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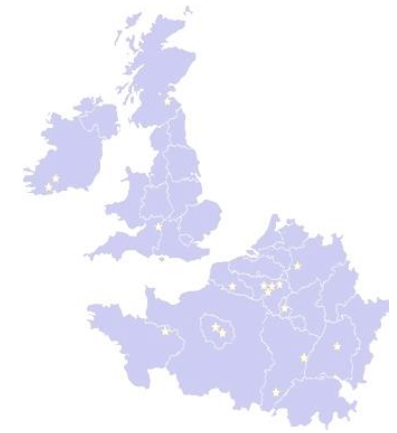


# Potential for assessing the pregnancy status of dairy cows by mid-infrared analysis of milk

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# Context of an European project



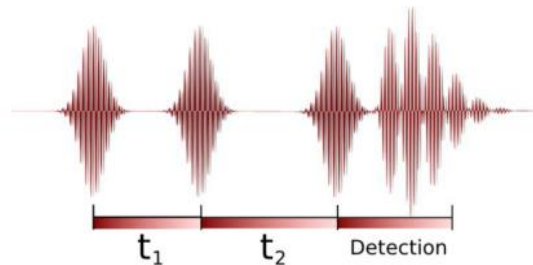
## OptiMIR

17 European partners → Common database

Milk recording organizations, research centers, milk analysis laboratory

*„New tools for a more sustainable dairy sector“*

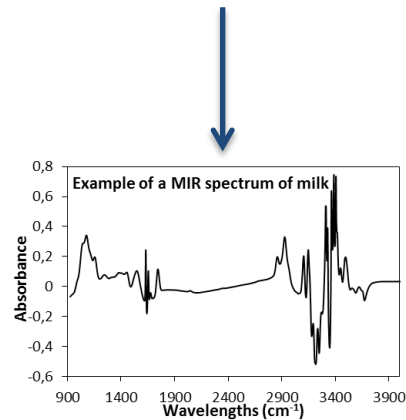
Based on mid-infrared spectral information from milk



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- ✓ Fertility
- ✓ Feeding
- ✓ Health
- ✓ Rejection of pollutants
- ✓ Milk quality

# Use of MIR spectrum of milk from milk recording programs

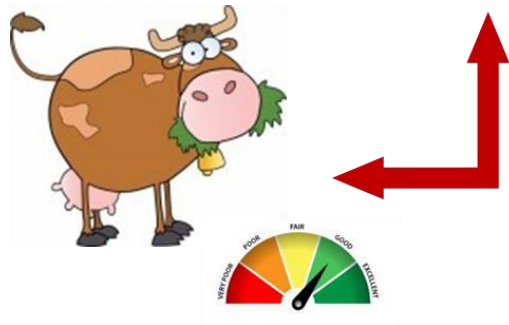
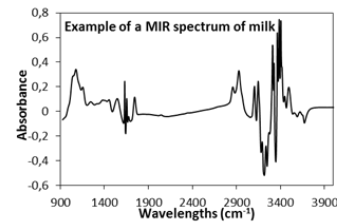


Fat  
Protein  
Lactose  
Urea  
Fatty acids  
Minerals  
Lactoferrin  
...



# Provide a signal of the pregnancy status from the MIR milk spectrum

*Why a pregnancy diagnosis?*



*Does the observed MIR spectrum belong to a pregnant cow or not ?*

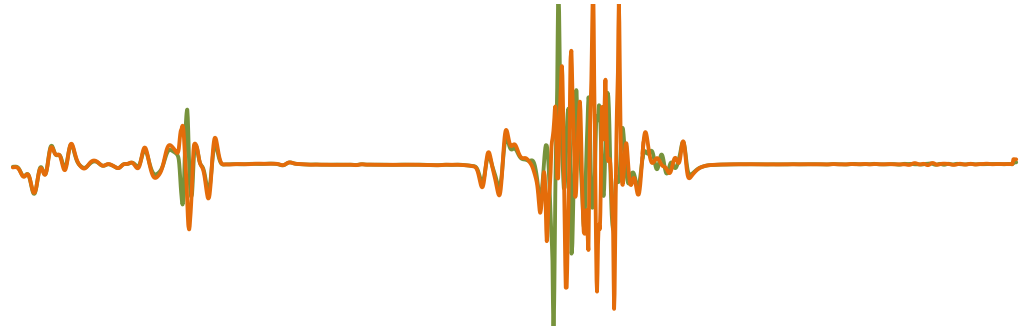
# Remove all factors influencing the shape of the spectra and not due to the pregnancy



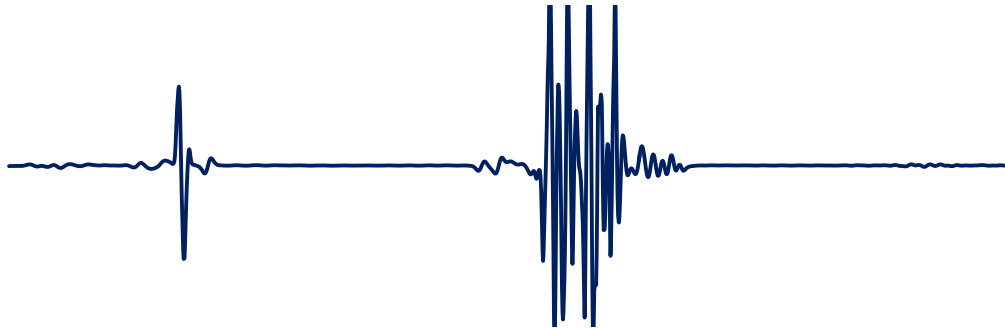
**Expected open spectrum** = The expected spectrum for the same day in milk if the animal was open



# Remove all factors influencing the shape of the spectra and not due to the pregnancy



$$\text{Residual spectrum} = \text{Observed spectrum} - \text{Expected open spectrum}$$



Reproductive status  
Unaccounted factors  
Errors

Residual spectra are used to perform discrimination between two groups of classification (Pregnant cow and non-pregnant cow)

# Model the expected open spectra

Dataset from Walloon Breeding Association (AWE, Belgium)

*348,191 observations (spectra)*

*2 years of records*

*49,849 cows from 920 herds*

Mixed model using fixed effects (parity, breed, ...)  
and random effects (animal, ...)

Data from open observations

*159,844 observations (spectra)*

*from known open cows*

# Construct a predictive equation to assign a new observation as coming from a pregnant or open cow

Perform the residual spectra of the whole dataset

*Residual = Observed - Expected*

The discriminant analysis was used with 2 groups of classification (Open vs Pregnant) and with residual spectral point as predictors

## *Training dataset*

*75% of lactations randomly selected*

*From 20 to 120 days after an insemination*

*Same proportion of pregnant and open observations*

*7,524 observations (residual spectra)*

## *Testing dataset*

*25% of lactation*

*From 20 to 120 days after an insemination*

*24,278 observations*



# Good results of classification compared to classical pregnancy diagnosis

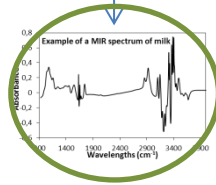
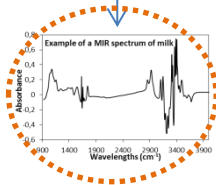
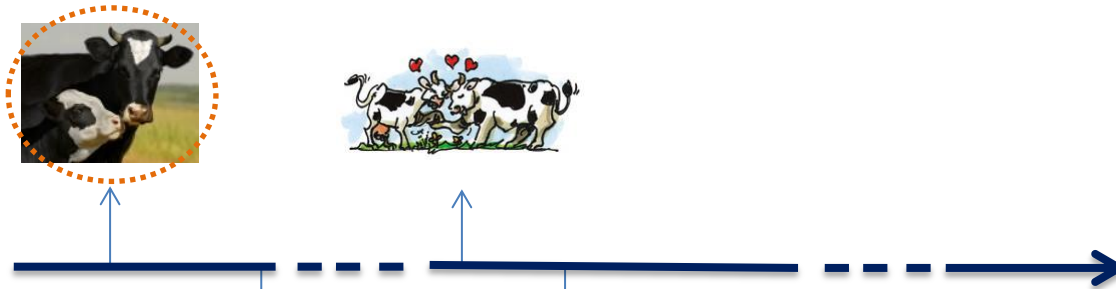
Error rate of classification on the testing dataset was 6.4% with a specificity of 95.3% and a sensibility of 93.5%

Days after insemination	N Open	N Pregnant	Error rates	Specificity	Sensibility
<b>21 – 30</b>	592 (22.2%)	2,071 (77.8%)	3.2%	96.8%	82.2%
<b>31 – 40</b>	489 (18.9%)	2,093 (81.1%)	10.5%	93.1%	88.7%
<b>41 – 50</b>	154 (6.8%)	2,126 (93.2%)	8.8%	96.1%	90.8%

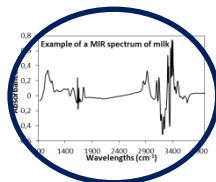
Specificity is defined as the ability of the equation to predict correctly open cows among all observations belonging to open cows

Sensibility is defined as the ability of the equation to predict correctly pregnant cows among all observations belonging to pregnant cows

# How the tool will concretely work on field conditions, a suggestion



Observed - Expected



= Residual

*Cow pregnancy status uncertain, this cow should be tested by a vet*

*Cow status considered as pregnant*

# Just a little part of MIR opportunities and OptiMIR project

Adapted to the scheme of a milk recording program  
but may be adjusted

*Off-farm tool*

*On-farm tool*

...

Example of the pregnancy diagnosis but may be adjusted  
to give information on other animal status

*Metabolic disorders*

*Udder health*

*Energy balance*

...



# Final *OptiMIR* scientific and expert meeting

16-17 April  
2015

PALAIS DES CONGRÈS  
NAMUR • BELGIUM

Held in conjunction  
with the IDF/ISO  
Analytical Week  
2015 in Namur  
(Belgium)  
from 12-17 April 2015





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Wallonie



Service public de Wallonie

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