

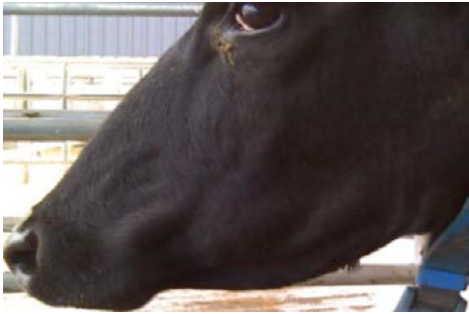
# Spatial, inter- and intra- repeatability of thermal imaging in cattle

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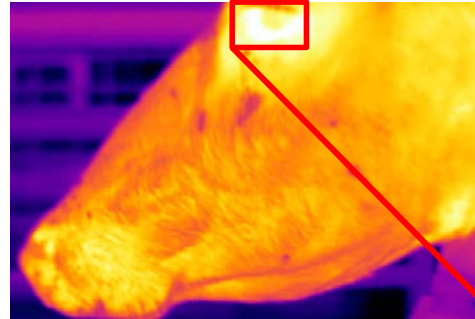
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**<sup>2</sup> Dublin City University, Glasnevin, Dublin 9, Co. Dublin, Ireland.**

# Infrared Thermography (IRT)

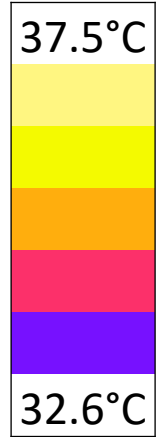


Digital Image



Thermal Image

32.9	33.7	34.4	35.1	34.8	34.3	33.7
34.2	34.4	34.8	34.8	34.8	34.8	34.3
34.9	34.8	35.5	35.5	35.5	35.2	34.9
35.5	35.4	35.9	35.6	35.6	35.5	35.4
36.7	36.2	36.1	35.7	35.9	36.2	36.7
36.8	36.4	35.9	35.9	36.1	36.4	36.8
36.9	36.5	36.1	36.2	36.3	36.5	36.9
37.2	37.1	36.5	36.4	36.4	36.5	37.1
37.4	37.2	36.9	36.5	36.5	37.1	37.3
37.3	37.3	37.2	37.1	36.9	36.9	37.2
34.8	37.1	37.1	36.9	36.8	36.7	34.8



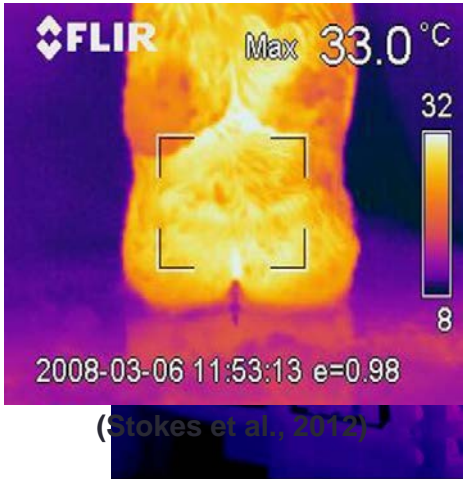
Max
37.4 °C

Min
32.9°C

Avg
36°C

# Uses of IRT

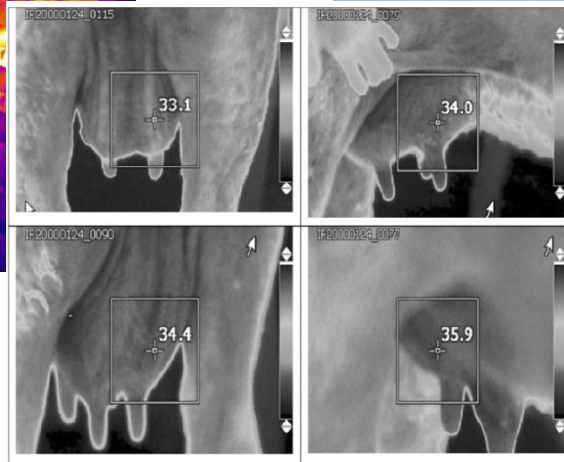
## Hoof Lesions



## Results

## Mastitis

Window Frame Leak



(Colak et al., 2008)

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

GL Lowe<sup>1</sup>, AL Schaefer<sup>4</sup>, JR Waas<sup>1</sup>, MT Wilson<sup>2</sup>, MA Sutherland<sup>3</sup> and M Stewart<sup>2\*</sup>

<sup>1</sup>University of Waikato, Hamilton 3240, New Zealand; <sup>2</sup>InterAg, Ruakura Research Centre, Hamilton 3214, New Zealand;

<sup>3</sup>AgResearch, Private Bag 3115, Hamilton 3240, New Zealand; <sup>4</sup>Animal Inframetrics, Box 5451, Lacombe, Alberta, T4L 1X2, Canada

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

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<sup>b</sup> University of Minnesota, Department of Ecology, Evolution and Behavior, St. Paul, MN 55108, USA

Accepted 3 January 2008

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

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<sup>b</sup> Alberta Agriculture, Lacombe, Alberta, Canada

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#### ABSTRACT

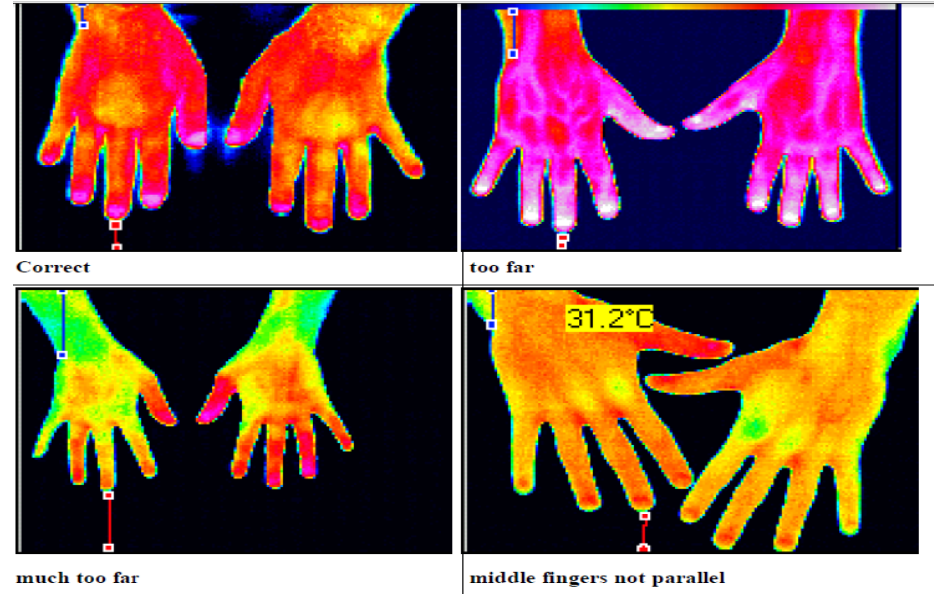
Bovine respiratory disease complex (BRD) causes considerable economic loss and biosecurity cost to the beef industry globally and also results in significant degradation to the welfare of affected animals. The



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

## Objective

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

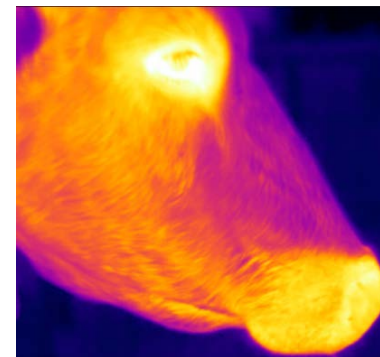
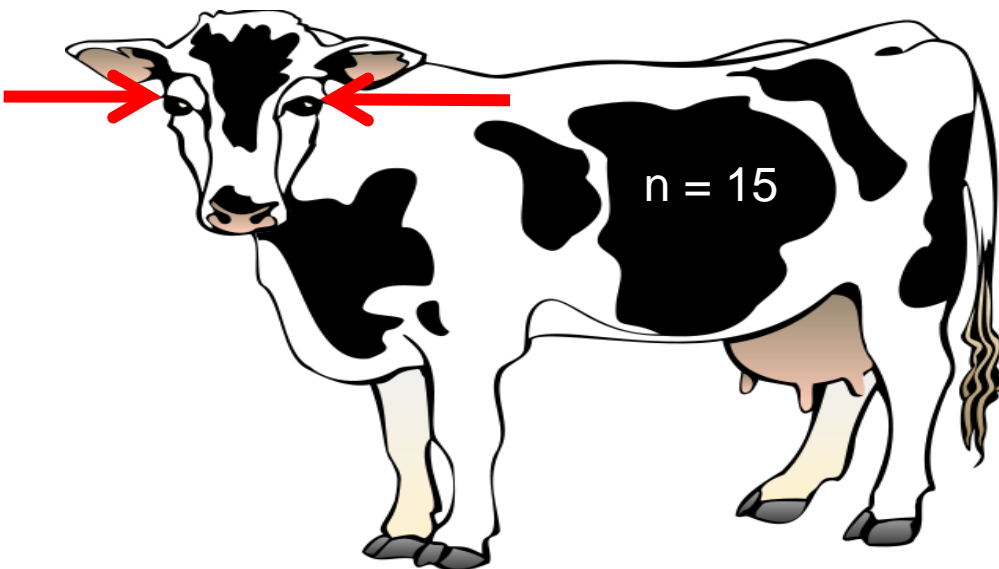


(Ammer, 2012)

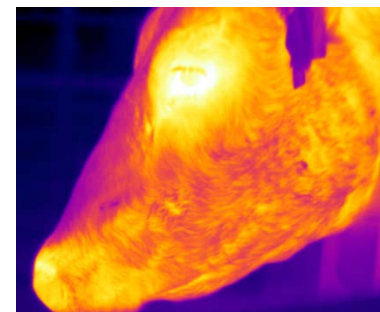
# Materials & Methods

## Objective

- Quantify the precision of **eye** images



n = 30

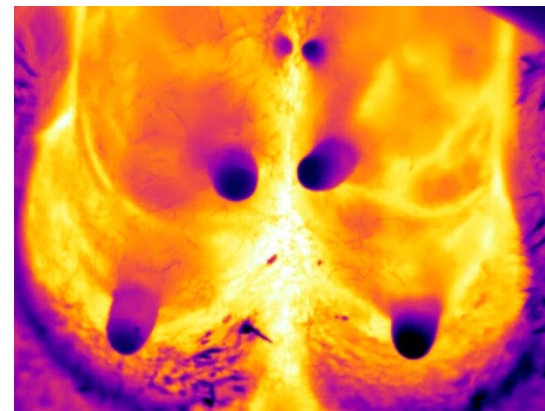
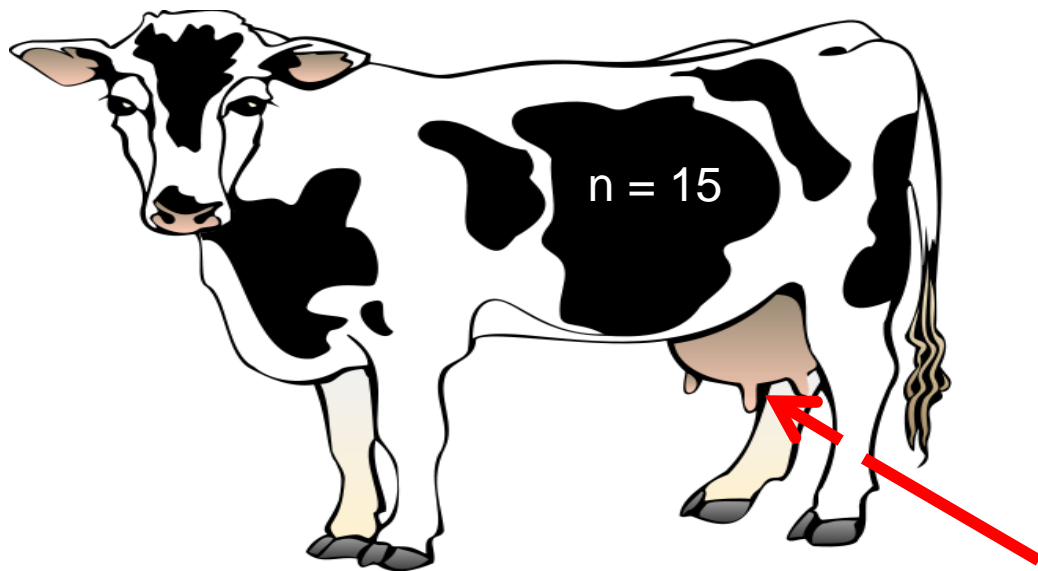


n = 30

# Materials & Methods

## Objective

- Quantify the precision of **udder** images



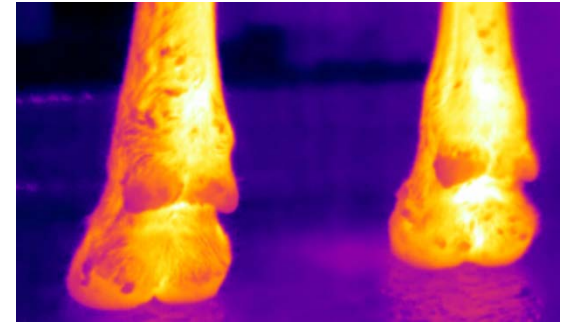
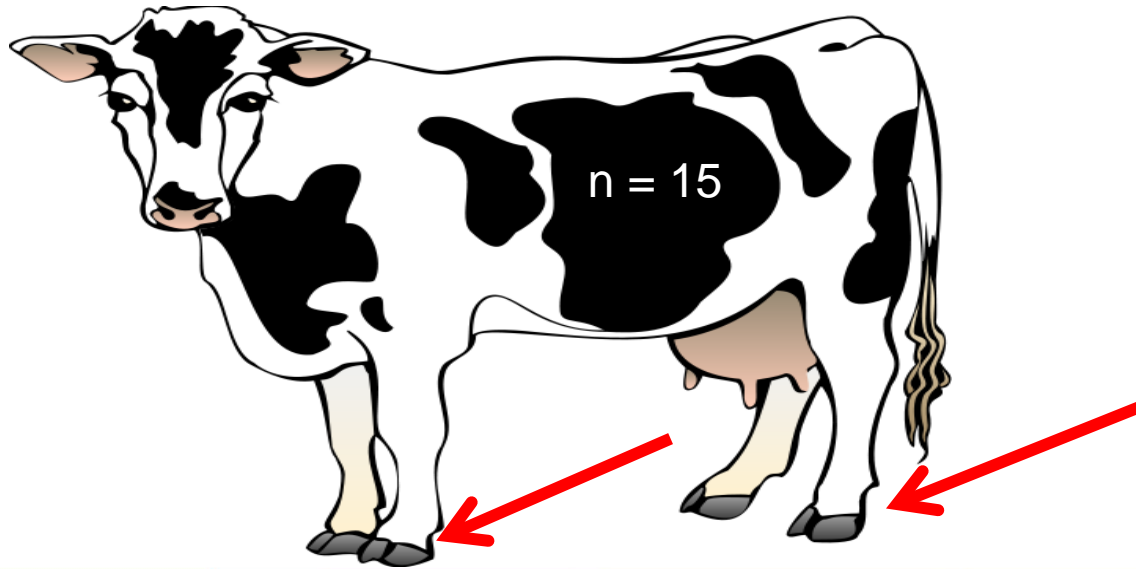
n = 30



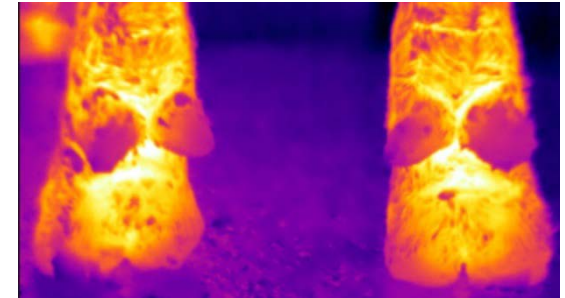
# Materials & Methods

## Objective

- Quantify the precision of **hoof** images



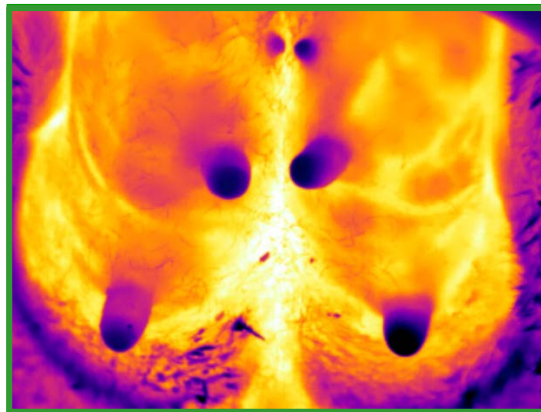
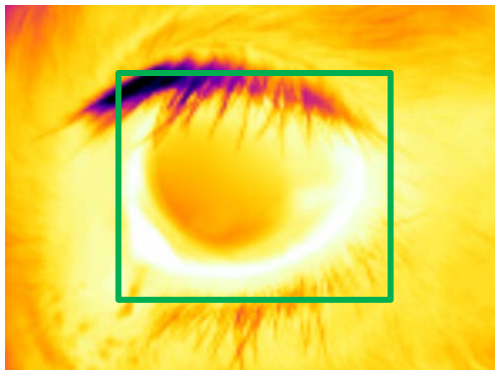
n = 30



n = 30

# Image Analysis

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

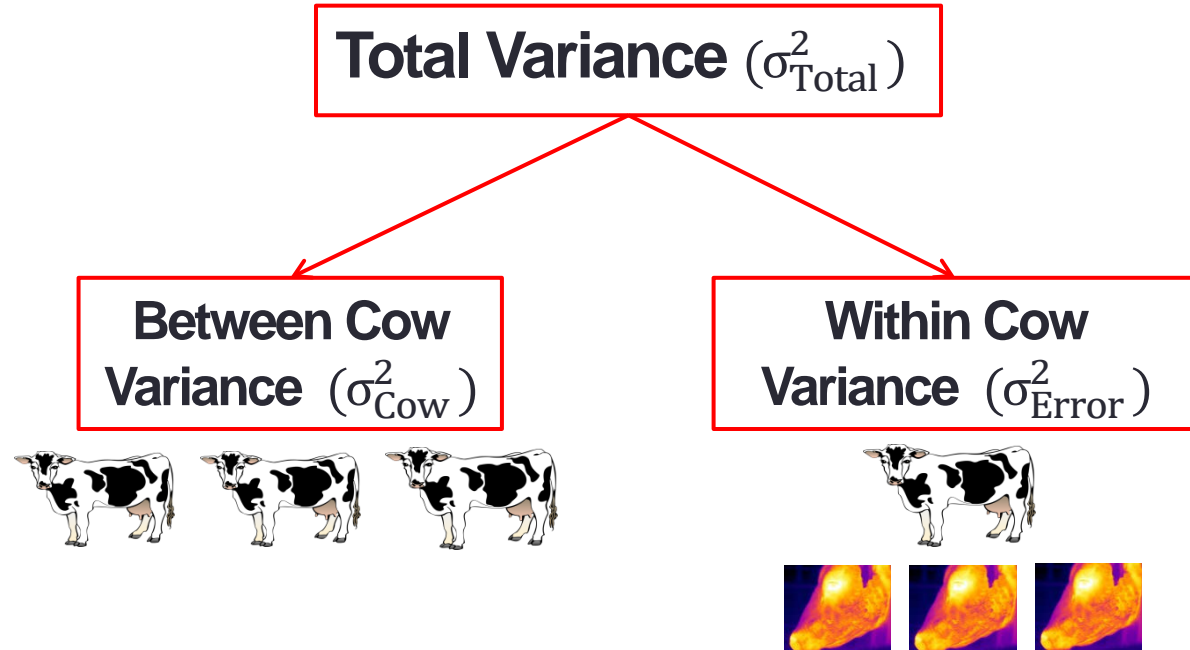




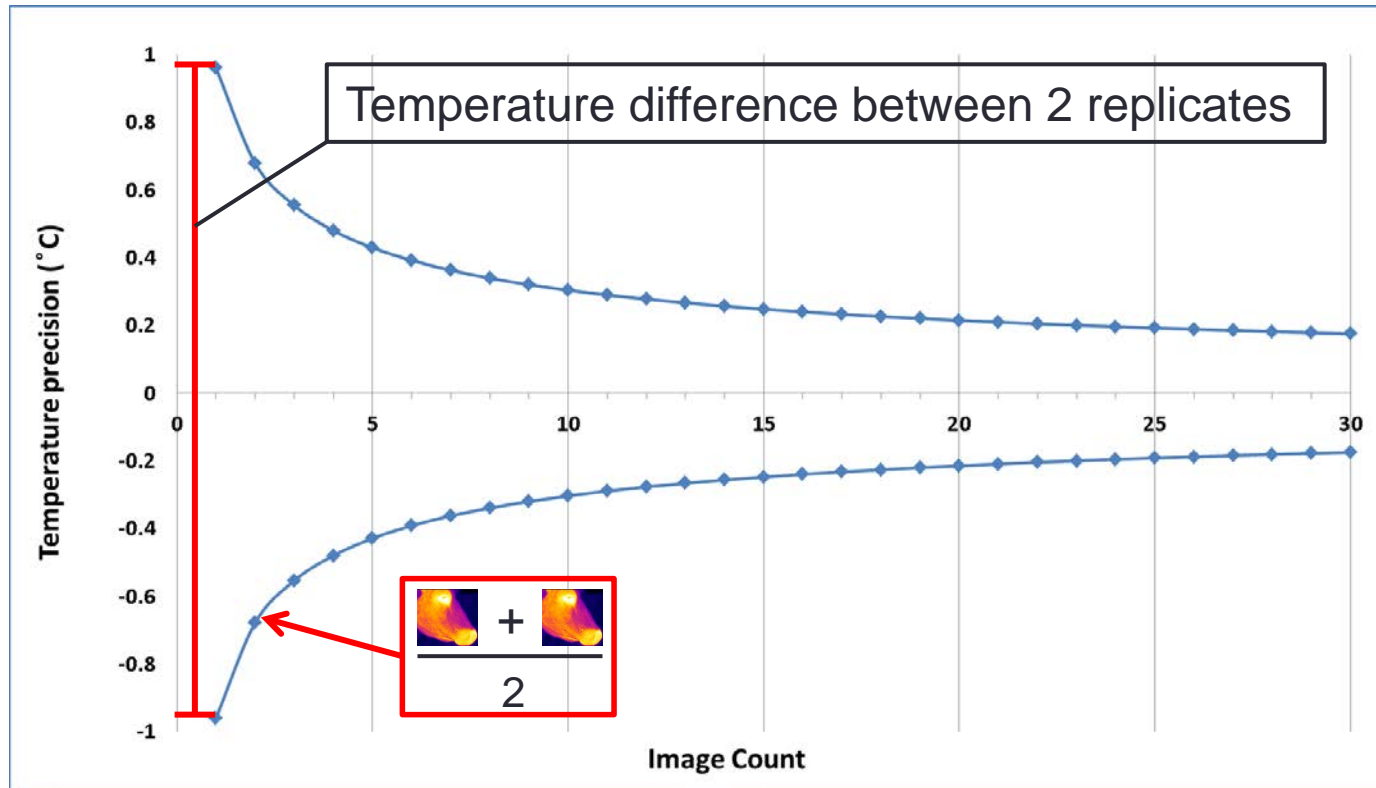
- Partition of the variance

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

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



# Precision



# Results

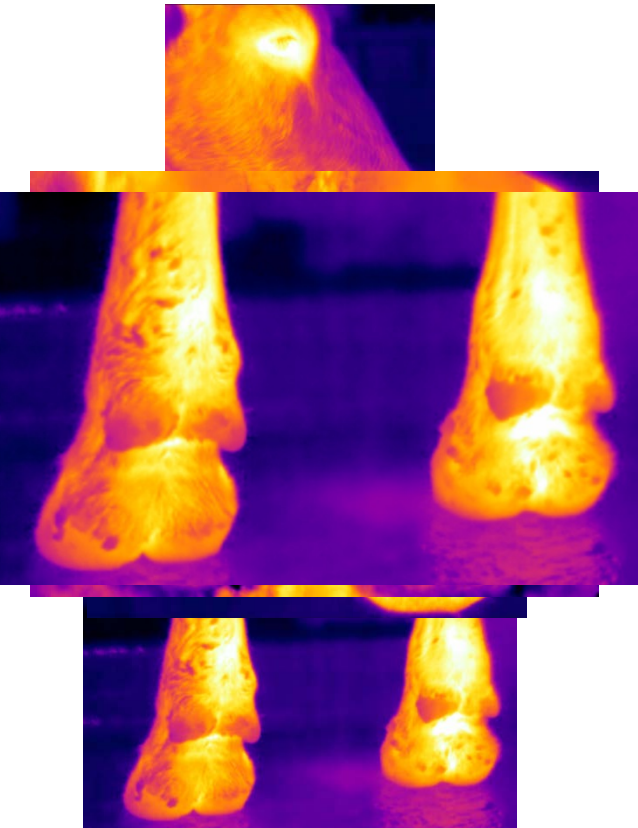
Temperature parameter to extract

Maximam

Temperature difference between 2 replicates

0.88°C

1 Image	2 Images	3 Images	4 Images	area	30 Images
0.88°C	0.02°C	0.75°C	0.65°C	99.3%	0.24°C

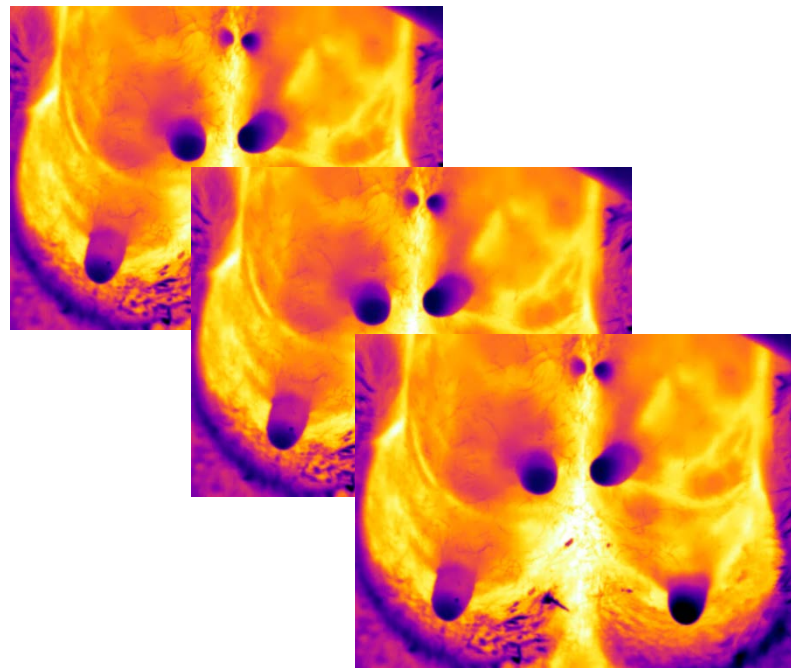


The Irish Agriculture and Food Development Authority

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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??