Using acceleration data to detect automatically the beginning of farrowing in sows

Imke Traulsen¹, W. Auer², K. Müller³ and J. Krieter¹

¹Institute of Animal Breeding and Husbandry, CAU Kiel, Germany
²MKW electronics GmbH, Weibern, Austria
³Chamber of Agriculture Schleswig-Holstein, Blekendorf, Germany

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Introduction

- Increasing herd sizes require management tools to support farmers and stockpersons
- Early warning system allow targeted animal observation and control
- Development of acceleration sensors to monitor the activity of sows
- Increasing activity of sows before farrowing, e.g. nest building behaviour

Prediction of the beginning of farrowing using acceleration measurements
Material and Methods

Data

- 30 sows in 3 batches
- 12/2013 – 03/2014

- Sows equipped with an ear tag to measure acceleration (1Hz)

- Video recordings as reference to determine beginning of farrowing (Birth of the first piglet)
Material and Methods

Trait

• Activity Index (Acc) based on acceleration measurement in x, y and z dimension

\[ Acc = \sqrt{x^2 + y^2 + z^2} \]

• Standardization of Acceleration index with sow individual average
Material and Methods

Method

• Cumulative sum (CUSUM) Control Chart
Material and Methods

Method

- Cumulative sum (CUSUM) Control Chart

- Sow individual initialization parameters based on average of day(s) ante partum (a.p.)
  - Day 3 a.p.
  - Days 3-4 a.p.
  - Days 3-5 a.p.
  - Days 3-6 a.p.
  - Days 3-7 a.p.

- Time windows of alarms (hours before beginning of farrowing)
  - 1-8
  - 9-16
  - ... 41-48
## Results

### Number of alarms per time window depending on initialization period

<table>
<thead>
<tr>
<th>Time window (hours before beginning of farrowing)</th>
<th>Time period before farrowing used to initiate CUSUM Chart</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Day 3</td>
</tr>
<tr>
<td>1-8</td>
<td>8</td>
</tr>
<tr>
<td>9-16</td>
<td>10</td>
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<tr>
<td>16-24</td>
<td>2</td>
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<tr>
<td>25-32</td>
<td>-</td>
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<tr>
<td>33-40</td>
<td>1</td>
</tr>
<tr>
<td>41-48</td>
<td>2</td>
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</tbody>
</table>
Results

Number of alarms per time window depending on initialization period and CUSUM calibration parameter

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<th>Time window (hours before beginning of farrowing)</th>
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<tbody>
<tr>
<td></td>
<td>Day 3</td>
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<tr>
<td></td>
<td>Average limits (H=10)</td>
</tr>
<tr>
<td>1-8</td>
<td>8</td>
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<td>9-16</td>
<td>10</td>
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Results

Cumulative Frequency of alarms depending on hour before beginning of farrowing and initialization period

- Day 3
- Days 3-5
- Days 3-7

Hours before beginning of farrowing

Cumulative Frequency (%)

0 10 20 30 40 50 60 70 80 90 100
Results

Cumulative Frequency of alarms depending on hour before beginning of farrowing and initialization period

- Histogram showing cumulative frequency (%) on the y-axis and hours before beginning of farrowing on the x-axis.
- Two types of limits are indicated:
  - Stricter limit Day 3
  - Average limit Day 3
  - Stricter limit Days 3-7
  - Average limit Days 3-7

The graph illustrates the trend of cumulative frequency over time for different periods and limits.
Conclusion

• Higher activity of sows before beginning of farrowing can be monitored using acceleration sensors as ear tags

• Some sows show no higher activity (4 of 27) before farrowing → not detectable

• Good results in early detection of the beginning of farrowing (about 75 % within 16 hours before beginning of farrowing)
  – Consider sow individual activity level
  – Initialization period of day 3 before farrowing is sufficient
  – Strict control limits should be preferred

Thank you for your attention!