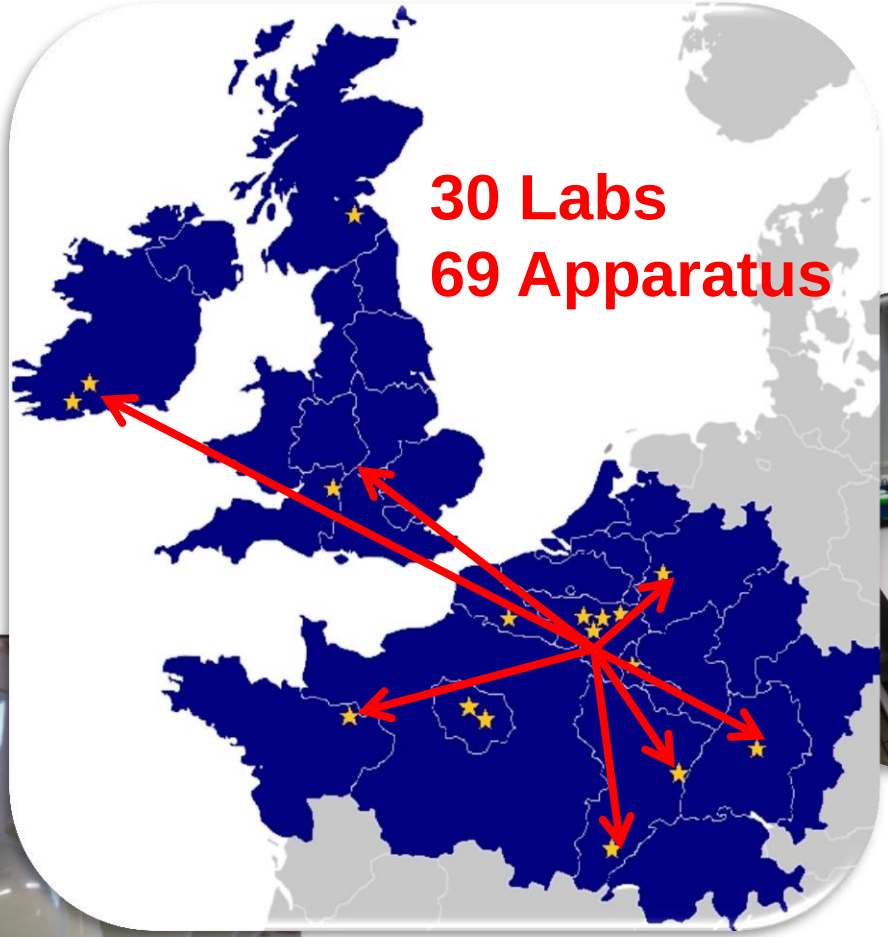
« Master »

« Slave »

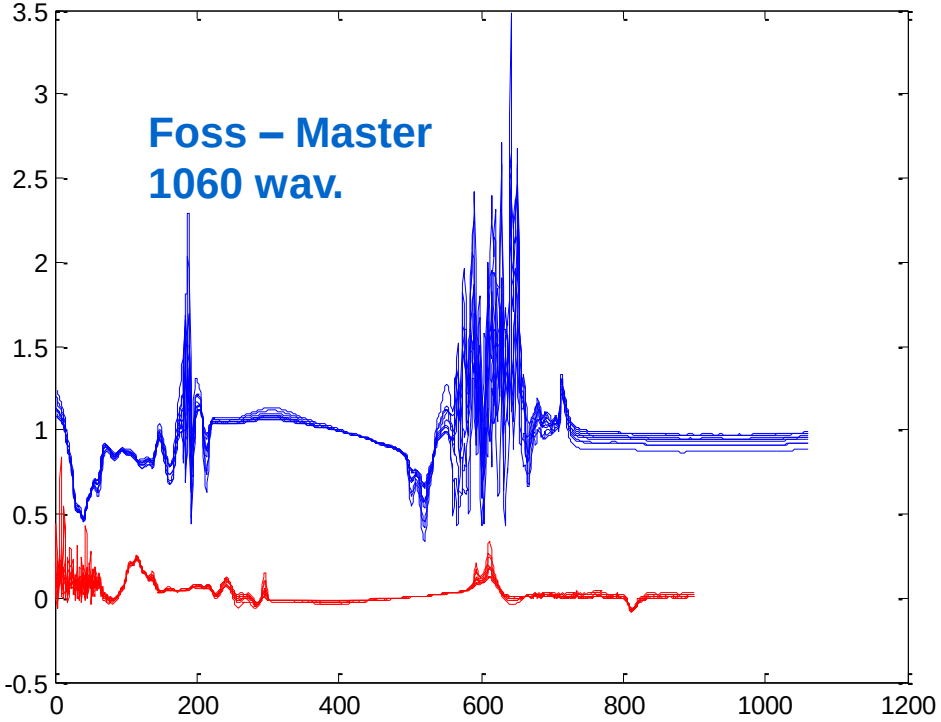


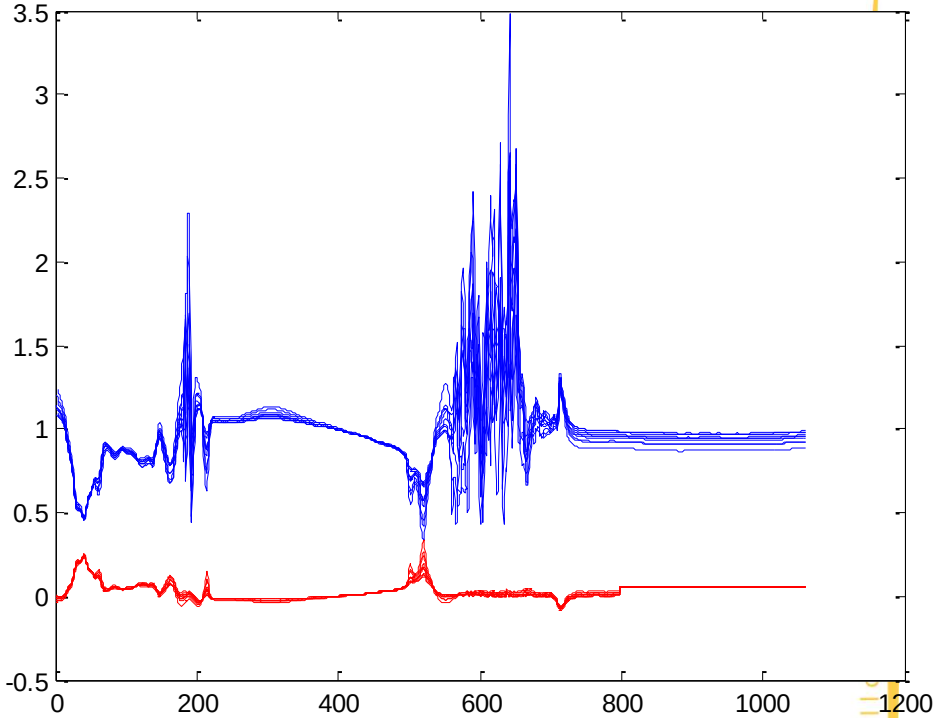
$$r_{1j} = R_{2j}\, b_j + b_{0j}$$

Method



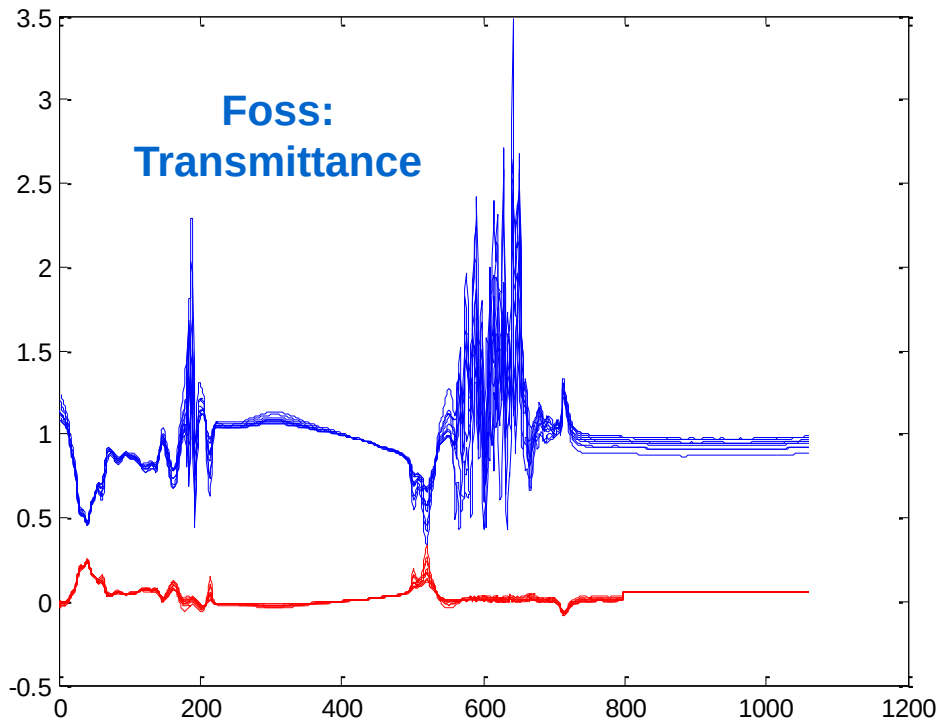
Method

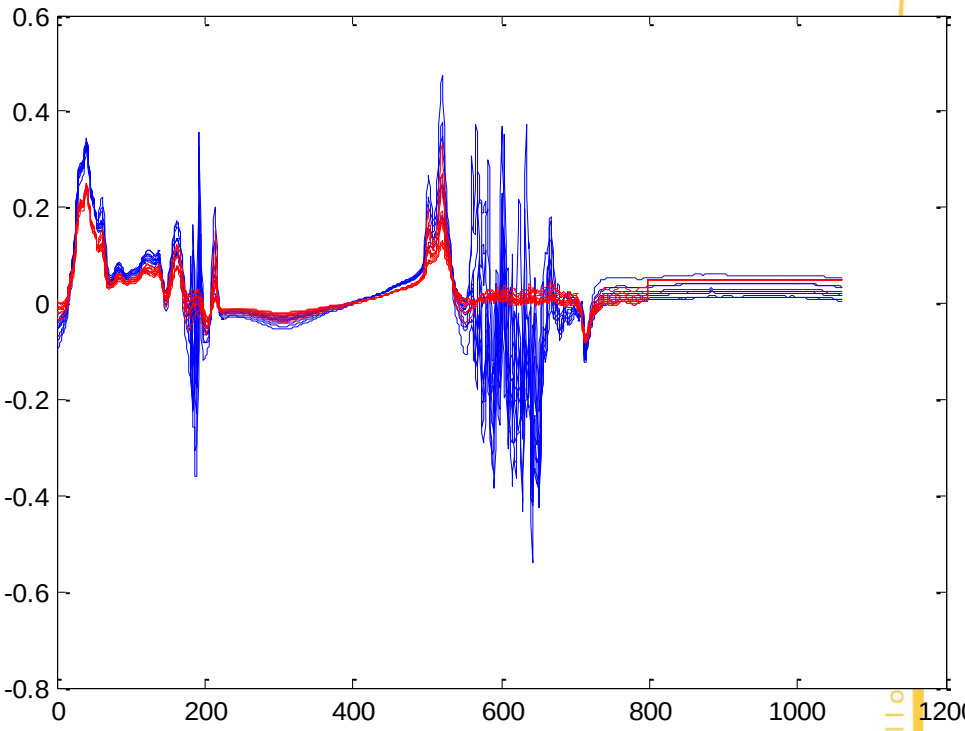




Interpolation

Method





Bentley: Absorbance

Logarithmic transformation

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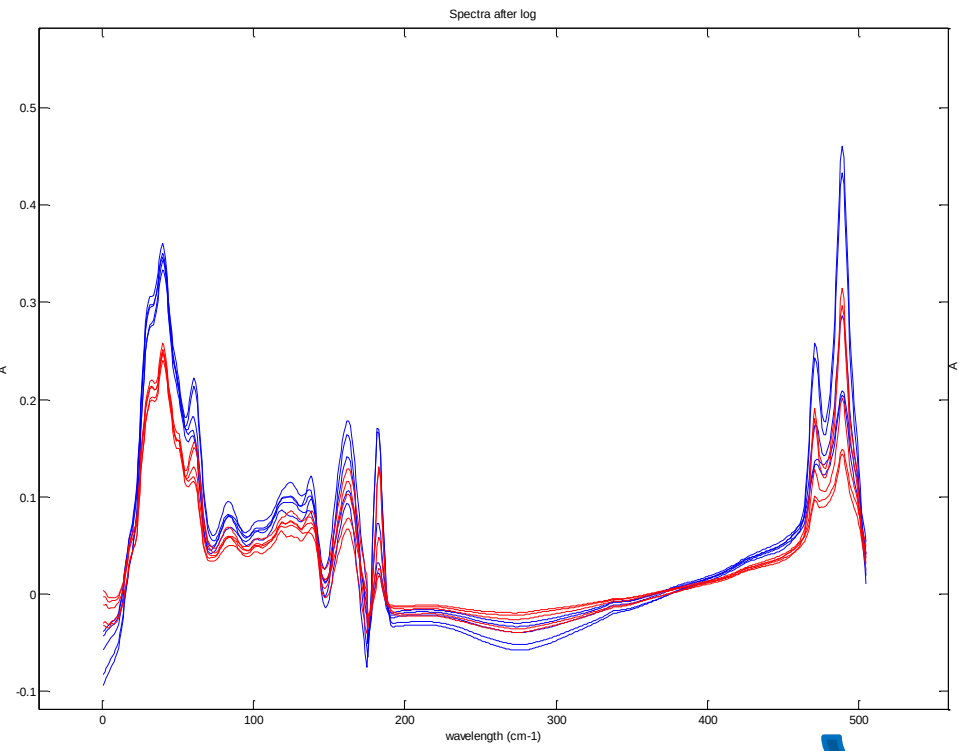
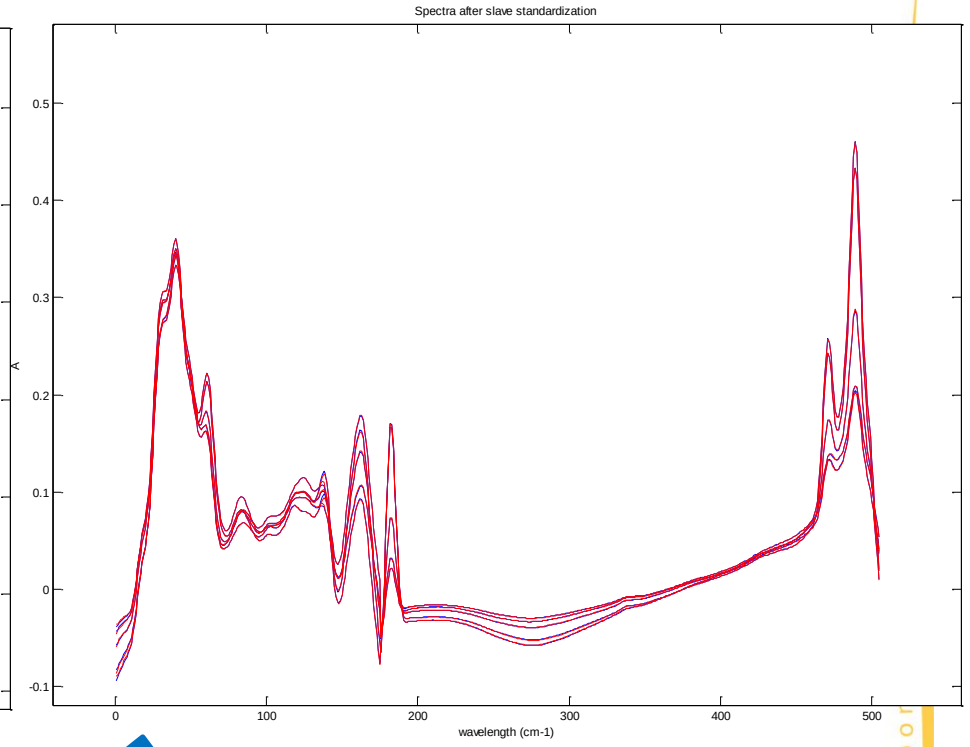
Method





PDS

Possibility to merge spectra into a common database

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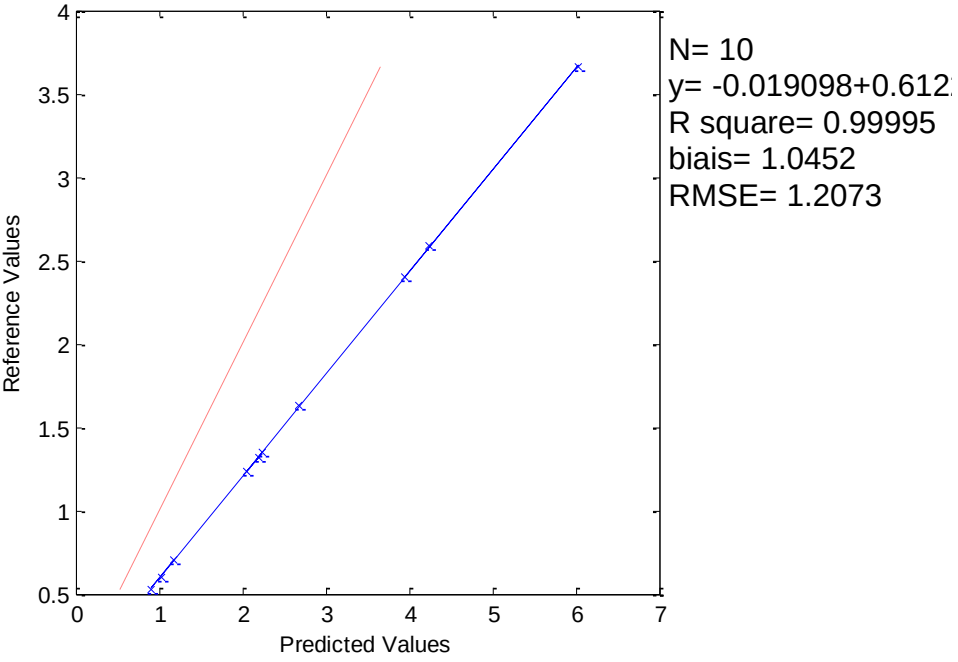
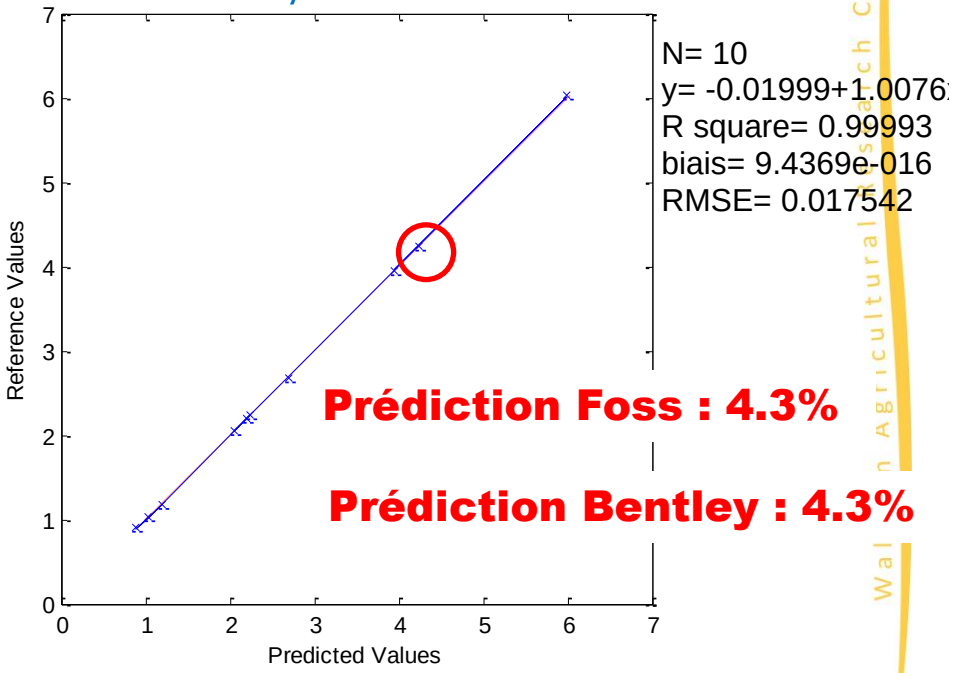
Results

Test: application of fat prediction

Regression of fat prediction Master/Slave before PDS



Regression of fat prediction Master/Slave after PDS



Prédiction Foss : 4.3%

Prédiction Bentley : 4.3%

Possibility to create and use models on all apparatus

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Application

Example of first tools: Methane prediction equation (A.Vanlierde, 2013)

368 Foss spectra

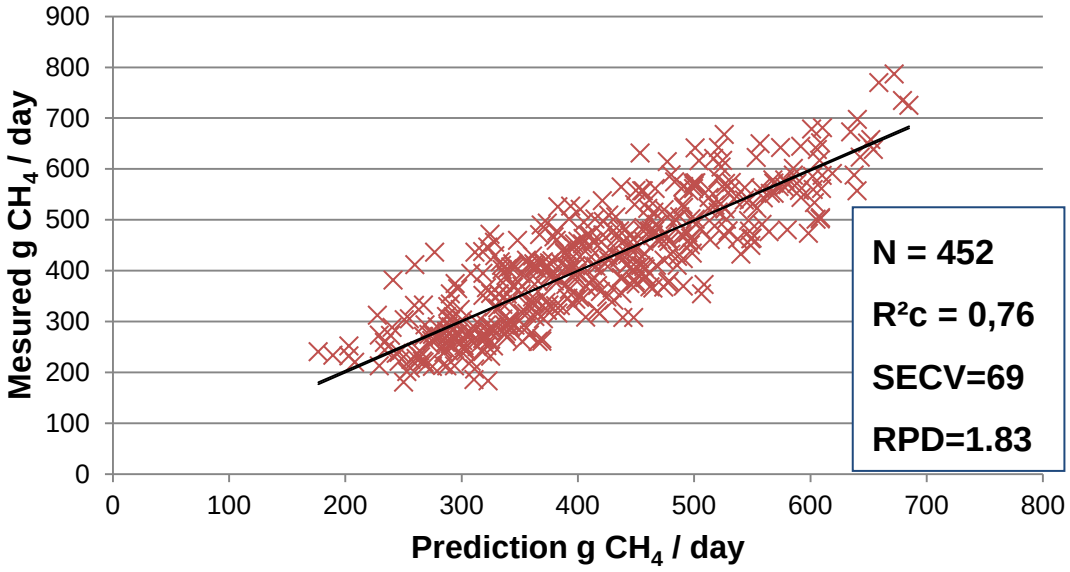
+

84 Delta spectra

= 452 spectra in a common format

+

Reference values (SF6)



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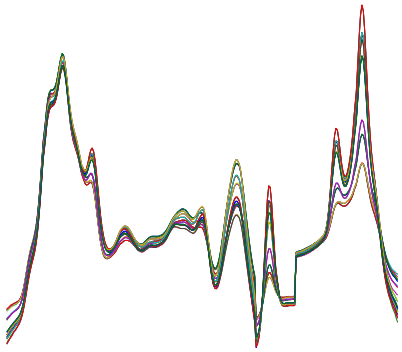
Conclusion

- ✓ **PDS allows to group spectra from all apparatus in a common database**

- ✓ **Allows to create and use universal equation on all apparatus**

2015



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Thanks for your attention !

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Investing in Opportunities

This project has received European Regional Development Funding through INTERREG IV B.

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