WITH THE SUPPORT OF

Investing in Opportunities

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

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

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65th EAAP Annual Meeting, Copenhagen, Denmark, August 25th – 29th 2014

Context of an European project

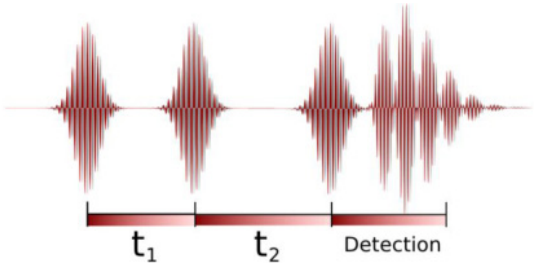
OptiMIR

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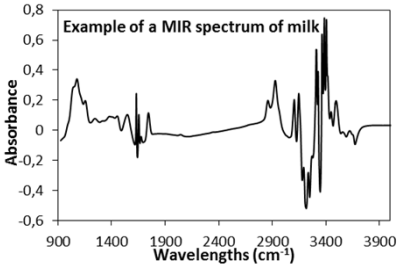
- ✓ Fertility
- ✓ Feeding
- ✓ Health
- ✓ Rejection of pollutants
- ✓ Milk quality

Use of MIR spectrum of milk from milk recording programs



Fat

Protein

Lactose

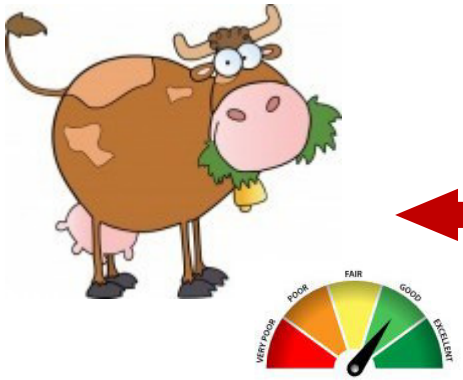
Urea

Fatty acids

Minerals

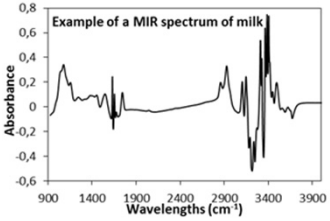
Lactoferrin

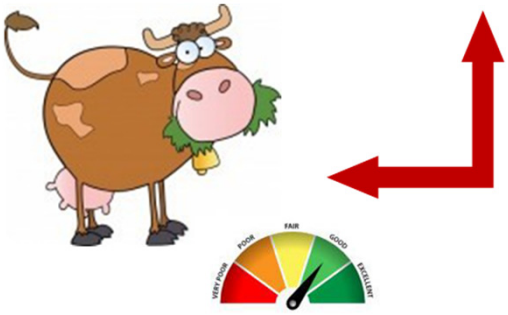
...



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

Why a pregnancy diagnosis?

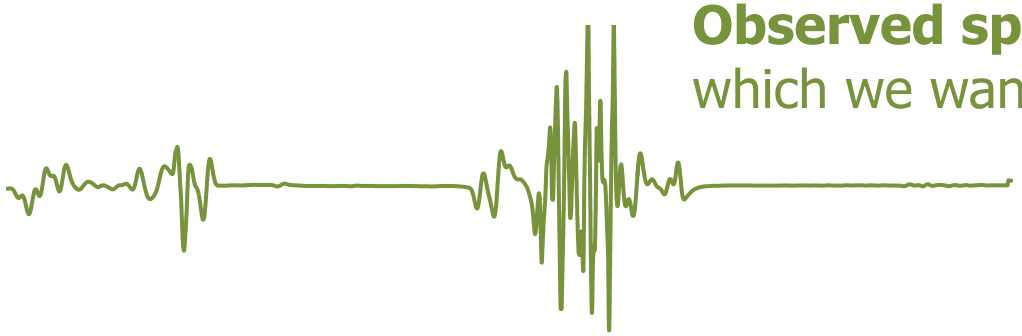




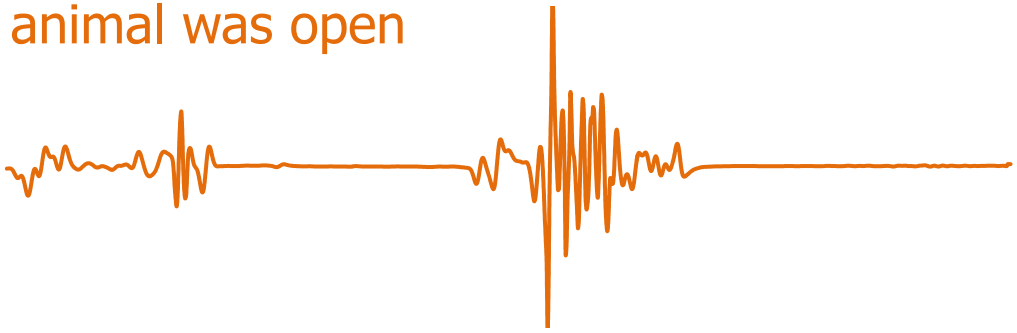
Does the observed MIR spectrum belong to a pregnant cow or not ?

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

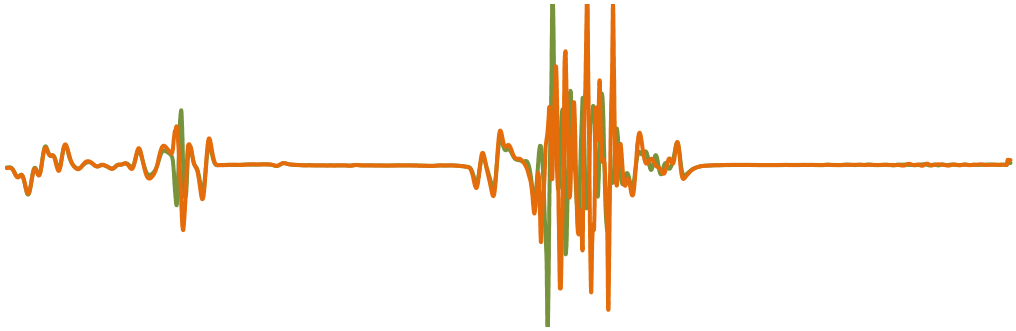
Observed spectrum = Milk sample on which we want to test the pregnancy



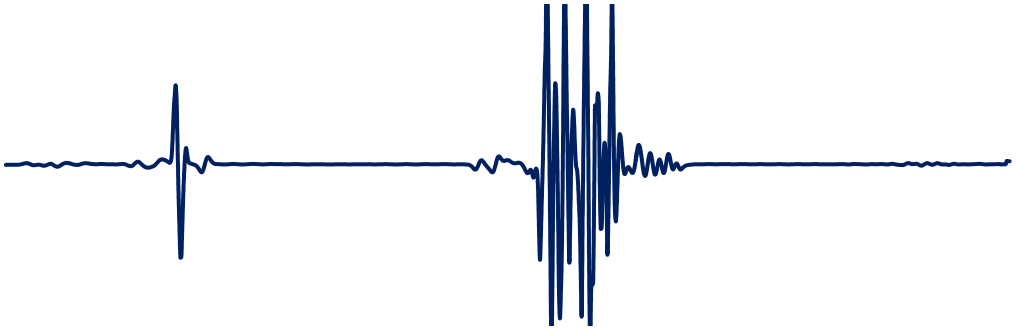
Expected open spectrum = The expected spectrum for the same day in milk if the animal was open



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



Residual spectrum =
Observed spectrum – 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

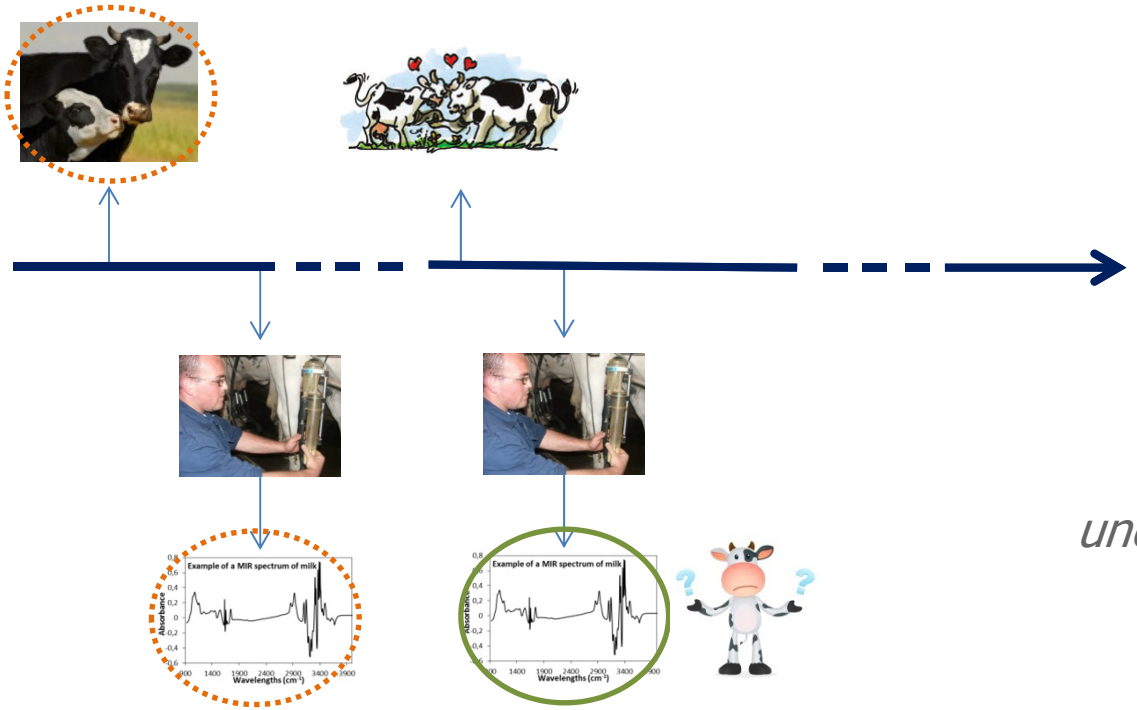
Error rate of classification on the testing dataset was 6.4% with a specificity of 95.3% and a sensibility of 93.5%

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

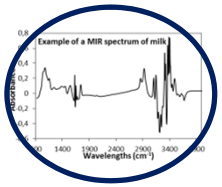
Specificity is defined as the ability of the equation to predict correctly open cows among all observations belonging to open cows

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
…

namurpalais descongrès

From Milk analysis to advisory tools

Final OptiWR scientific and expert meeting

16-17 April 2015

PALAIS DES CONGRÈS
NAMUR • BELGIUM

Held in conjunction with the 2015 ISO/IDF analytical week

Held in conjunction with the IDF/ISO Analytical Week 2015 in Namur (Belgium)

from 12-17 April 2015

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Wallonie

SPW Service public de Wallonie

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