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Separating normal from abnormal variation caused by lameness in a detection model

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Dairy lameness situation

Negative effect on cow health, welfare, longevity and production
High prevalence hugely underestimated

→ Detect those cows that need extra attention

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Negative effect on cow health, welfare, longevity and production
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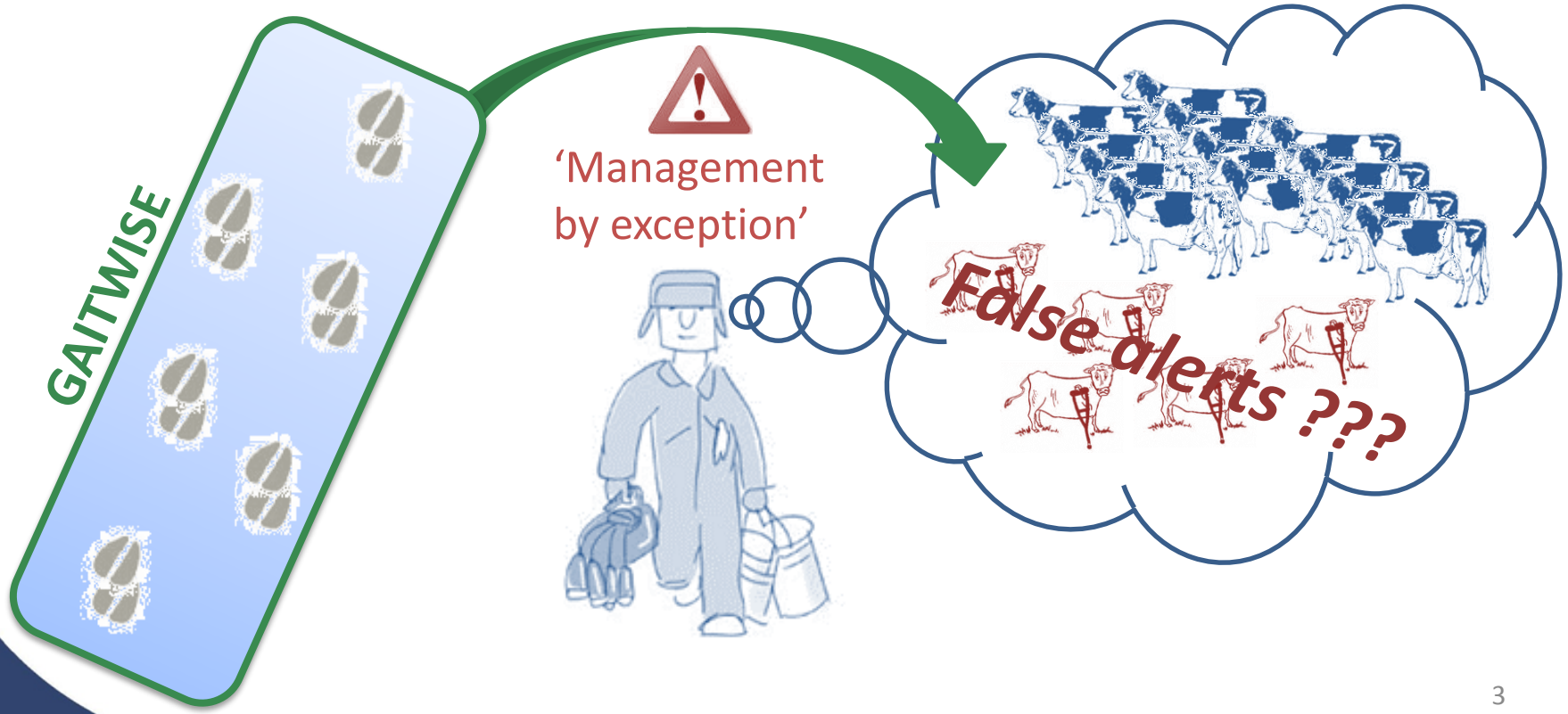
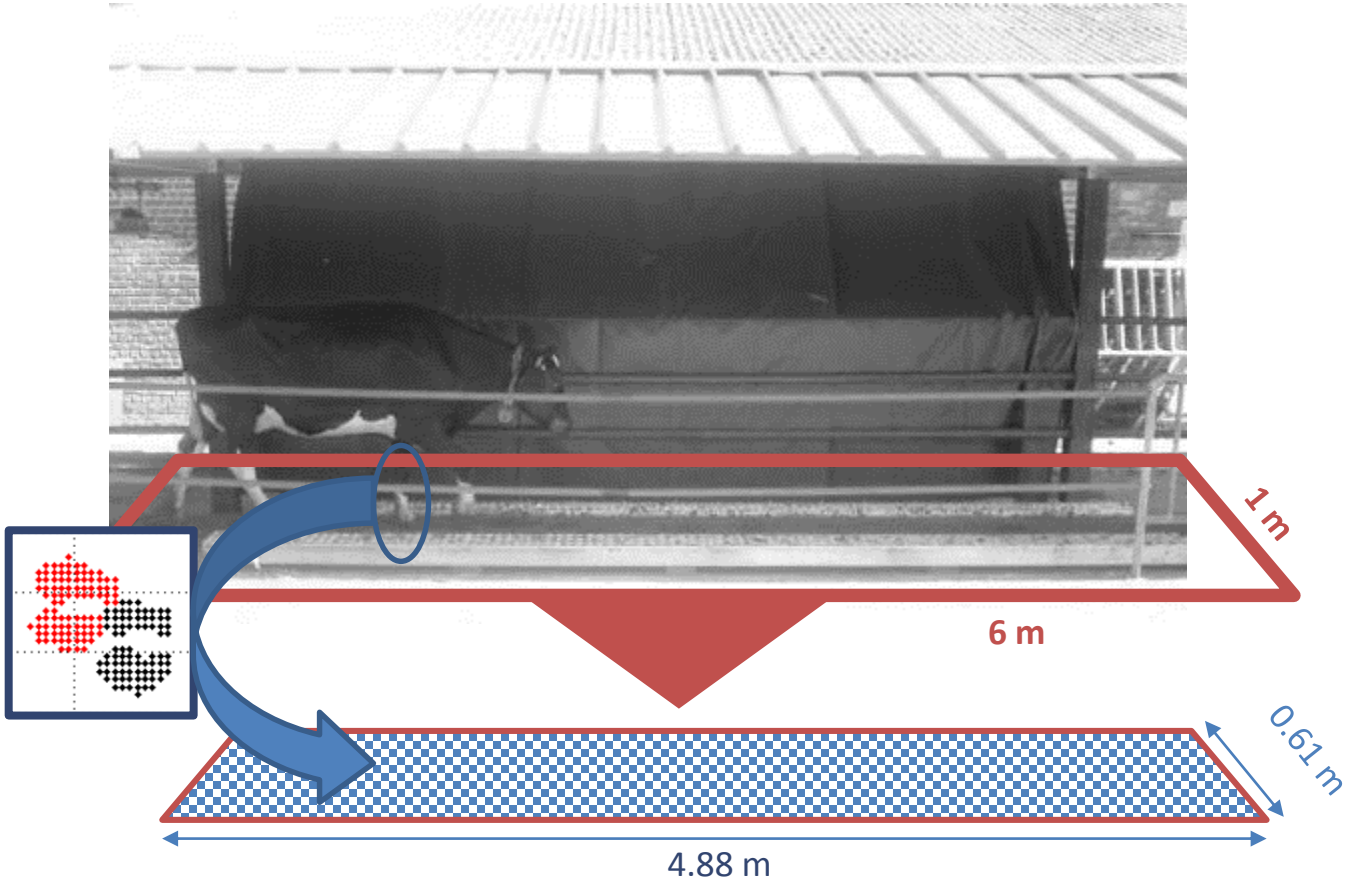


How to avoid false alerts

1. Ignore non-lameness causes for changes in gait

2. Use a detection algorithm based on individual thresholds compared to group thresholds

Gaitwise



TIME – LOCATION – FORCE

Gaitwise

10 Specific variables

- → Stride length
- → Stride time
- → Stance time
- → Step overlap
- → Abduction
- → Asymmetry in
  - Stepwidth
  - Steplength
  - Steptime
  - Stance time
  - Force

What causes normal variation?

Environmental and cow- specific factors that influence cow gait

Criteria for cow selection:

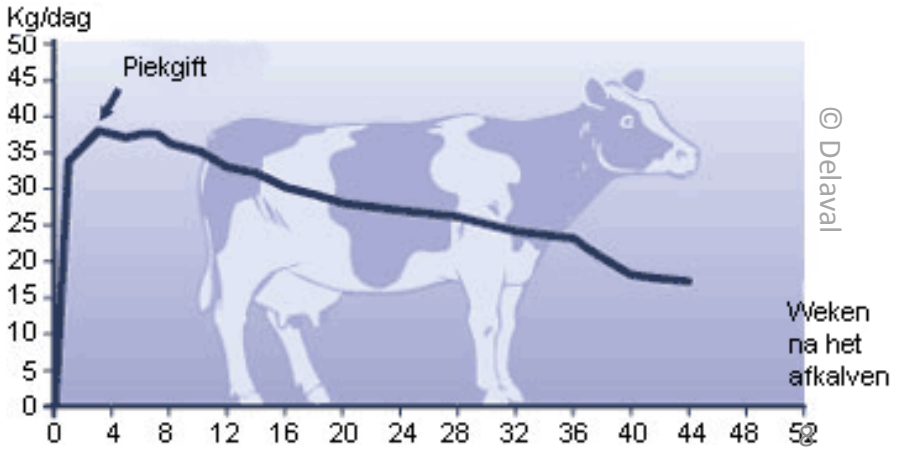
- No other health problems (mastitis, …)
- Non-lame according to expert
- Received no trimming sessions prior and during experimental period

What causes normal variation?

Environmental and cow- specific factors that influence cow gait

Selected factors:

- Light/dark environment
- Wet surface (rain)
- Age
- Production level
- Lactation stage
- Gestation stage



What causes normal variation?

Light or Dark environment

Wet surface

Gaitwise variables	P-value (light)	P-value (wet)
Asymm stepwidth ↑		
Asymm steplength ↑		
Asymm steptime		
Asymm stance time		
Asymm force		
Stride length ↓		
Stride Time		
Stance Time		
Step Overlap ↓		
Abduction		

Shorter, more asymmetrical strides with less stap overlap

What causes normal variation?

Gaitwise variable	Age	Production
Asymm stepwidth ↑		
Asymm steplength		
Asymm steptime ↑		
Asymm stance time		
Asymm force ↑		
Stride length		
Stride Time ↑		
Stance Time ↑		
Step Overlap		
Abduction ↑		

Slower, more asymmetrical strides with more abduction

What causes normal variation?

Lactation stage

Gestation stage

Gaitwise variable	P-value (light)
Asymm stepwidth	
Asymm steplength ↑	
Asymm steptime	
Asymm stance time	
Asymm force	
Stride length ↓	
Stride Time	
Stance Time	
Step Overlap ↓	
Abduction	

Shorter strides, more asymmetrical with less step overlap

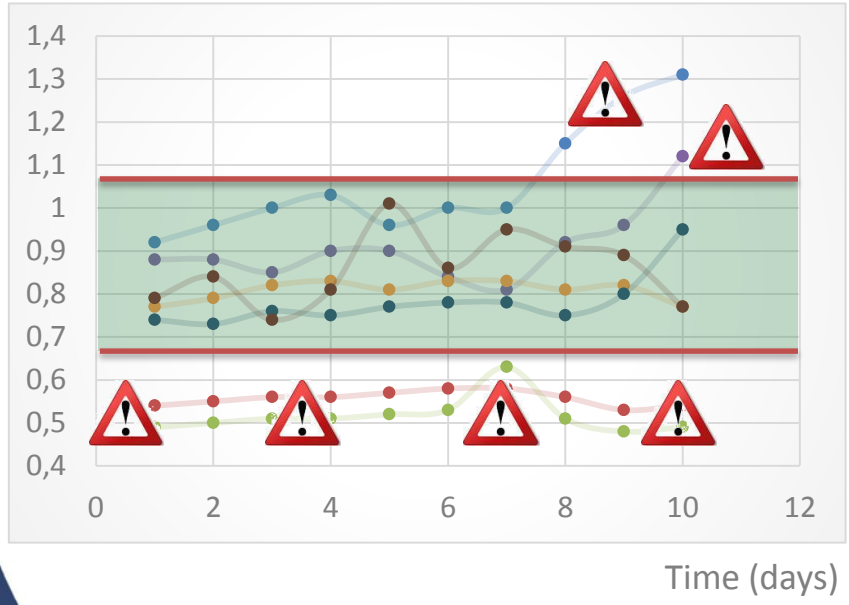
How to avoid false alerts

1. Ignore non-lameness causes for changes in gait

2. Use a detection algorithm based on individual thresholds compared to group thresholds

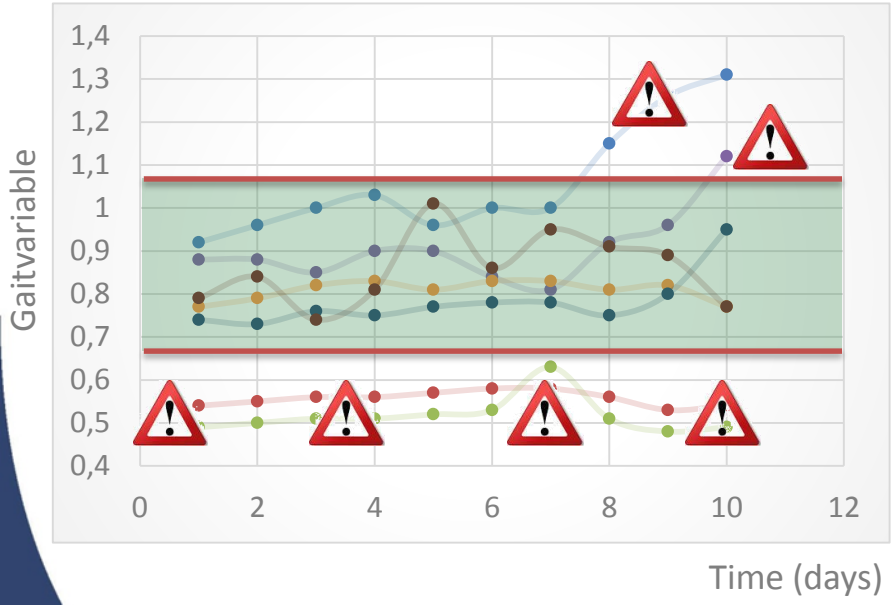
Group vs. individual threshold?

- Threshold at group level

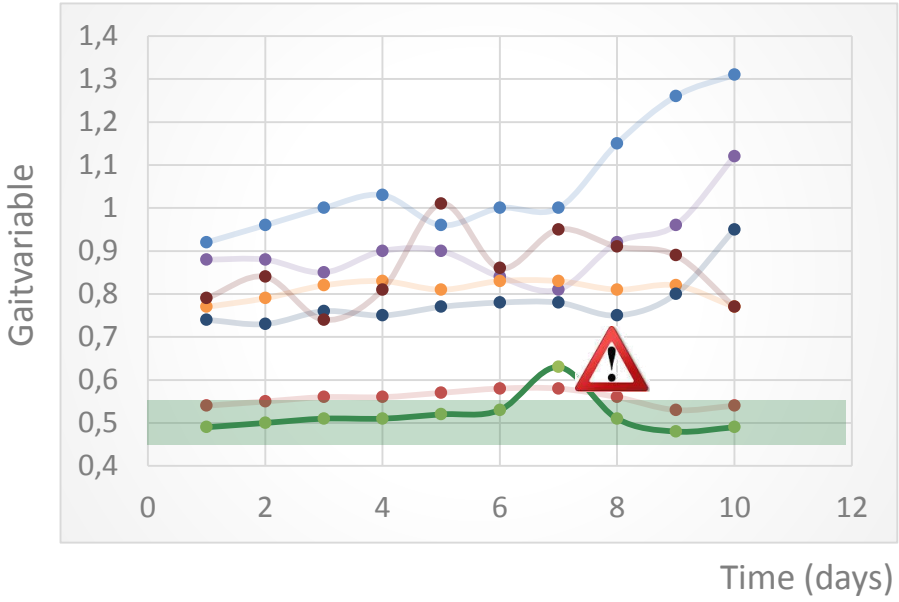


Group vs. individual threshold?

- Threshold at group level



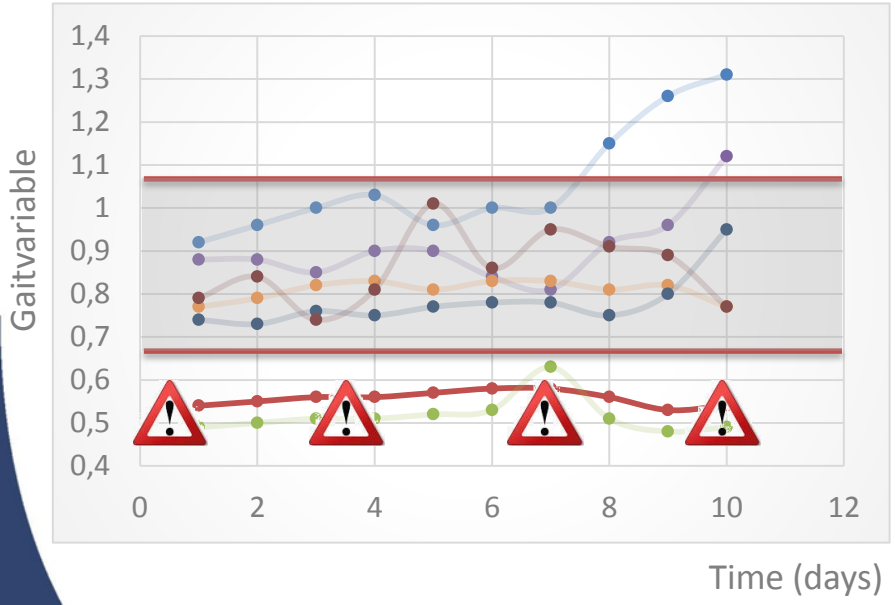
- Threshold at individual level



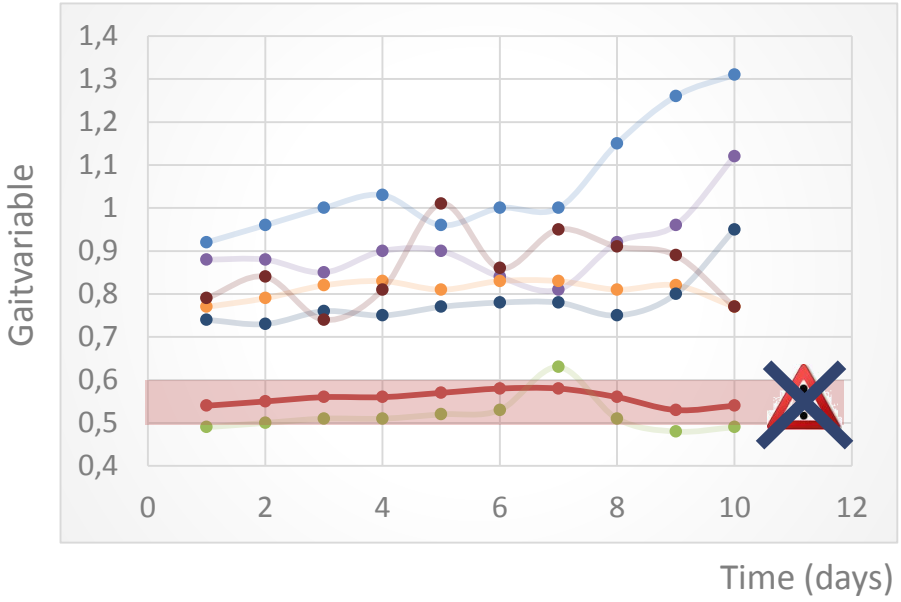
Alerts when necessary

Group vs. individual threshold?

- Threshold at group level



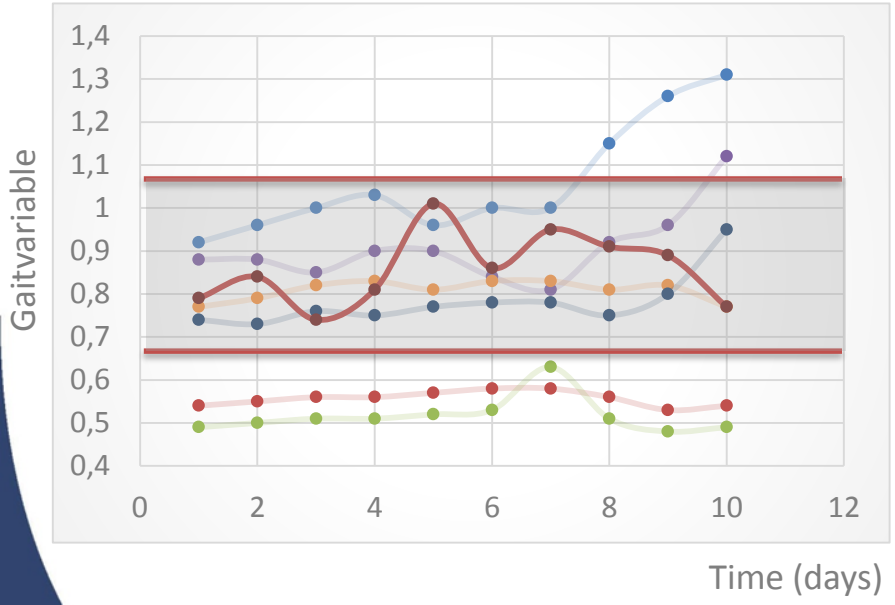
- Threshold at individual level



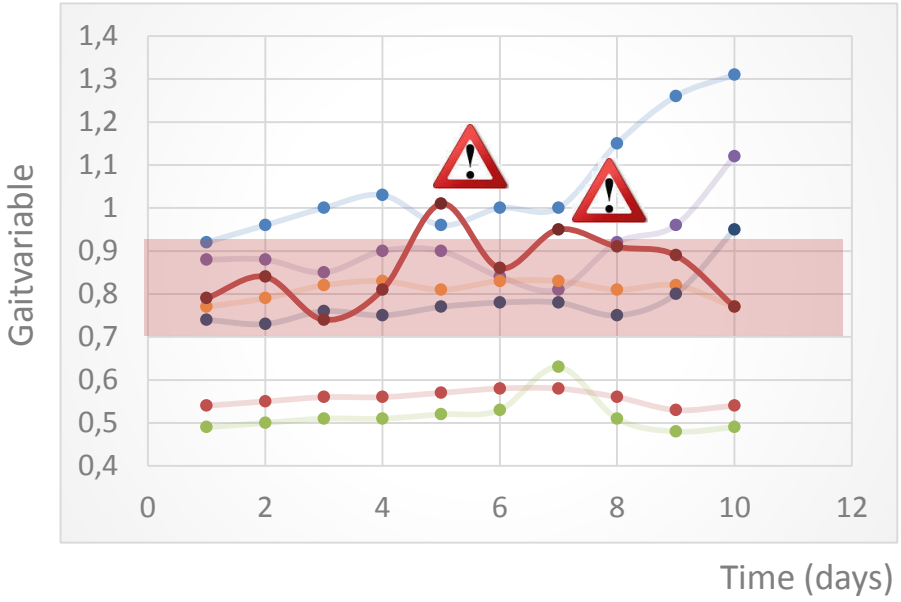
Less false alerts

Group vs. individual threshold?

- Threshold at group level



- Threshold at individual level



Higher sensitivity

Synergistic Control (SGC)

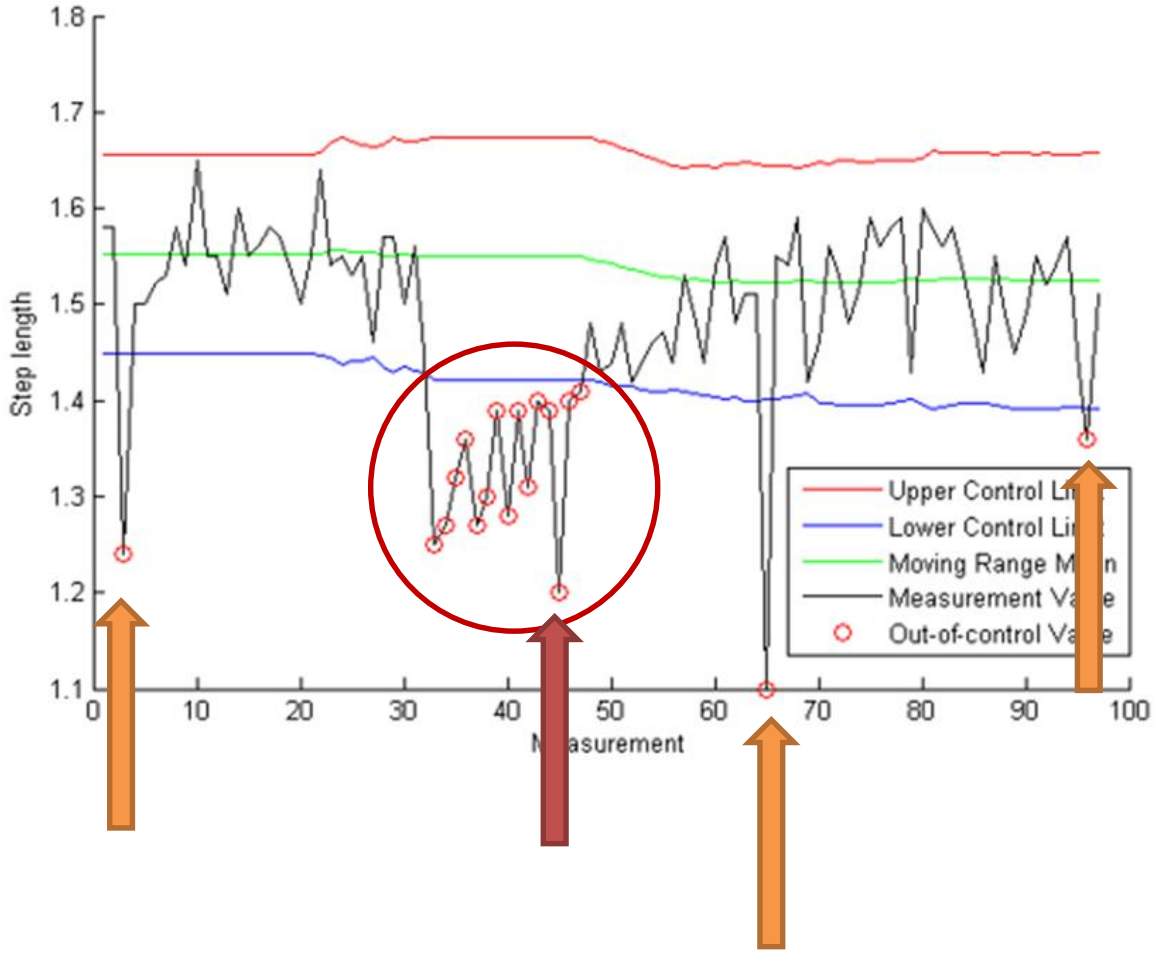
Statistical Proces Control (SPC):

- Normal variation
- Abnormal variation due to lameness

→ Use of control charts

→ Preprocess data by Engineering Proces Control (EPC)

Synergistic Control (SGC)



Challenges for further development of Gaitwise

- Improve lameness detection
  - Combining Gaitwise data with other data
  - Including information on normal variation
  - Improve the detection by using individual thresholds

    → SILF-project (poster 9.5.23)

Any questions?

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