

“Calibration, monitoring and control approach for multi-devices system performing analysis in rough environment”

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Outlines

- In-line milk analysis
- Multiple sensor system as part of an automated data collection system
- Calibration, monitoring and control
- Summary



In-line Real time milk analyzer



- ✓ Free flow - Continuously measures milk components during milking
- ✓ Non destructive Measurement – No use of reagents needed
- ✓ Provides daily milk analysis for animal health and performance
- ✓ Easy maintenance
- ✓ Part of the regular cleaning system in the milking parlor

**Automated coupling of the “lab” to each stall in real time
at an affordable price**



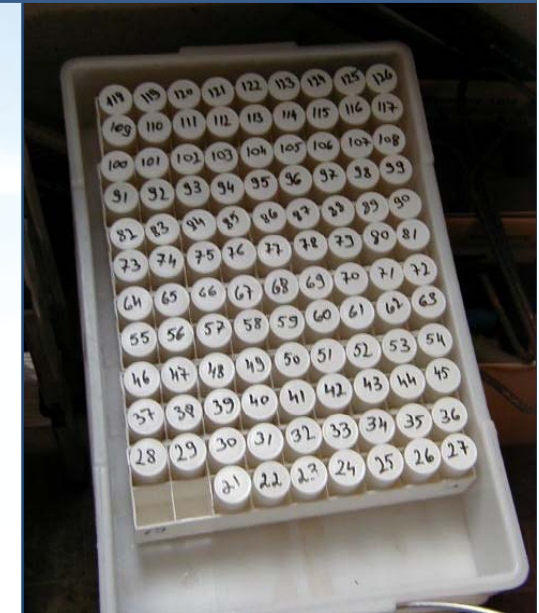
Daily analysis of milk components shifts the emphasis in the data from genetic improvement to farm management.

The same evolution that occurred with the introduction of the first electronic milk meter - is now expected.



Requirements:
Low cost
Robust
Easy to maintain

Trade off:
Accuracy cannot
be as good as the
lab



AfiLab is an extension to the milk meter adding extra abilities evaluating milk components daily.

afimilk®
The Heart of the Dairy Farm



Stand-alone analytical device – QA/QC

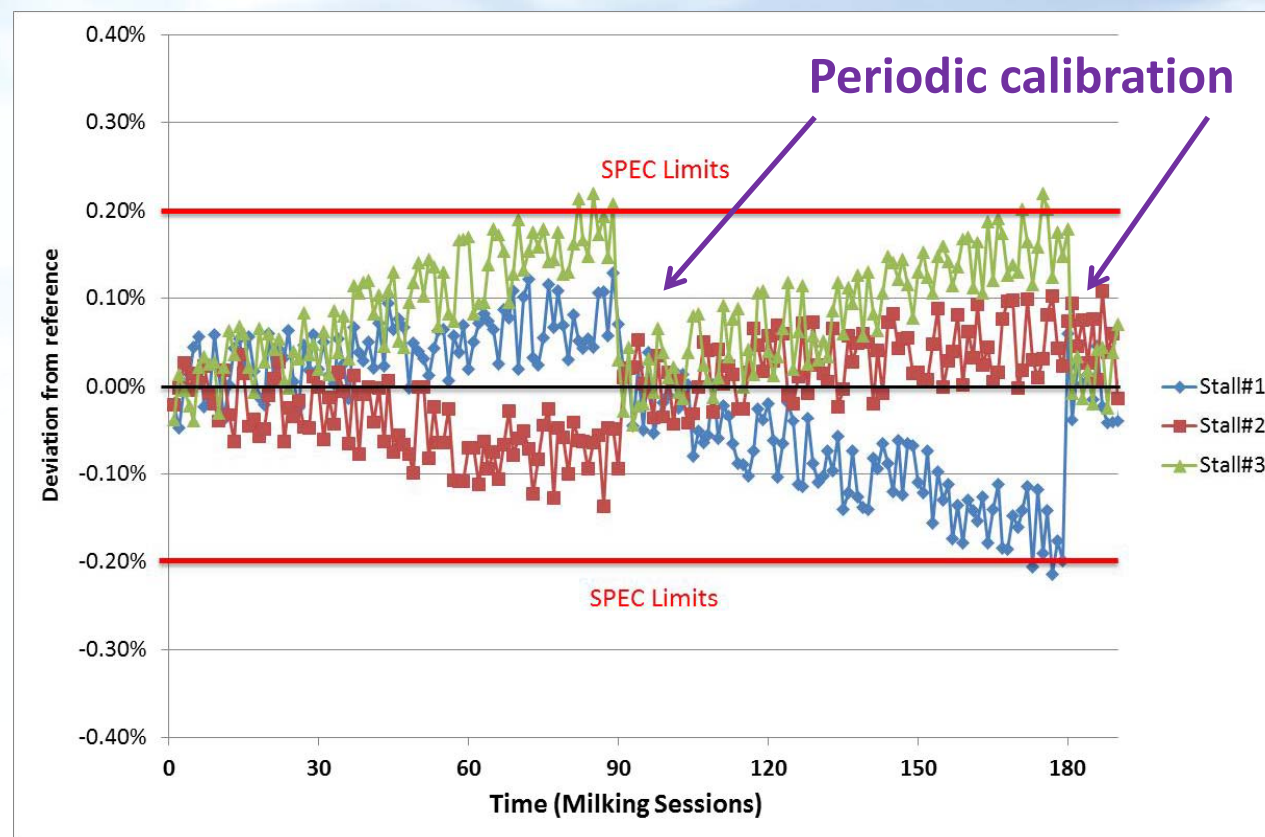
Any analytical technique requires careful calibration.
QA/QC demands calibration through several steps
including check sample, calibration verification and
calibration standards.

**The standard lab maintenance and calibration routine
is not practical in the parlor**

New approach is required



The problem: Stability between periodic calibrations (illustration)



The solution: Routine maintenance protocol for in-line milk analysis system

- Daily monitoring
- Calibration inspection
- Problem detection and classification (internal device problems, maintenance problems in the parlor, Cow's & Group problem)
- Compensation and/or Alarm



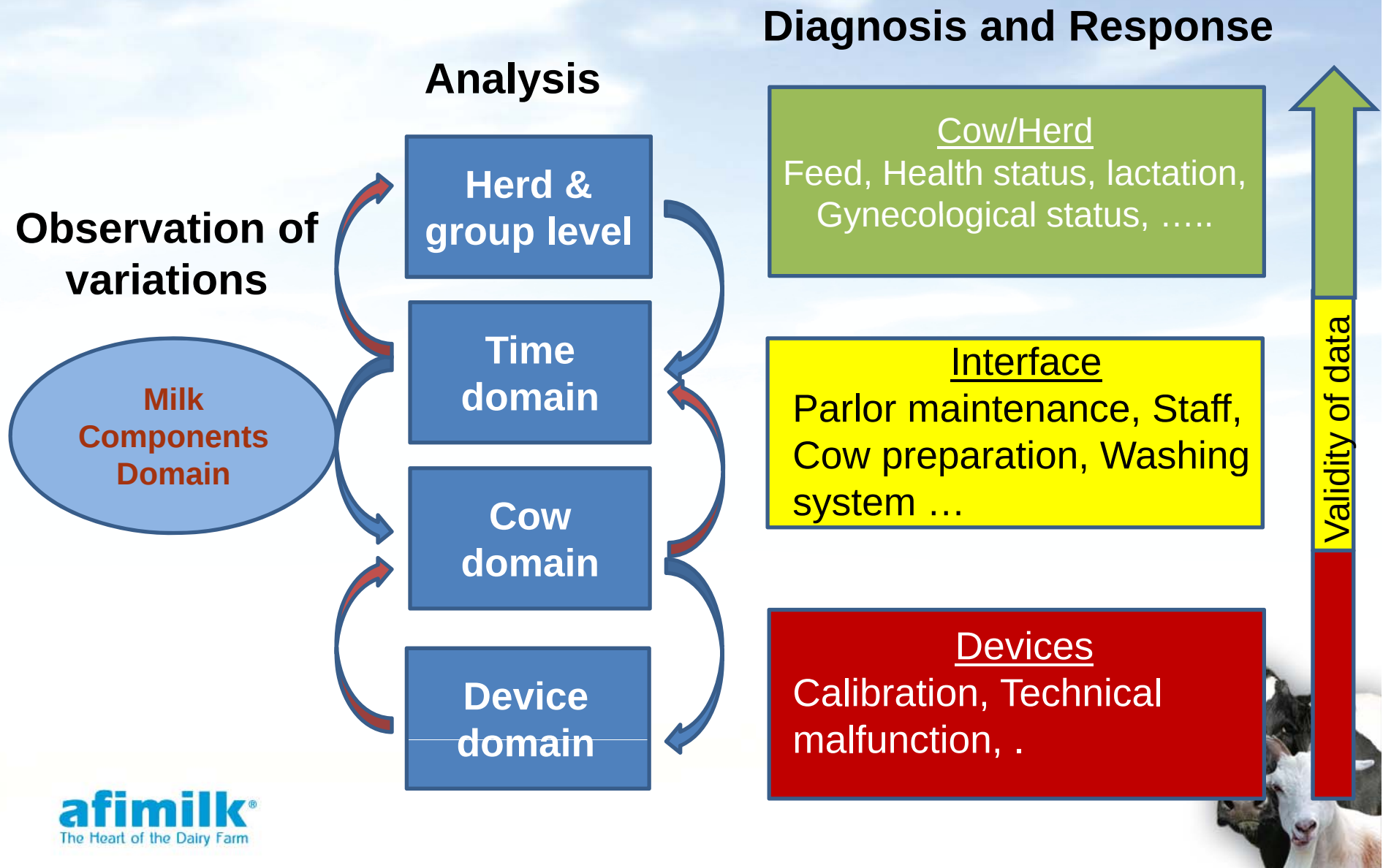
Multi devices system performing in-line analysis in rough environment

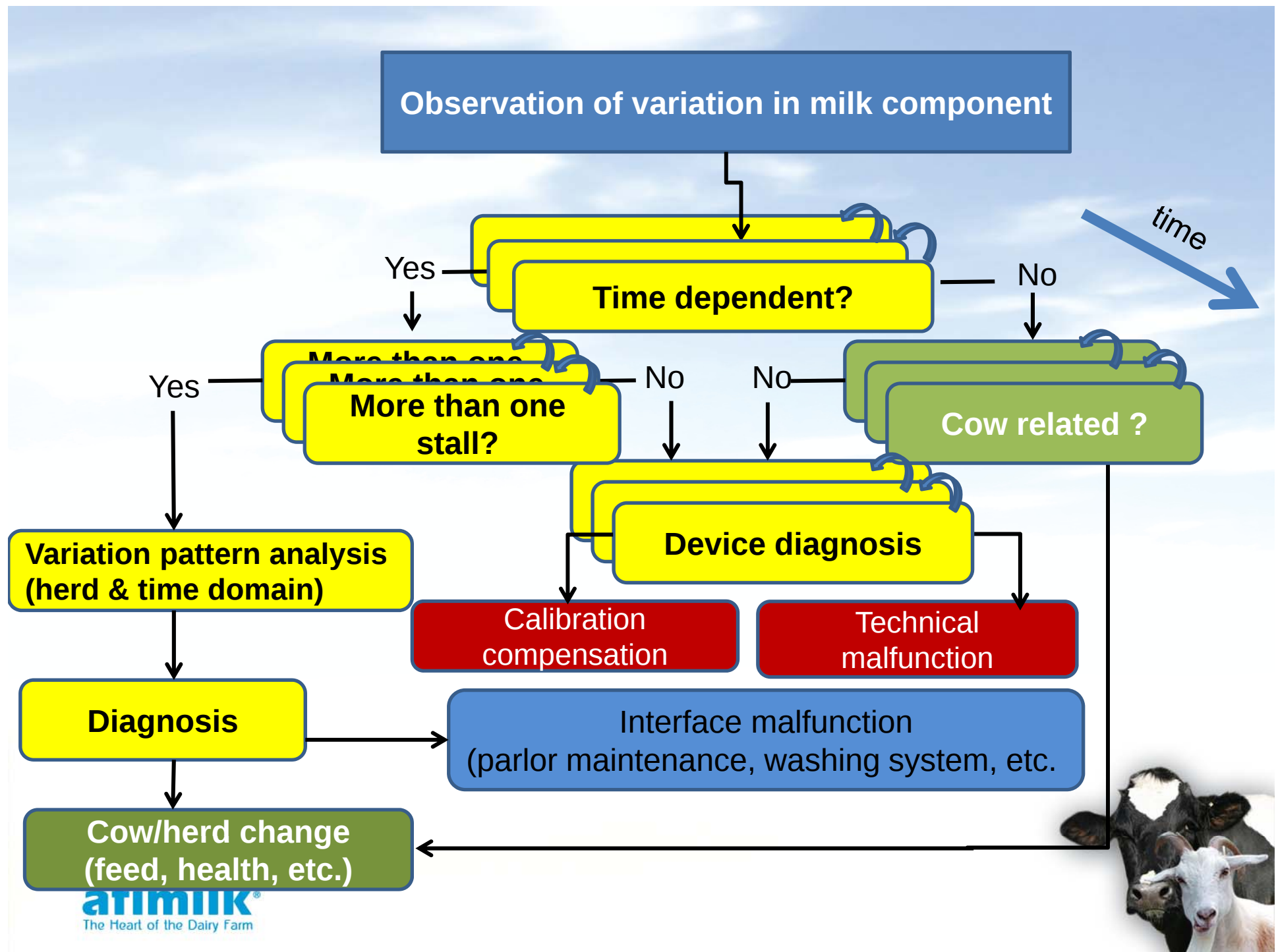


The system can conduct self surveillance and monitoring exploiting it's device multiplicity



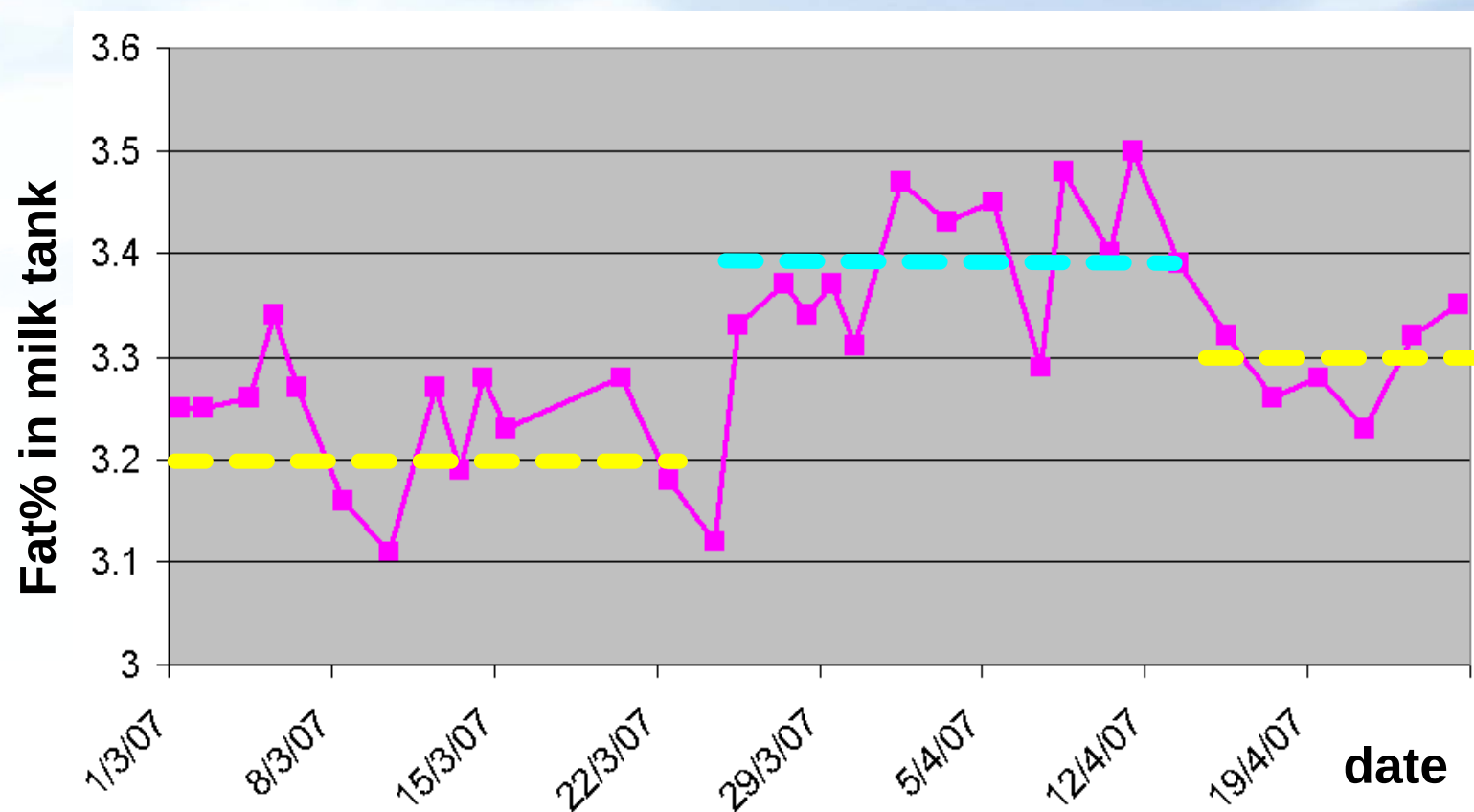
Monitoring and Control Scheme





Herd Variation Diagnosis

Feed Change

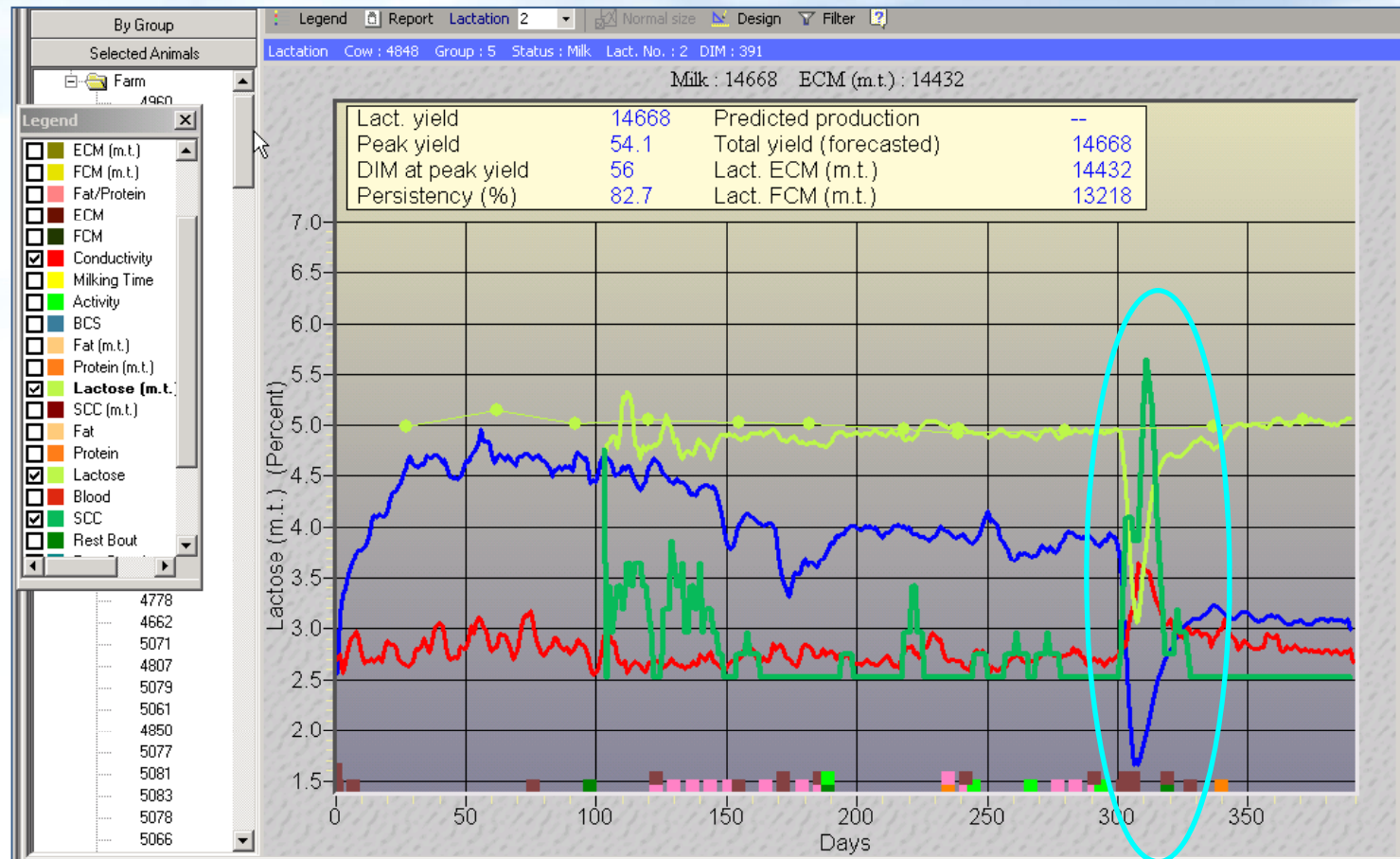


Ramat Zvi Farm (n=60) milk fat % in milk tank



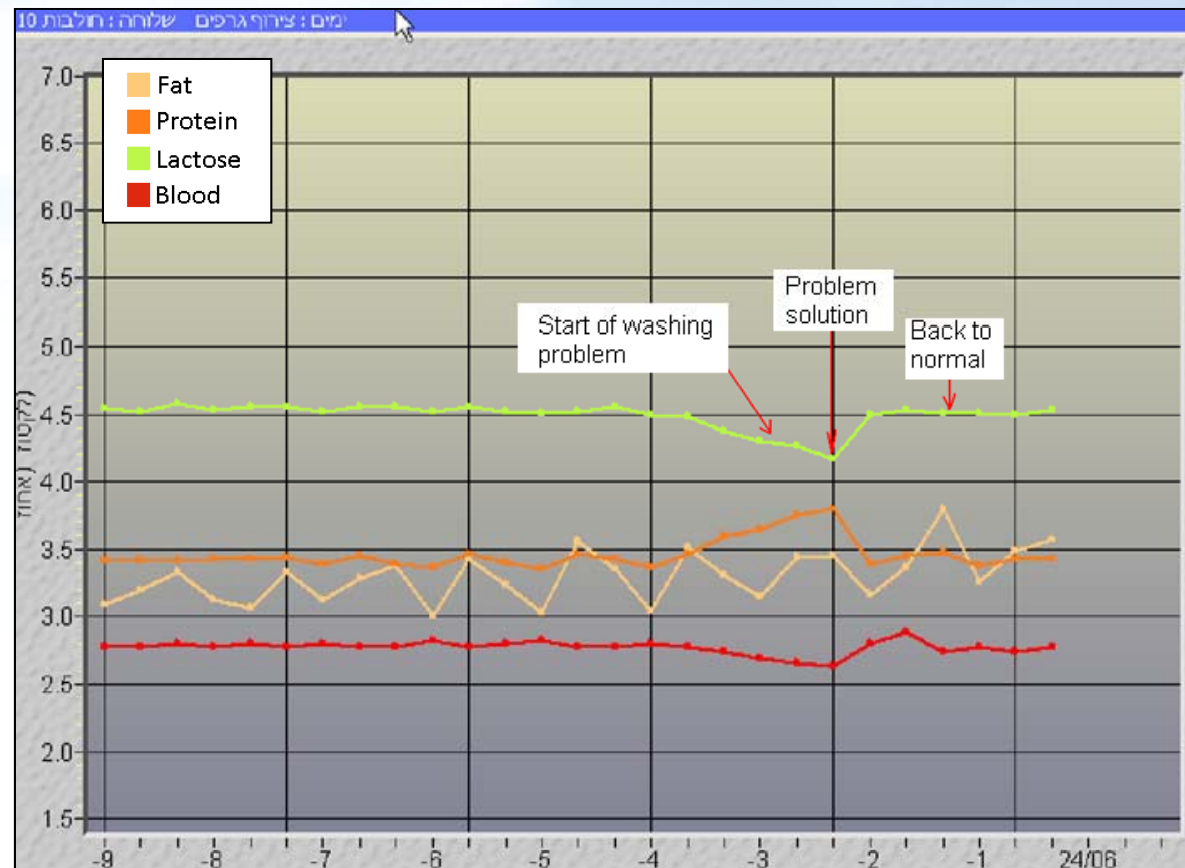
Cow Variation Diagnosis

Mastitis Detection



Interface Diagnosis

An example of maintenance (washing) problem and its correction for AfiLab

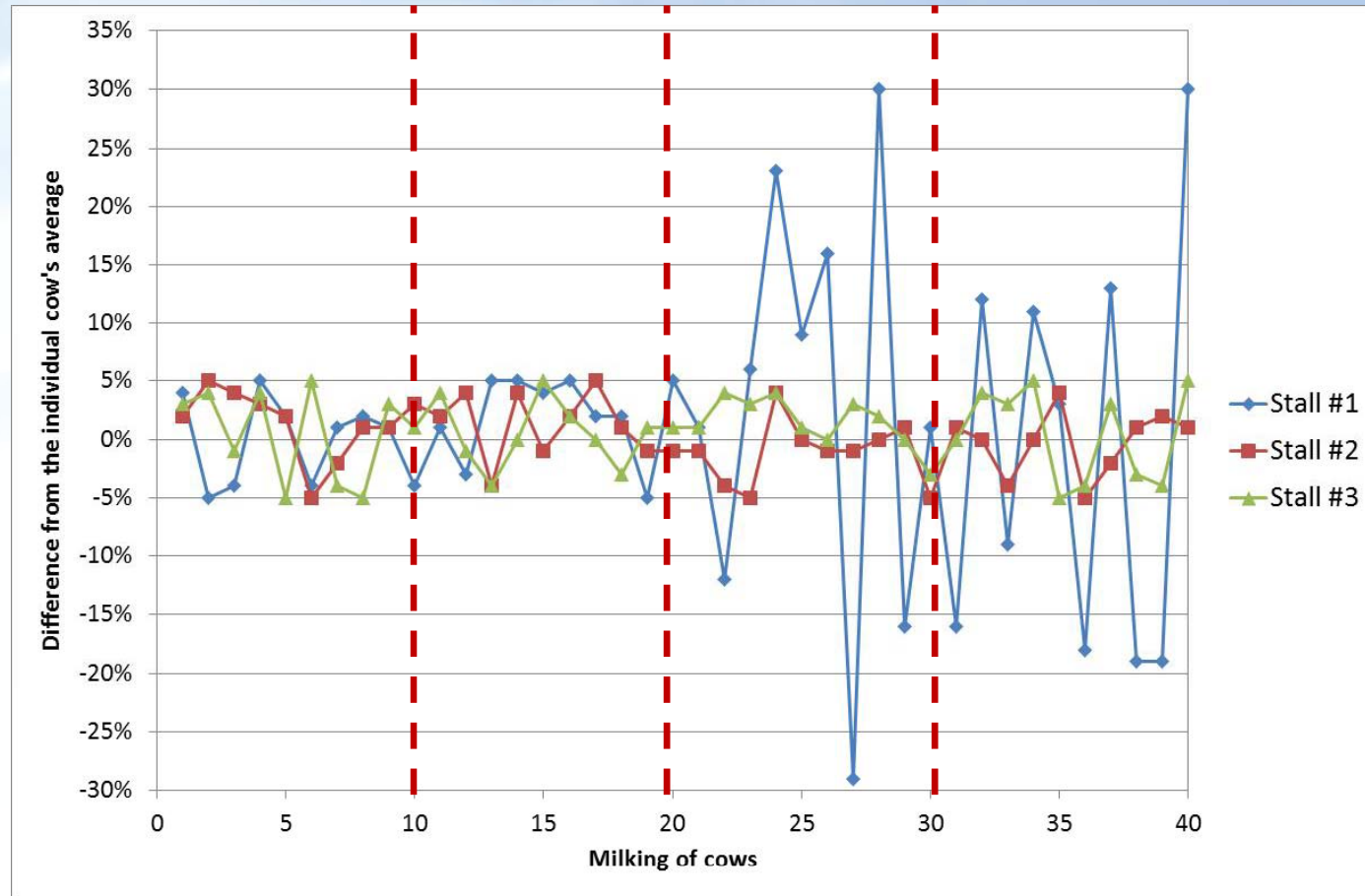


Devices Malfunction diagnosis

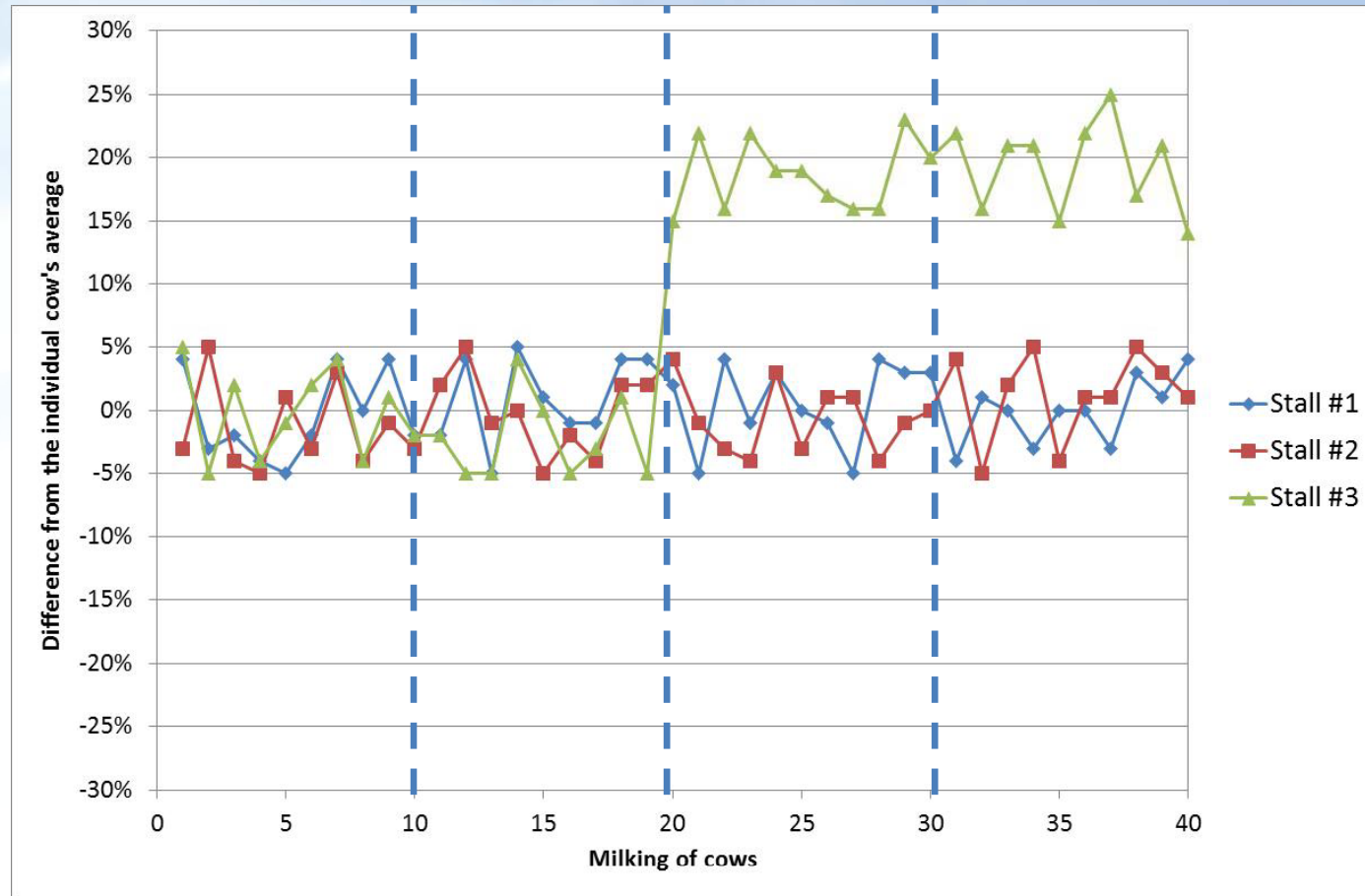
- Malfunction example
- Calibration example



Spotting a Malfunctioning Device



Spotting a Calibration Malfunction



Automated Compensation can be performed daily to overcome calibration problems. This will improve accuracy and robustness.

Assumption

The overall milk measured by each device reflects the average tank milk



Constraints

- Multiple number of devices at the farm is required to form multi-device system.
- Statistical ensemble for the evaluation of a single device should be large enough to represent normal herd distribution.

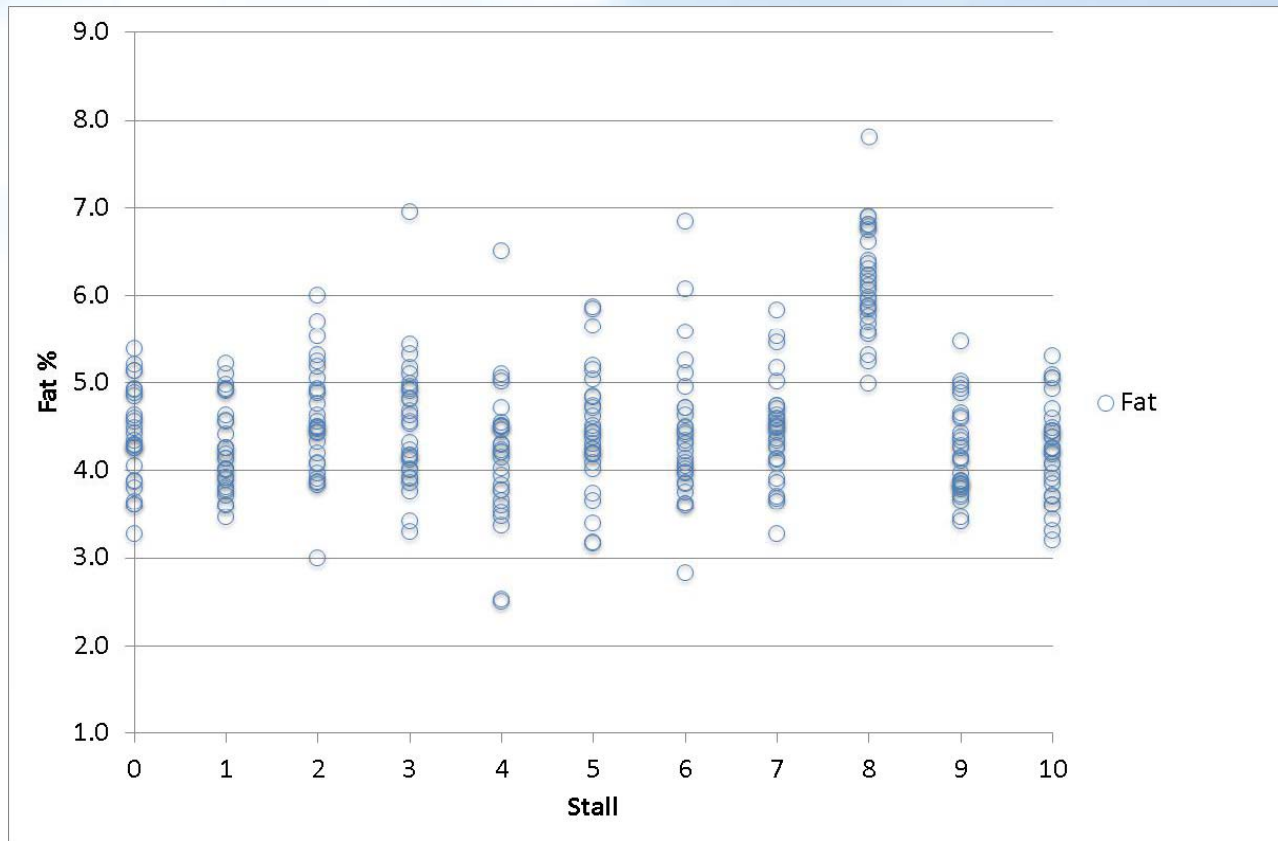


Variability Between Devices in the System

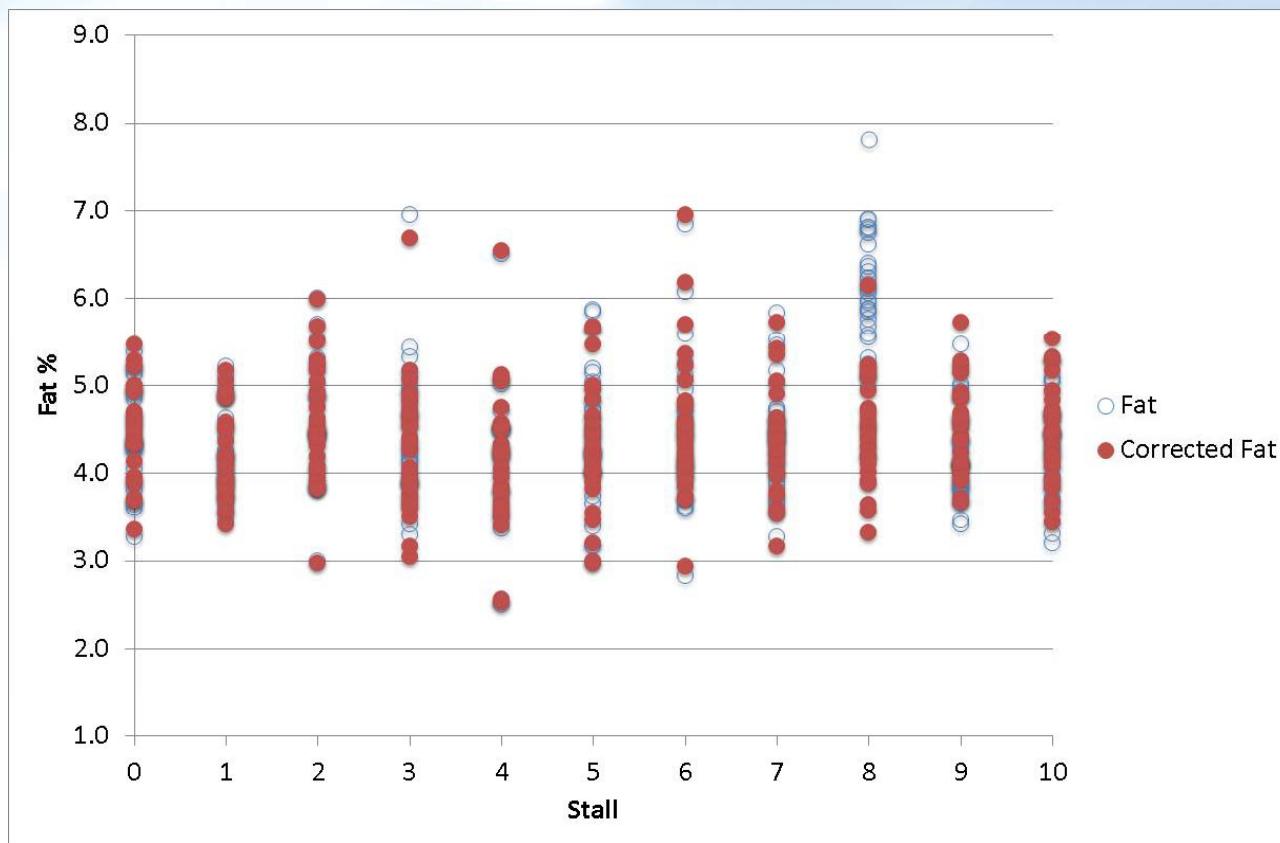
- High repeatability is required between the different devices.
- Self-calibration can minimize differences between the devices. This is achieved by filtering and neutralizing the effects of known noise influencing the precision of the measurement.



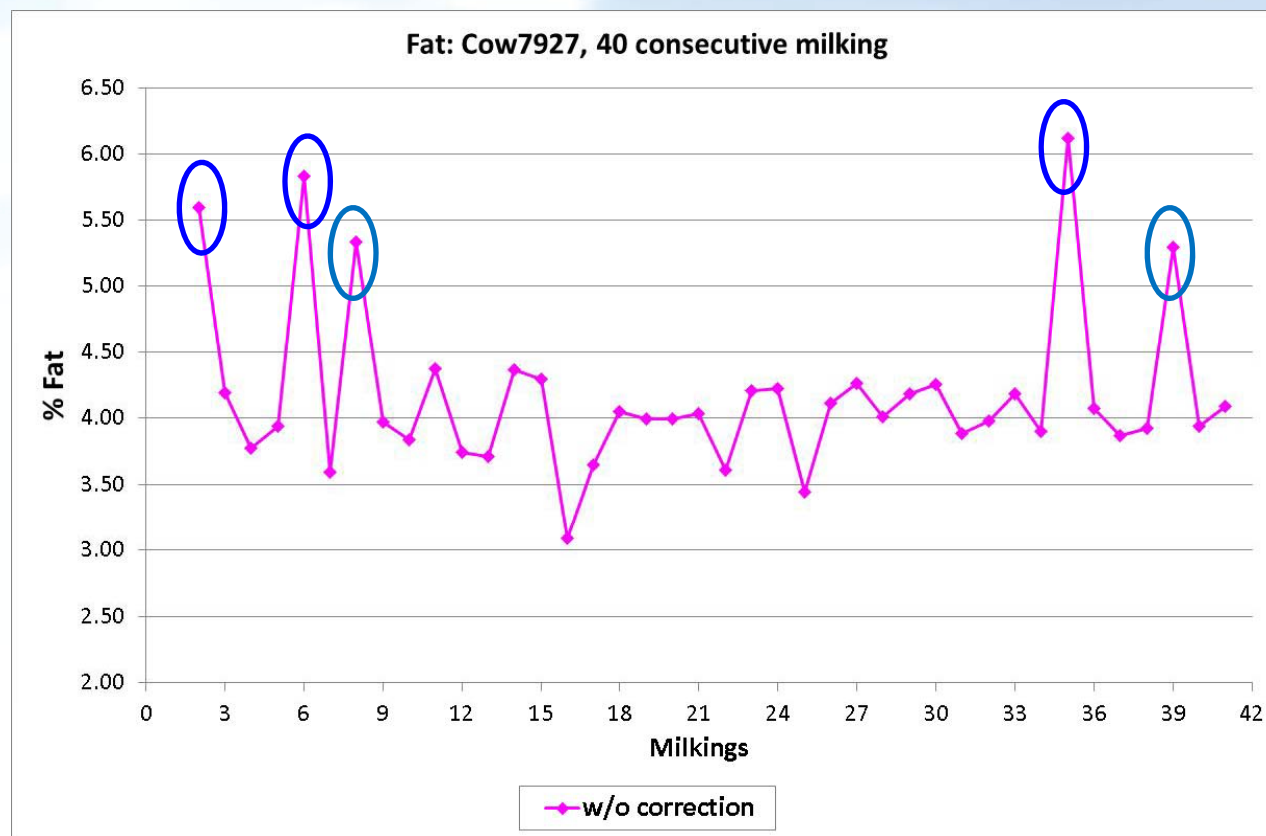
Variability between devices in same farm: fat example – device dimension



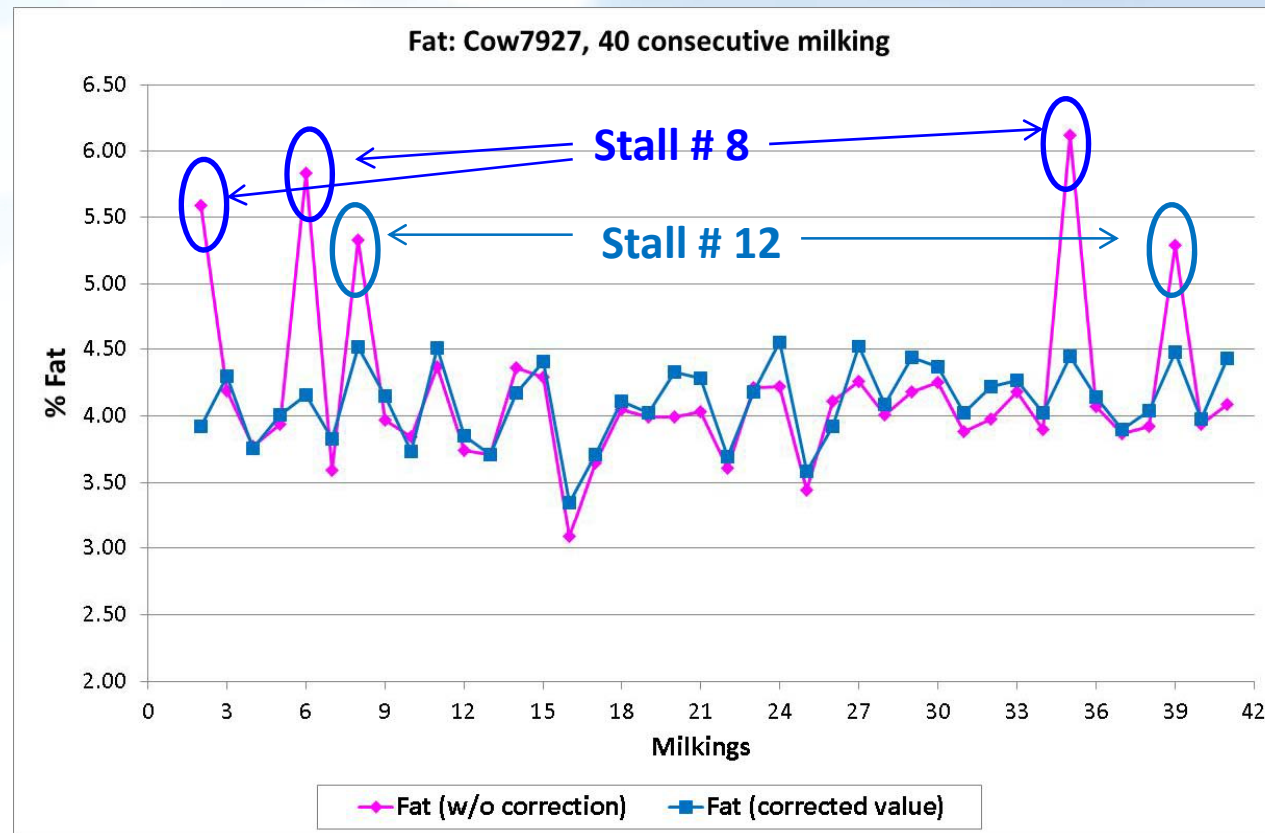
Variability between AfiLab's in same farm: fat example



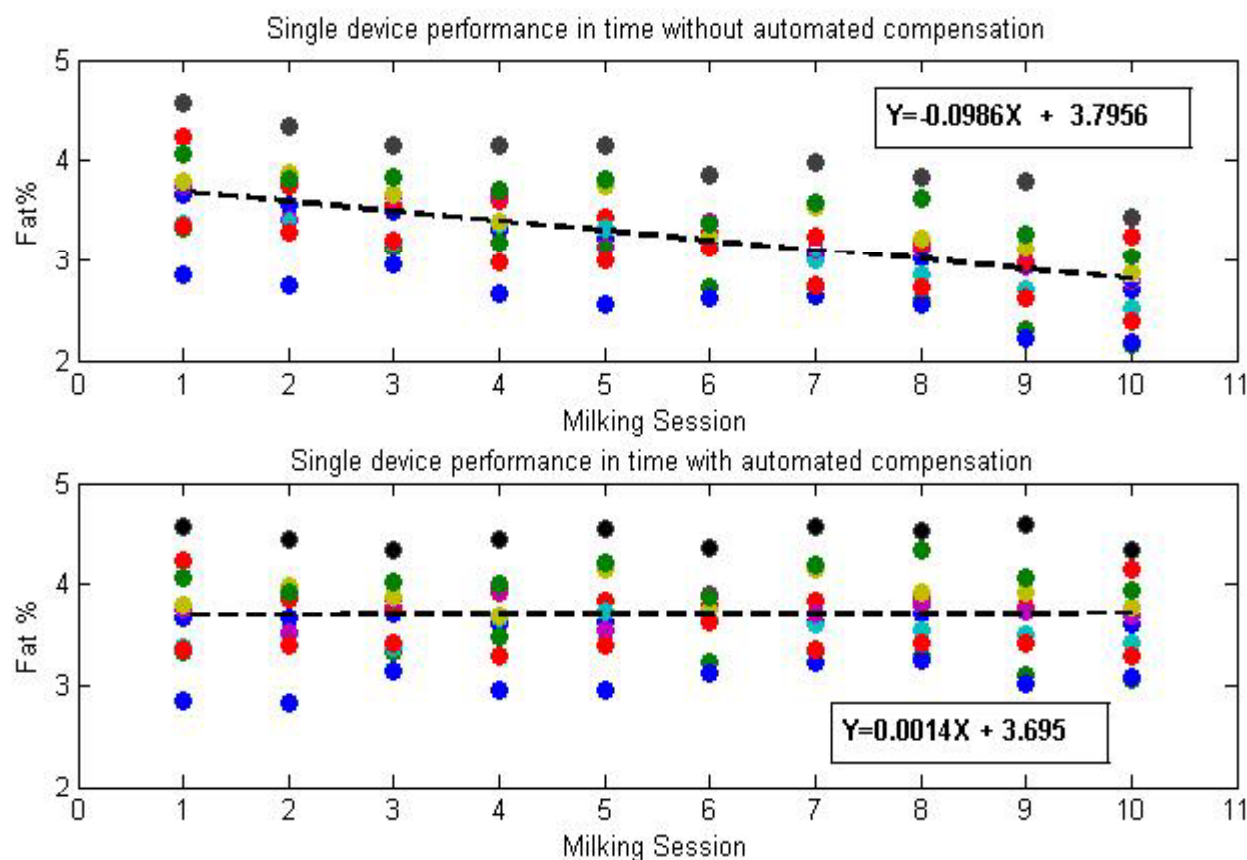
Variability between Devices in same farm: fat example – Cow dimension



Variability between Devices in same farm: fat example – Cow dimension



Time dimension influence on fat evaluation and its correction for the AfiLab



Summary

- Periodic calibration of the system is based on the reference analysis for every device in the farm.
- Automated on going compensation (self-calibration) based on the approach that the sensor is not a stand-alone analytic device but a part of the automated data collection system.
- Accuracy is significantly improved by filtering the noise and neutralizing the effects of known built-in factors such as: different cows, type of session (morning, afternoon, evening), etc.



Thank you!

