Spatial, inter- and intra- repeatability of thermal imaging in cattle

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Infrared Thermography (IRT)

Max
37.4 °C

Min
32.9°C

Avg
36°C
Uses of IRT

Electrical Faults
Insulation Inspection
(Stokes et al., 2012)

Mastitis
Hen Window Frame Leak
(Colak et al., 2008)

Hoof Lesions

BRIEF COMMUNICATION: The use of infrared thermography and feeding behaviour for early disease detection in New Zealand dairy calves

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Detection of foot-and-mouth disease virus infected cattle using infrared thermography

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9 Accepted 3 January 2008

The non-invasive and automated detection of bovine respiratory disease onset in receiver calves using infrared thermography

AL Schaefer 2 9, N J Cook 2, C Bench 1, J B Chabot 4, J Colyn 9, T Liu 9, E K Okine 9, M Stewart 4, J R Webster 1

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ARTICLE INFO
ABSTRACT

Recent respiratory disease outbreaks have resulted in significant economic losses to the beef industry and have also demonstrated the severity of the disease in cattle.
Introduction

• Medical research
• Controlled conditions
• Precision
• Sick vs healthy temperatures

Objective

• Quantify the precision of IRT
• Irish agricultural environment
• Dairy cattle

(Ammer, 2012)
Materials & Methods

Objective
• Quantify the precision of eye images

n = 15
n = 30
n = 30
Materials & Methods

Objective
• Quantify the precision of udder images

n = 15

n = 30
Materials & Methods

Objective
• Quantify the precision of hoof images

n = 15
n = 30
n = 30
Image Analysis

- Rectangular shape for the eye
- Whole udder analysis
- Parallelogram shape for hooves
- Max Min Avg extracted
Statistics

- Partition of the variance

- \( t_{cow} = \frac{\sigma_{Cow}^2}{\sigma_{Total}^2} \)

- \( P_n = 1.96 \times \frac{\sigma_{Error}^2}{\sqrt{n \in (1,30)}} \)

- Total Variance \( (\sigma_{Total}^2) \)

- Between Cow Variance \( (\sigma_{Cow}^2) \)

- Within Cow Variance \( (\sigma_{Error}^2) \)
Precision

Temperature difference between 2 replicates

Temperature precision (°C)

Image Count

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Results

Temperature parameter to extract

Maximum

Temperature difference between 2 replicates

0.88°C

Most Repeatable anatomical area: Homers (Hoc 97.8 – 99.3%)

<table>
<thead>
<tr>
<th>1 Image</th>
<th>2 Images</th>
<th>3 Images</th>
<th>4 Images</th>
<th>30 Images</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.88°C</td>
<td>0.02°C</td>
<td>0.75°C</td>
<td>0.64°C</td>
<td>0.24°C</td>
</tr>
</tbody>
</table>

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Conclusion

- Max temperature (udder & eye)
- Average temperature (hoof)
- Hoof Images are the most repeatable
- High level of precision possible
- Minimum of 3 replicates
- Disease detection
Thank you for Listening

Any Questions??

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