ATB
Leibniz-Institut für
Agrartechnik und Bioökonomie

Artificial intelligence for measuring the respiration rate in dairy cows

L. Dißmann, R. Antia, L. Chinthakayala, N. Landwehr, T. Amon, G. Hoffmann

KAMI

Leibniz
Association

Why do we record the respiration rate in cows ?

- Respiration rate (RR) = Very sensitive parameter for heat stress, pain and diseases
- Suitable animal welfare indicator
- Counting of flank movements through observation → Laborious and time-consuming
- Objective: Automatic and less biased RR Recording

Approach 1: Analysing the flank movement of the cow

Source: ATB, 2019

Veterinary Research Communications
https://doi.org/10.1007/s11259-022-09984-7

RESEARCH

How should the respiration rate be counted in cattle?

L. Dißmann[1] · J. Heinicke[1] · K. C. Jensen[2] · T. Amon[1,3] · G. Hoffmann[1]

Received: 16 June 2022 / Accepted: 8 August 2022

KAMI
(07/2021- 06/2024)

With support from
Federal Ministry of Food and Agriculture
by decision of the German Bundestag

Project manager
Federal Office for Agriculture and Food

Artificial intelligence for recording of respiration in dairy cows

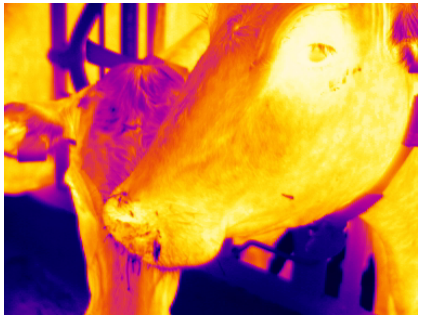
- Infrared camera
- Depth camera

Source ATB, 2020

Infrared Thermography (IRT)

<u>Fundamental principle:</u>

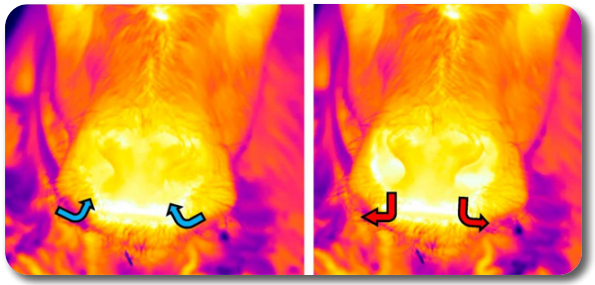
Measuring the temperatur of the airflow through the nostrils



Dißmann, ATB 2022

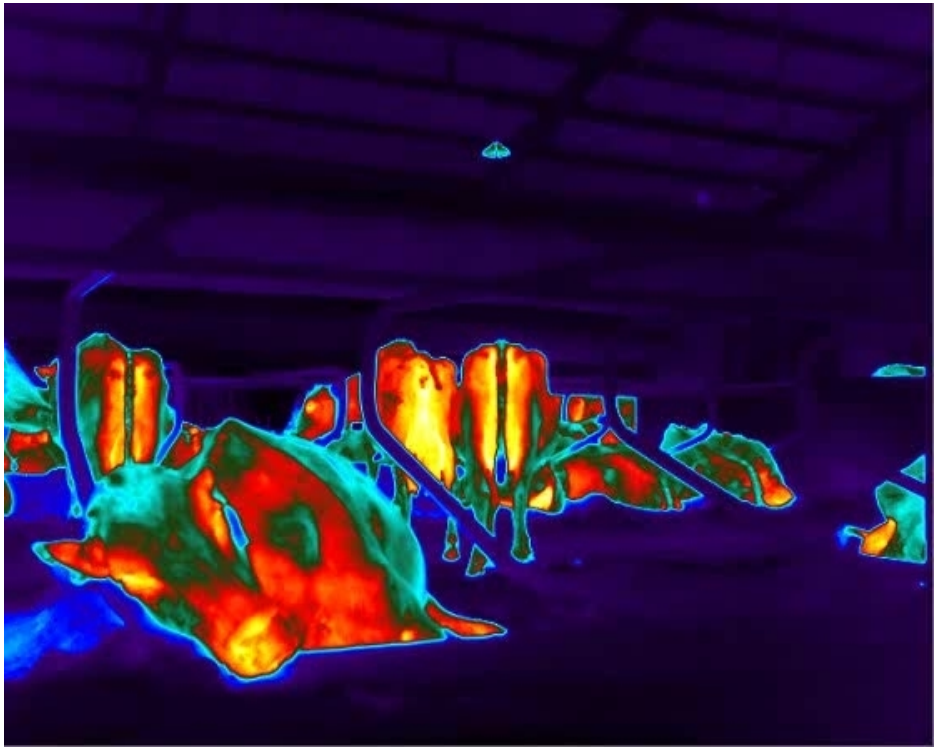
- cold air flows in
- warm air flows out

→ Temperature difference is shown by color change on thermal images



Lowe at al., 2019

IRT Recording



Source: ATB 2022

Previous Studies

animals

MDPI

Article

Infrared Thermography—A Non-Invasive Method of Measuring Respiration Rate in Calves

Gemma Lowe [1,2,*], Mhairi Sutherland [3], Joe Waas [2], Allan Schaefer [4], Neil Cox [5] and Mairi Stewart [1]

1 InterAg, Ruakura Research Centre, Hamilton 3214, New Zealand
2 School of Science, The University of Waikato, Hamilton 3216, New Zealand
3 AgResearch Ltd., Ruakura Research Centre, Hamilton 3214, New Zealand
4 Animal Inframetrics, Box 5451, Lacombe, AB, T4L 1X2, Canada
5 NeilStat Ltd., 9 Ngaere Ave, Hamilton 3210, New Zealand
* Correspondence: gll1@students.waikato.ac.nz

Received: 16 May 2019; Accepted: 3 August 2019; Published: 7 August 2019

check for updates

J. Dairy Sci. 100:3893–3901
https://doi.org/10.3168/jds.2016-12055

The use of infrared thermography and accelerometers for remote monitoring of dairy cow health and welfare

M. Stewart,*[1] M. T. Wilson,* A. L. Schaefer,† F. Huddart,‡ and M. A. Sutherland‡
*InterAg, Ruakura Research Centre, 10 Bisley Rd., Hamilton 3214, New Zealand
†Animal Inframetrics, Box 5451, Lacombe, AB, T4L 1X2, Canada
‡AgResearch Ltd., Private Bag 3123, Hamilton 3240, New Zealand

animals

MDPI

Article

Breathing Pattern Analysis in Cattle Using Infrared Thermography and Computer Vision

Sueun Kim * and Yuichi Hidaka

Laboratory of Veterinary Surgery, Department of Veterinary Science, University of Miyazaki, 1-1 Gakuen Kibana-dai Nishi, Miyazaki 889-2192, Japan; yhidaka@cc.miyazaki-u.ac.jp
* Correspondence: kim_su_eun@med.miyazaki-u.ac.jp; Tel.: +81-985-58-7791

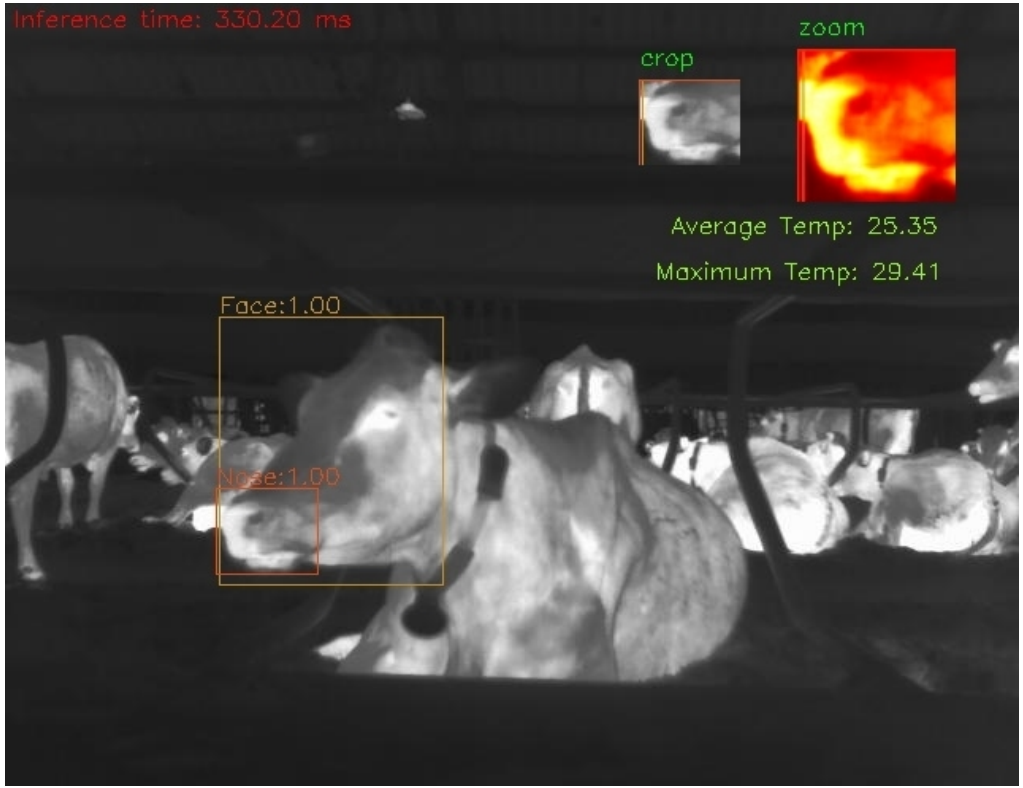
IRT Camera

Source: Teledyne FLIR 2023

- FLIR A65
- Permanently installed

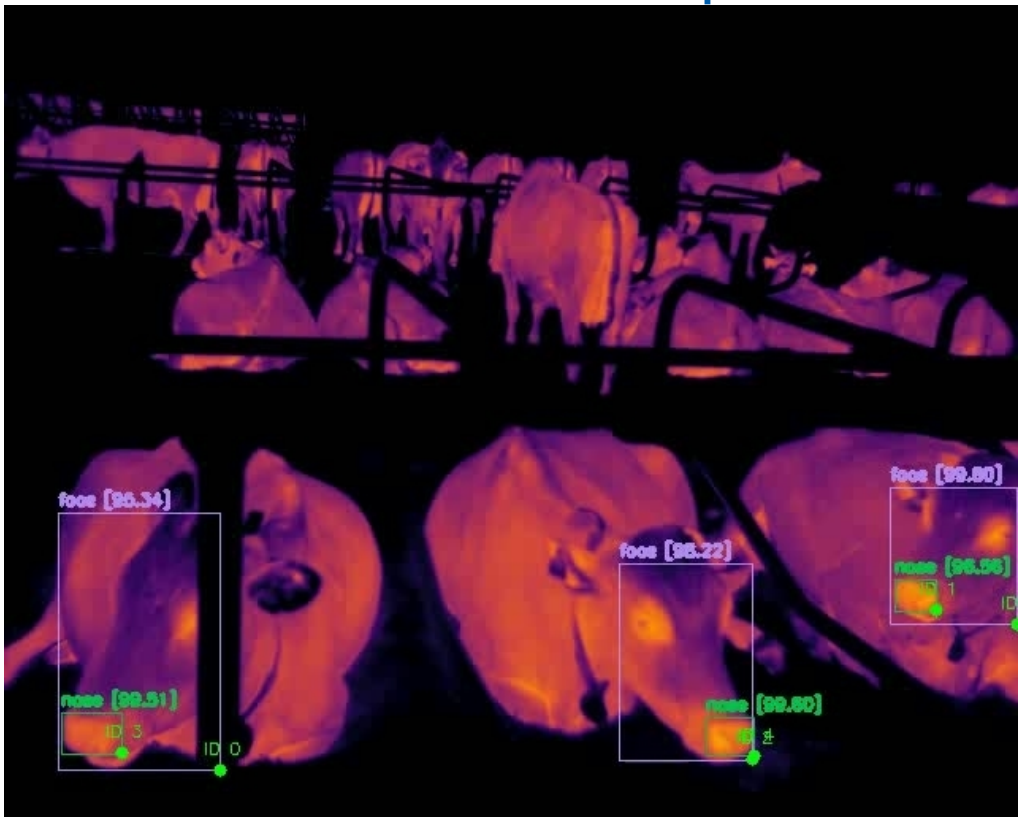
Source: ATB 2023

Area of Interest (AOI) Detection



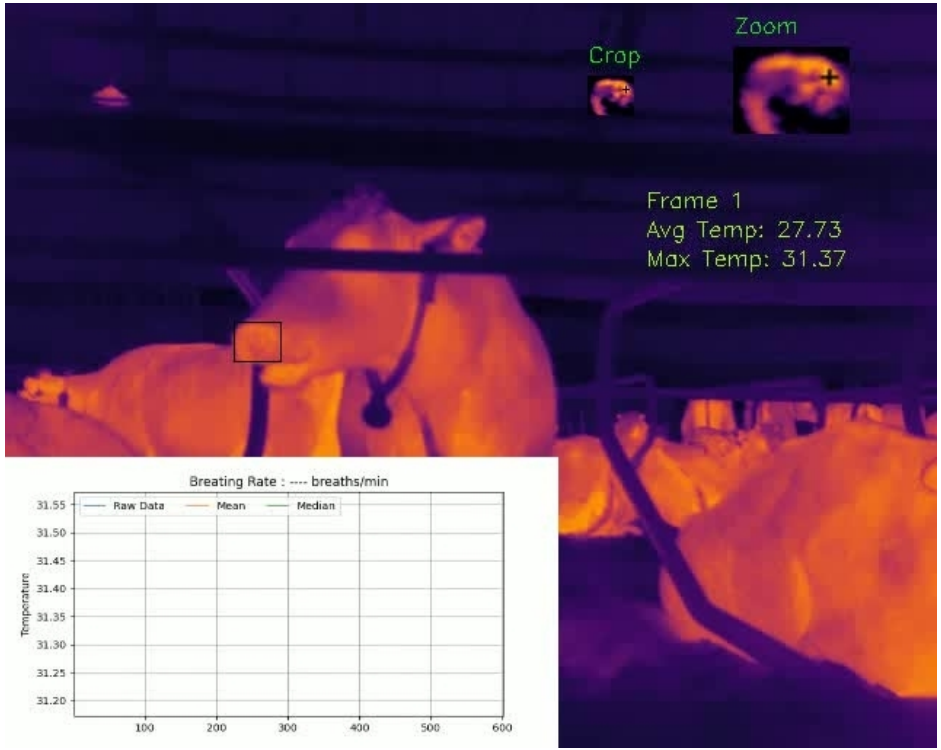
Source: ATB & Uni Hildesheim 2022

AOI Detection of multiple cows



Source: ATB & University Hildesheim, 2023

RR recording using IRT

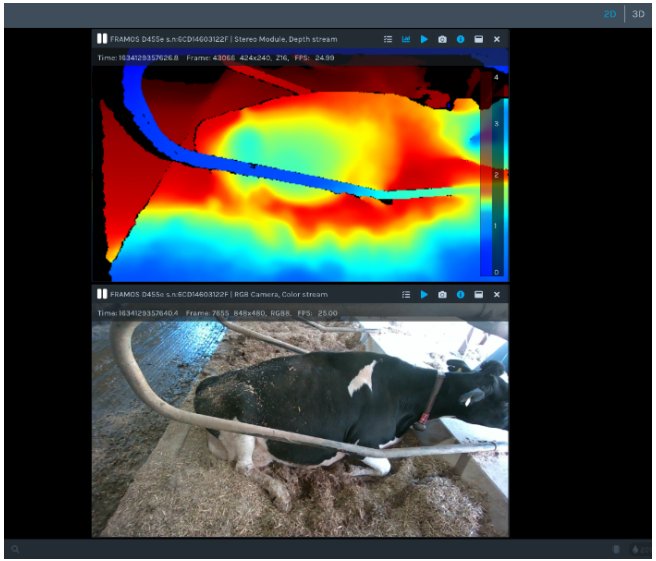


Source: ATB & University Hildesheim, 2023

Depth camera D455 IntelRealsense

Source; FRAMOS Depth Camera D455e (camera only) | FRAMOS

- Depth Resolution: 1280 x 720
- Distance 0,6 to 6 m



Source: ATB 2022

Fundamental principle:

Measuring the respiration rate in cattle by automatically counting the flank movement

Previous studies

Proceedings of the ASME 2015 International Design Engineering Technical Conferences &
Computers and Information in Engineering Conference
IDETC/CIE 2015
August 2-5, 2015, Boston, USA

DETC2015-46309

NON-CONTACT MONITORING OF PRETERM INFANTS USING RGB-D CAMERA

Annalisa Cenci
Department of Information Engineering
Università Politecnica delle Marche
Via Brecce Bianche, 12 Ancona 60131
Email: a.cenci@pm.univpm.it

Daniele Liciotti, Emanuele Frontoni,
Adriano Mancini, and Primo Zingaretti
Department of Information Engineering
Università Politecnica delle Marche
Via Brecce Bianche, 12 Ancona 60131
Email: {d.liciotti, e.frontoni, a.mancini, p.zingaretti}@univpm.it

J. Dairy Sci. 102:9076–9081
https://doi.org/10.3168/jds.2019-16550

Hot topic: **Automated assessment of reticulo-ruminal motility in dairy cows using 3-dimensional vision**

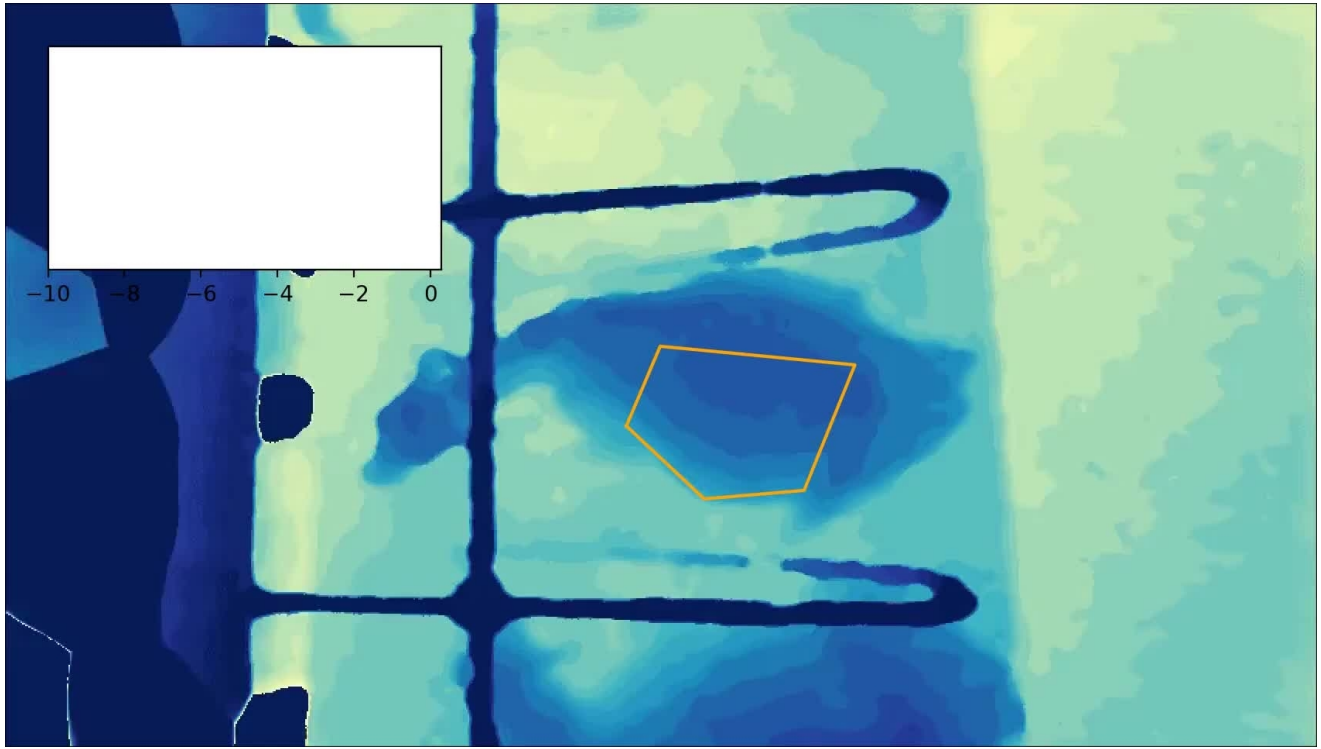
X. Song,[1,2]* P. P. J. van der Tol,[1] P. W. G. Groot Koerkamp,[1] and E. A. M. Bokkers[3]
[1]Farm Technology Group, Wageningen University and Research, PO Box 16, Wageningen, 6700 AA, the Netherlands
[2]Sensors and Data Analysis Department, Lely Innovation, Cornelis van der Lelylaan 1, Maassluis, 3147 PB, the Netherlands
[3]Animal Production Systems Group, Wageningen University and Research, PO Box 338, Wageningen, 6700 AH, the Netherlands

AOI Detection

- Pose Estimation Model - SLEAP

Source: ATB 2022

RR Recording Using Depth Images



Source: ATB & Dida, 2023, Colormap reference — Matplotlib 3.7.2 documentation

RGB recording without modeling

Source: ATB & Dida 2023

Recording of the RR using magnification

Oh et al. 2018

DOI: 10.1007/978-3-030-01225-0_39 • Corpus ID: 4718360

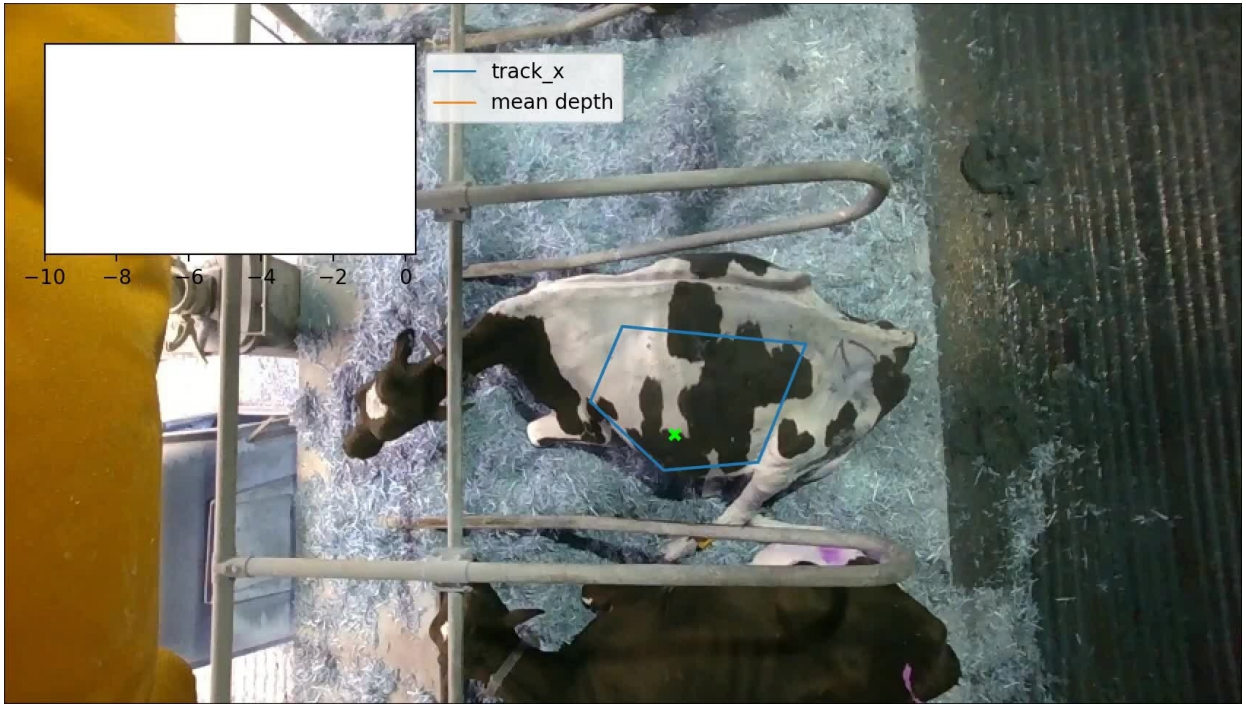
Learning-based Video Motion Magnification

Tae-Hyun Oh, Ronnachai Jaroensri, Changil Kim, Mohamed A. Elgharib, F. Durand, W. Freeman, W. Matusik, less

Published in European Conference on... 8 April 2018 • Computer Science

TLDR This paper seeks to learn the filters directly from examples using deep convolutional neural networks, and shows that the learned filters achieve high-quality results on real videos, with less ringing artifacts and better noise characteristics than previous methods.

Mean depth and Motion magnification tracking in comparison



Source: ATB & Dida 2023

Conclusion

Camera Type	Infrared Camera	Depth Camera	
Image Type	Infrared thermography	Depth images	Magnified RGB images
Location	Outside	Inside	Inside
Place of Camera	In front of the lying cubicle	In the lying cubicle	Before the milking robot
Number of cows that can be recorded	Max 2-3	Max 1-2	1
Costs	>10,000 Euro	Approx. 1,100 Euro	
Challenges	Animal identification, record more cows with one camera per day		Identification of unicoloured cows

Future Steps

- Evaluation of the 3 methods regarding their accuracy
- Animal Identification in the lying cubicle
- Automatic reporting of the RR in real-time
- Integration in herd management system

Thanks for your attention! Questions?

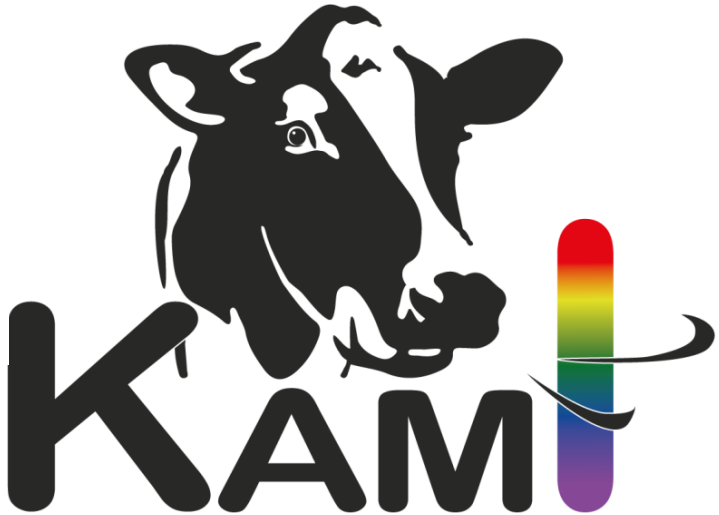
With support from

Federal Ministry of Food and Agriculture

Project manager

Federal Office for Agriculture and Food

by decision of the German Bundestag



dida

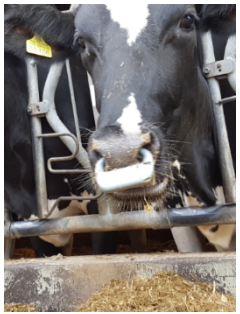
Stiftung Universität Hildesheim 2003

LEIBNIZ INNOHOF

ldissmann@atb-potsdam.de

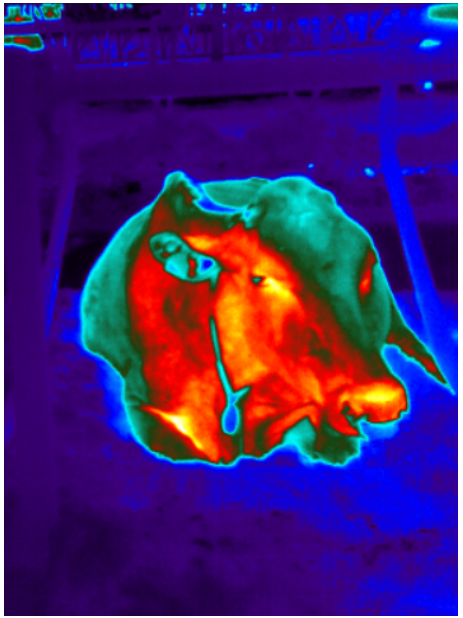
ATB

Reference Method



- RR Sensor

Source: ATB 2020



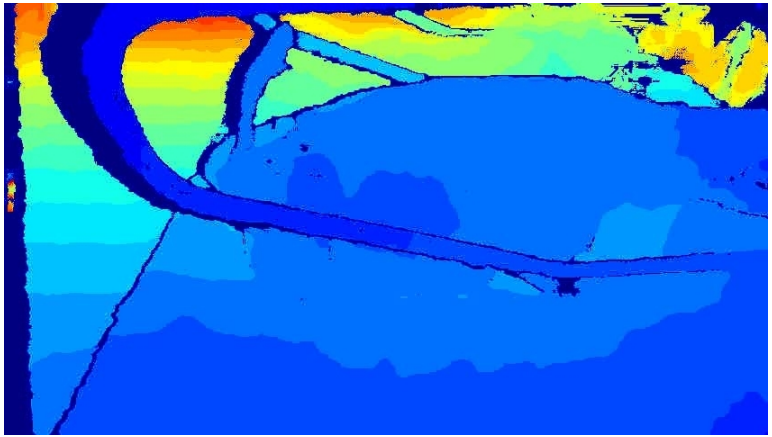
Source: ATB 2023

J. Dairy Sci. 102:690–695
https://doi.org/10.3168/jds.2018-14999

Technical note: Development of a noninvasive respiration rate sensor for cattle

S. Strutzke,[1] D. Fiske,[1] G. Hoffmann,[1]* C. Ammon,[1] W. Heuwieser,[2] and T. Amon[1,3]
[1]Leibniz Institute for Agricultural Engineering and Bioeconomy (ATB), Department of Engineering for Livestock Management, Max-Eyth-Allee 100, 14469 Potsdam, Germany
[2]Clinic of Animal Reproduction, and
[3]Institute of Animal Hygiene and Environmental Health, Department of Veterinary Medicine, Freie Universität Berlin, 14163 Berlin, Germany

Recording of RR



Area of Interest Detection _SLEAP

Video daten Rec 24 bunt