Faculty of Agricultural and Nutritional Science

Christian-Albrechts-University Kiel
Institute of Animal Breeding and Husbandry

Automatic image analysis to predict the onset of farrowing in sows

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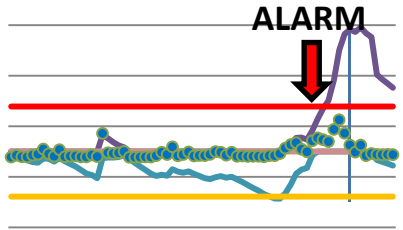

Introduction

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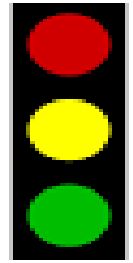
- Increasing herd sizes require management tools to support farmers and stockpersons
- Early warning system allow targeted animal observation and assistance
- Increasing activity of sows before farrowing, e.g. nest building behaviour
- Video recordings non-invasive, easy to set up



Predict the onset of farrowing using automatic image analysis algorithms

Material and Methods

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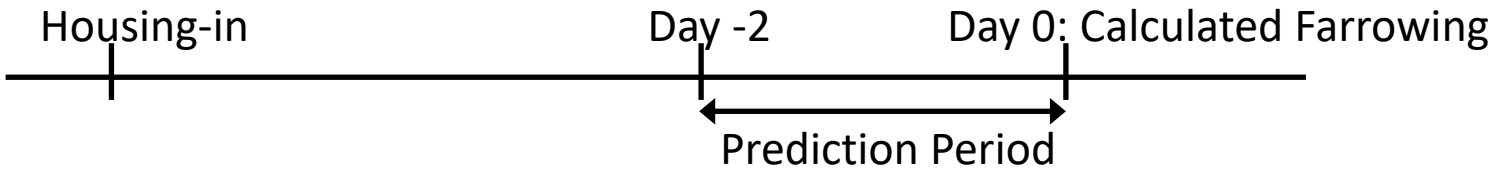
Data

- 30 sows in 3 batches
- 12/2013 – 03/2014
- Video recordings from housing-in until two days after farrowing
- Onset of farrowing defined as birth of the first piglet determined manually
- Prediction period starting two days before calculated date of farrowing



Material and Methods

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Image analysis algorithms

- Amount of change in pixel color with
  a. Background subtraction (BG)
  b. Optical flow (Flow)
- Implementation in C++ with OpenCV library (v.2.4.6)

Original

Section of interest

Algorithm

Material and Methods

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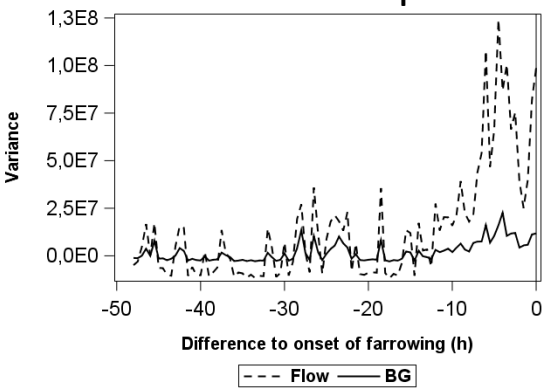
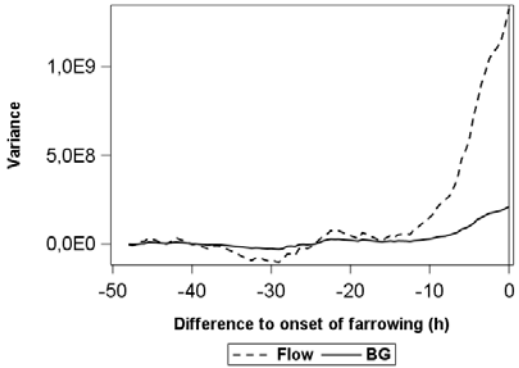
Trait

- *Amount of pixel change in half-hour steps*
- *Distribution sequence*: mean, standard deviation, variance, maximum and 1st, 2nd and 3rd -variation
- *Comparative sequence*: Difference to/ quotient of average of the half hour
- *Cancelled sequence*: cumulative sum up to the half hour

Distribution sequence



Cancelled sequence



Material and Methods

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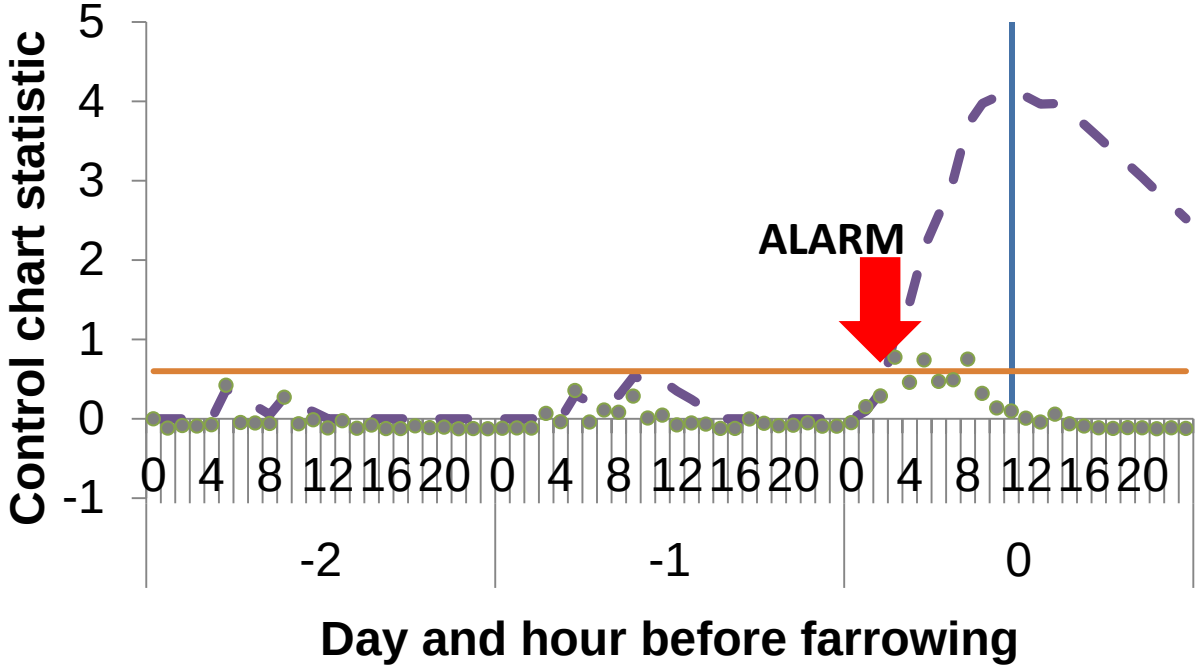
Method

- Cumulative sum (CUSUM) Control Chart



Calibration parameter:
- k-value
- h-value

Results

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Fraction of sows (%) with an alarm up to 12 or 48 hours before the onset of farrowing depending on analysis algorithm for standard deviation as distribution sequence

	Background Subtraction		Optical Flow	
	12 hours	48 hours	12 hours	48 hours
Standard deviation				
Distribution seq.	66.7	75.0	75.0	75.0
Comparative seq. - Diff	66.7	75.0	75.0	75.0
Comparative seq. - Quot	66.7	75.0	75.0	75.0
Cancelled seq. - Diff	91.7	91.7	91.7	91.7
Cancelled seq. - Quot	91.7	91.7	91.7	91.7

Results

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Fraction of sows (%) with an alarm up to 12 or 48 hours before the onset of farrowing depending on analysis algorithm for maximum as distribution sequence

	Background Subtraction		Optical Flow	
	12 hours	48 hours	12 hours	48 hours
Maximum				
Distribution seq.	41.7	91.7	75.0	91.7
Comparative seq. - Diff	41.7	91.7	75.0	91.7
Comparative seq. - Quot	41.7	91.7	75.0	91.7
Cancelled seq. - Diff	83.3	83.3	91.7	91.7
Cancelled seq. - Quot	91.7	91.7	91.7	91.7

Results

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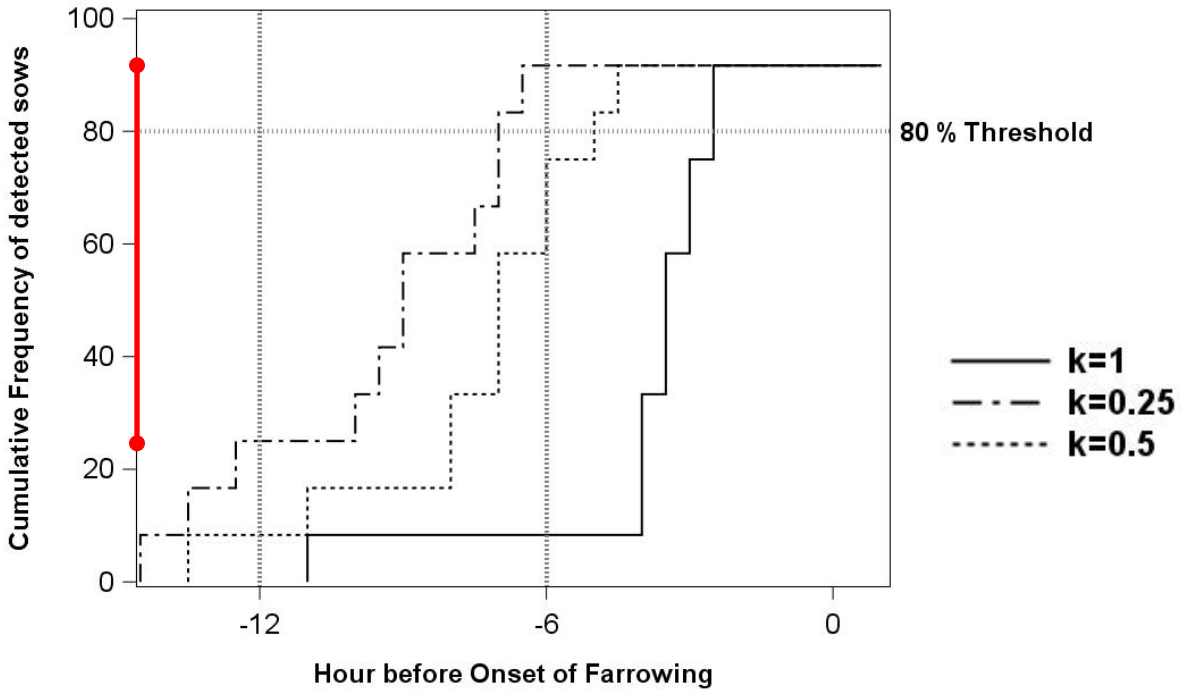
Cumulative Frequency of alarms depending on hour before beginning of farrowing and calibration parameter k (h=4)



Trait

Cancelled sequence of the variance quotient of algorithm optical flow

Results

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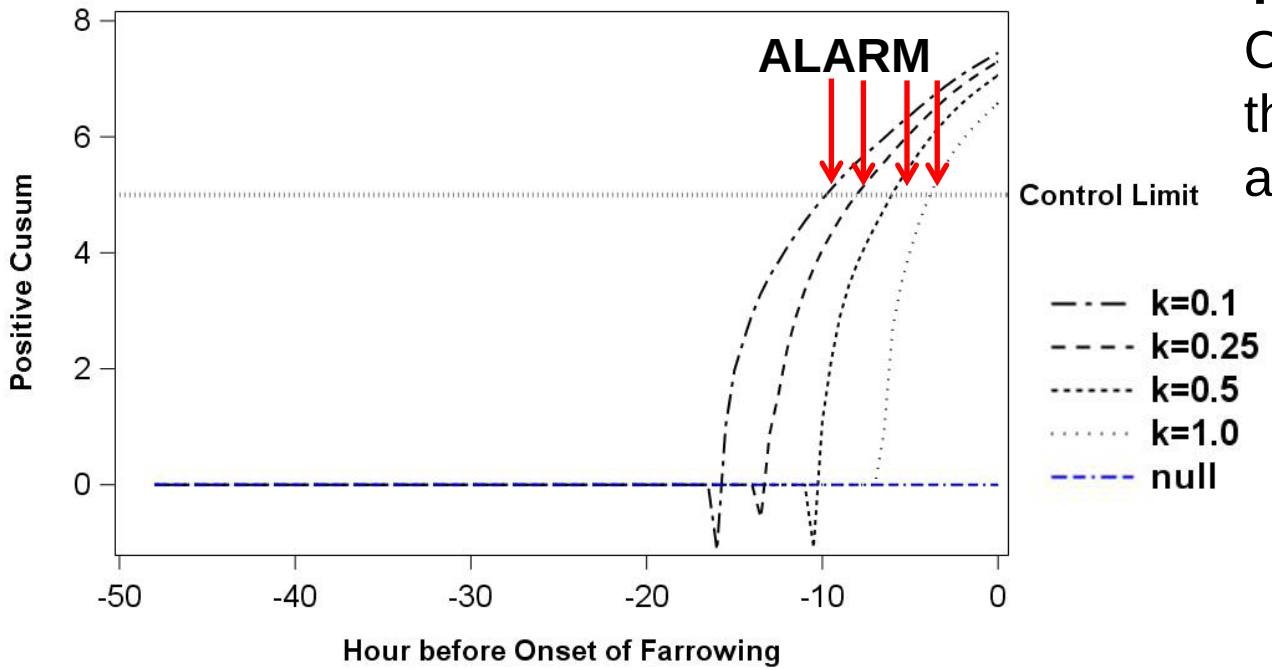
Influence of calibration parameter k (h=3) on time point of alarm, example of one sow



Trait

Cancelled sequence of the variance quotient of algorithm optical flow

Conclusion

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- Higher activity of sows before onset of farrowing can be monitored with automatic image analysis algorithms
  - >90% detection rate in both time windows
- Transformation up to cancelled sequence necessary for adequate detection rates
  - Distribution sequences describing fluctuations performed best
- Fine tuning of CUSUM chart to adjust time point of alarm
  → user-defined (stockperson) calibration

Thank you for your attention!