



Validation of an indoor positioning system for automated behavior assessment in dairy cows

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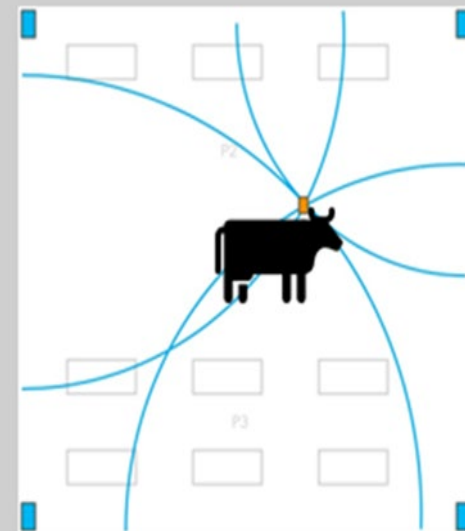
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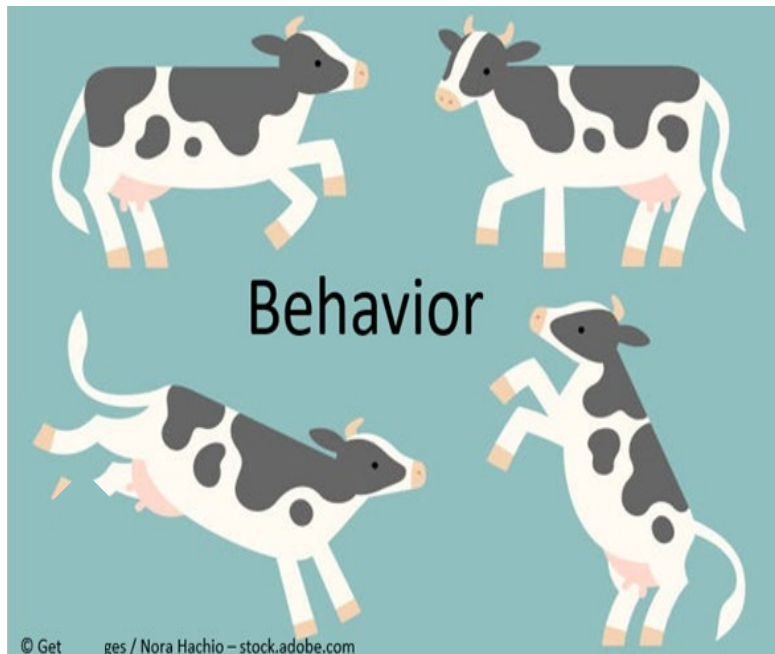
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Introduction



Article

The Relationship between Estrous Behavioral Score and Time of Ovulation in Dairy Cattle

F.J.C.M. Van Eerdenburg ^{*}  , D. Karthaus ^{*}, M.A.M. Taverne ^{*}, I. Mercis [†], O. Szenci [‡]

Alterations in sick dairy cows' daily behavioural patterns

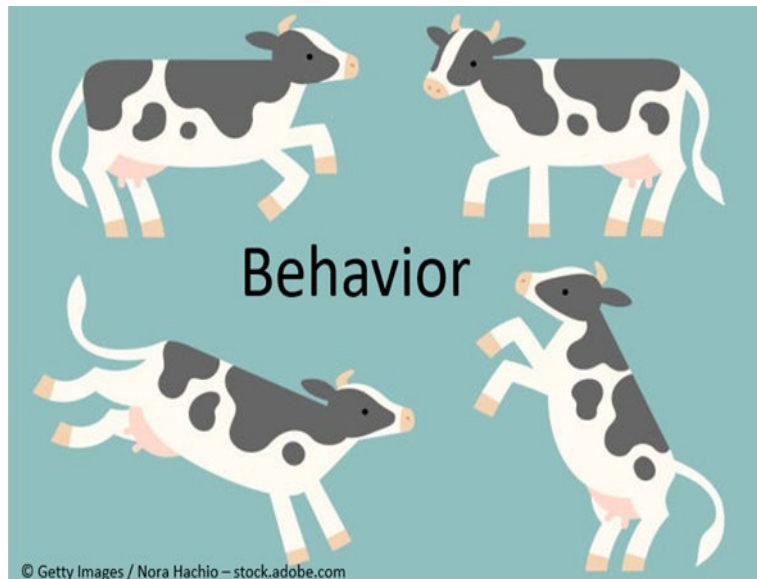
I. Dittrich   • M. Gertz • J. Krieter

Open Access • Published: November 22, 2019 • DOI: <https://doi.org/10.1016/j.heliyon.2019.e02902>  •

A Review of the Effects of Stress on Dairy Cattle Behaviour

by Viktor Jurkovich ¹  , Péter Hejál ²   and Levente Kovács ^{3,4,*} 

Introduction



- Gives insights to many different aspects of the animals life
- One task (behavioral observation) covers many prerequisites for good animal husbandry
- Time is crucial for farmers
 - Early detection of alterations
 - Requires observation for a long period with a high frequency

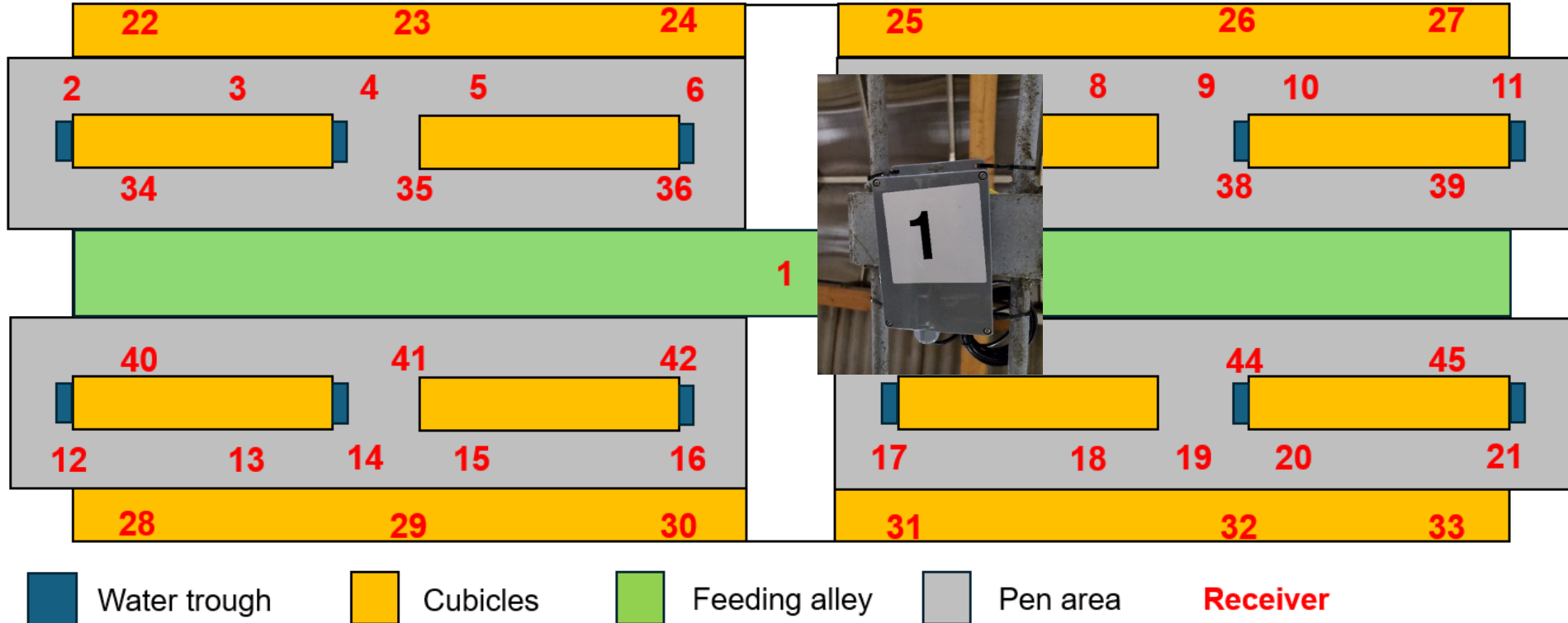


Introduction

- Automated Systems necessary
- Advantages of a positioning system
 - Less data than camera
 - More information than accelerometer
 - Less invasive than bolus
- Accuracy in past studies
 - ± 51 cm (Porto et al. 2014)
 - ± 180 cm (Wolfger et al. 2017)

Positioning system

Stable of the Research farm Karkendamm



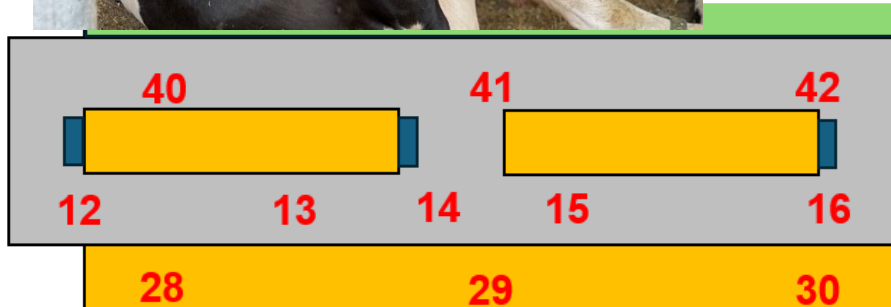
Positioning system



- 1 group ~ 60 cows equipped with beacons
- Beacons send signal once per second
- Receivers are timely synchronized

– Time difference of arrival

→ Triangulation (2 D)



Water trough



Cubicles



Feeding alley

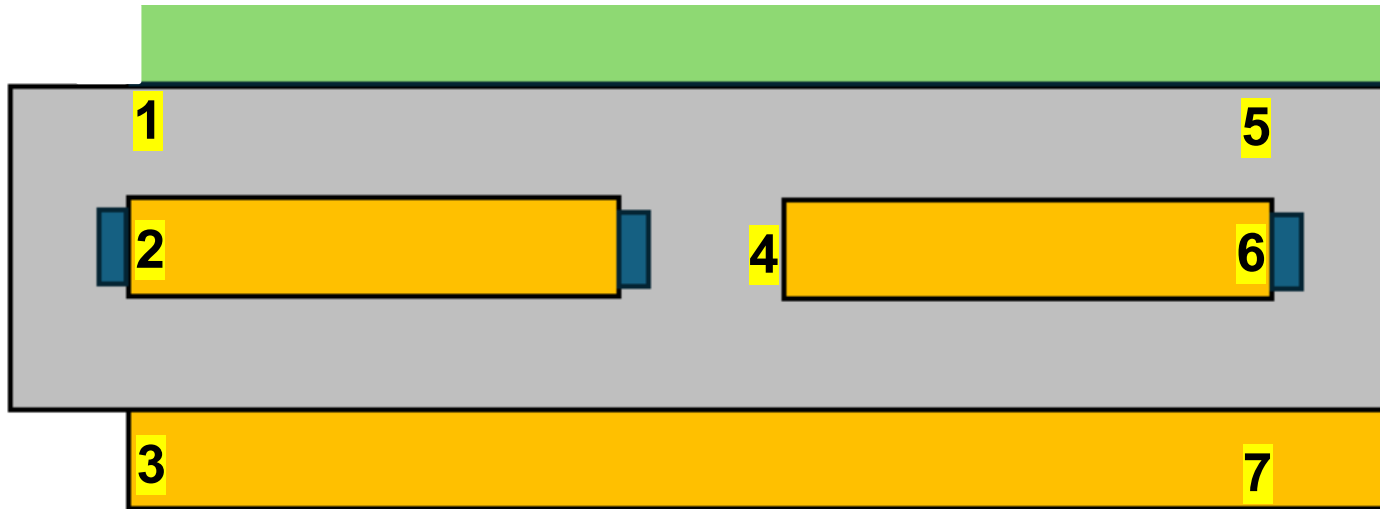


Pen area

Receiver

Validation methods

- 3 beacons
 - 7 stationary locations
 - 5 minutes at each position



Water trough



Cubicles



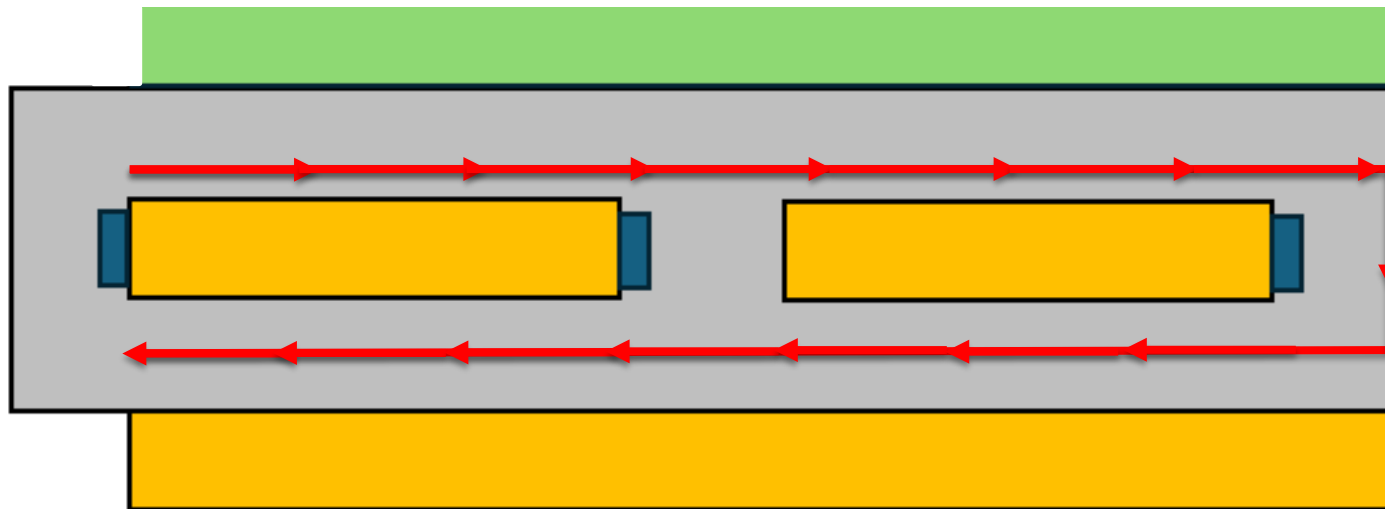
Feeding alley



Pen area

Validation methods

- Walking a **test route** in a steady pace (~ 1 step per second)
 - 3 beacons
 - 3 repetitions of the same route



Water trough



Cubicles



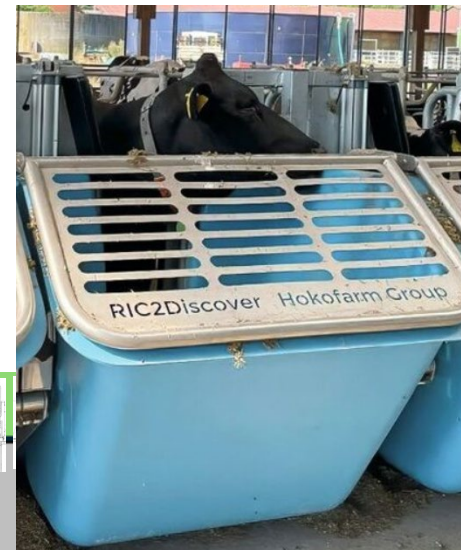
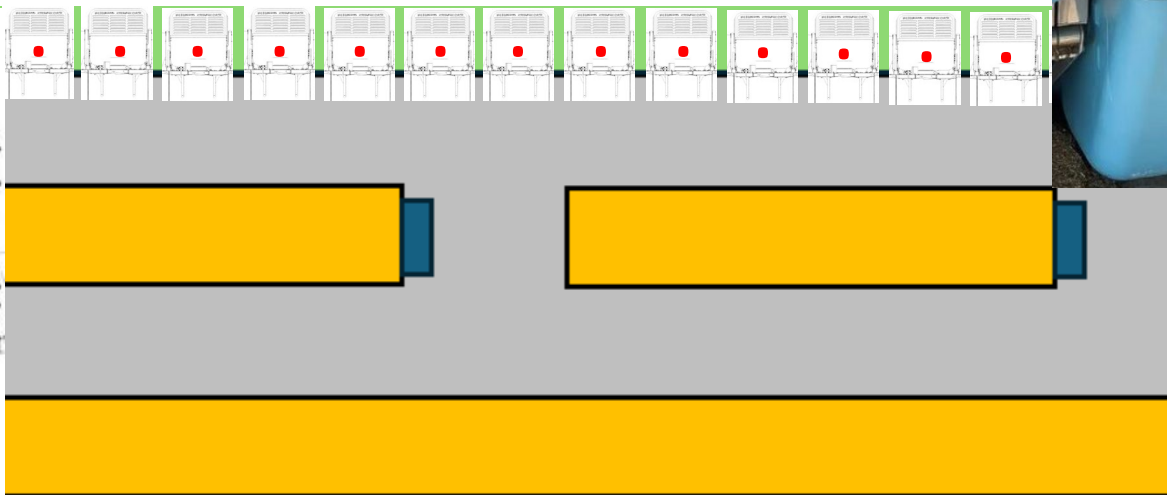
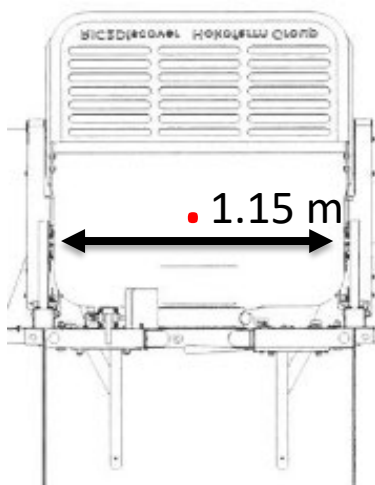
Feeding alley



Pen area

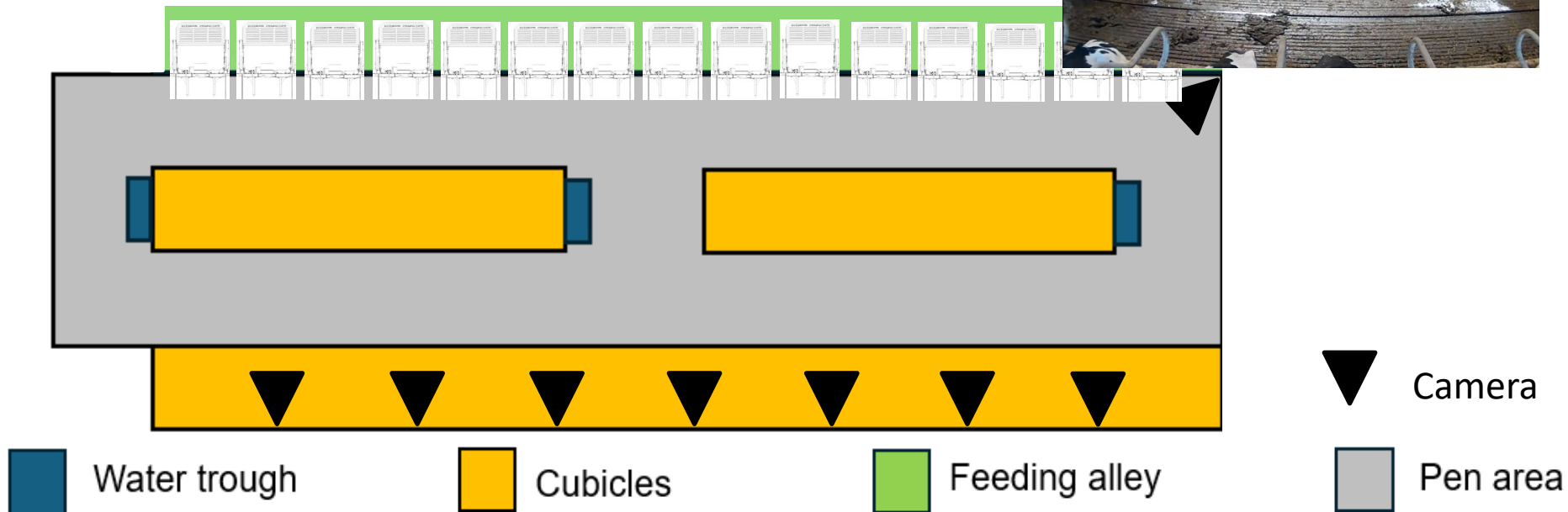
Validation methods

- 32 feeding troughs (Hokofarm RIC2 Discover)
 - ID
 - Timestamp (start/end)
 - Dataset of 6 hours
 - Distance from the **middle** of the bin to the beacon



Validation methods

- 8 cameras
 - Visual confirmation as back up
 - Cubicle evaluation



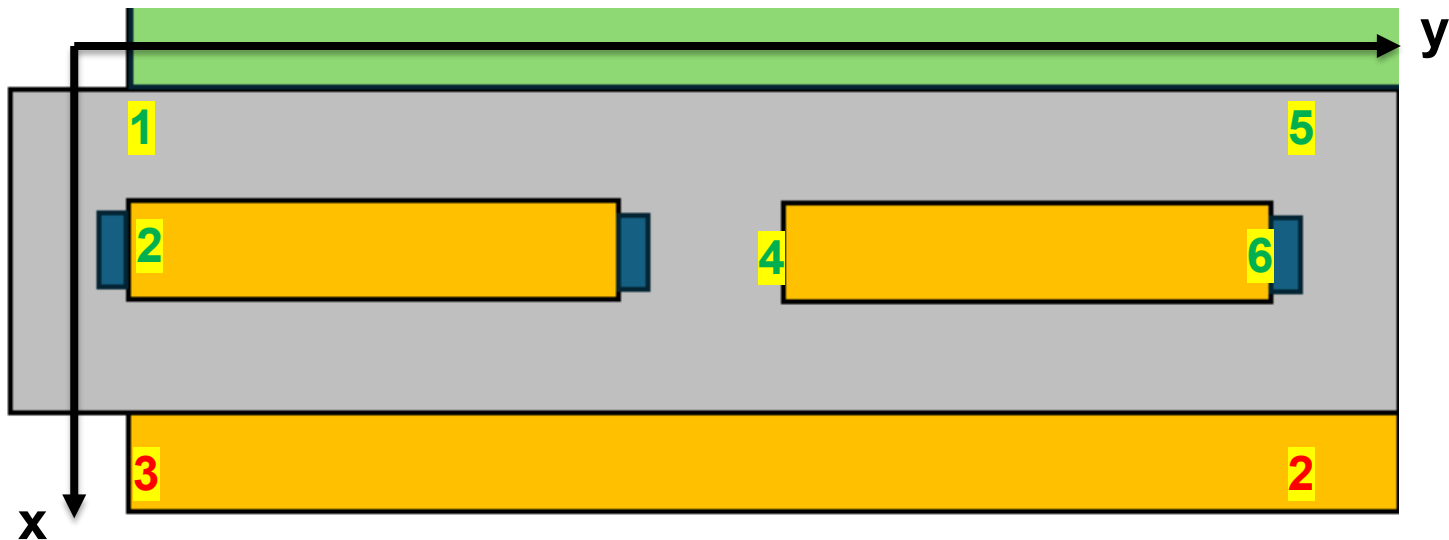
Validation methods

- 1 hour video for each camera
- YOLOv8 object detection software
 - Trained on
 - 1,508 manually annotated frames
- Detections
 - Empty, Cow standing, Cow lying
- Detection rate 1 frame/second
- Model performance
 - Precision = 0.99
 - Recall rate = 0.98

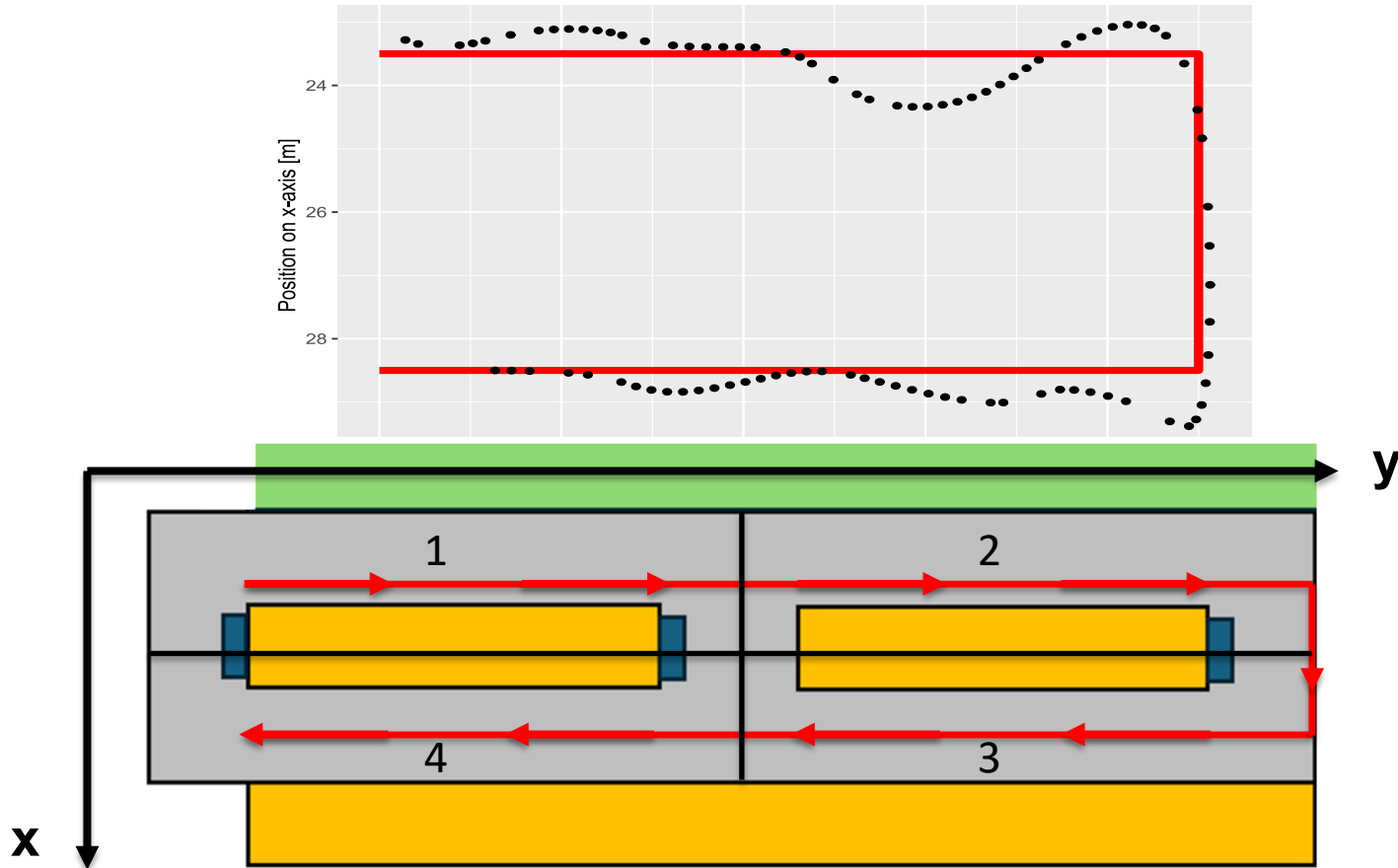


Results stationary

Position	Dev. x [$\pm$ m]	Dev. y [$\pm$ m]	Missing [%]	Obs.
1, 2, 4, 5, 6	0.09 - 0.30	0.12 - 0.42	16 - 59	1,500
3, 7	0.27 - 0.99	0.27 - 1.52	33 - 84	600



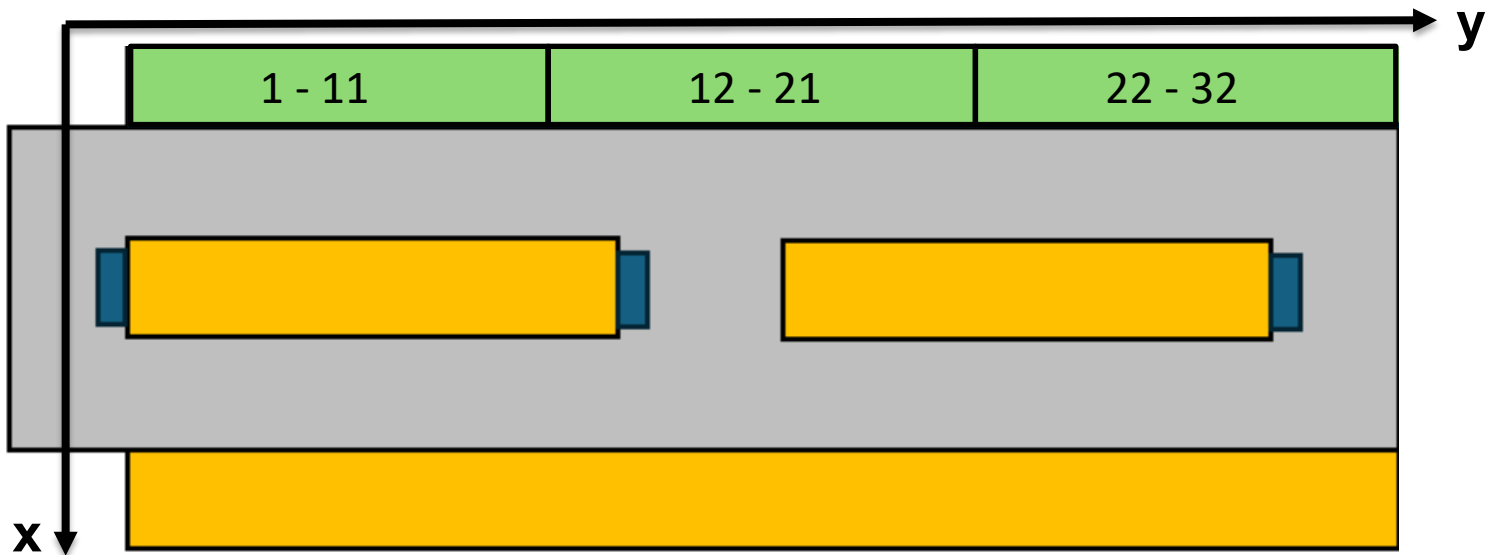
Results test route





Results feeding troughs

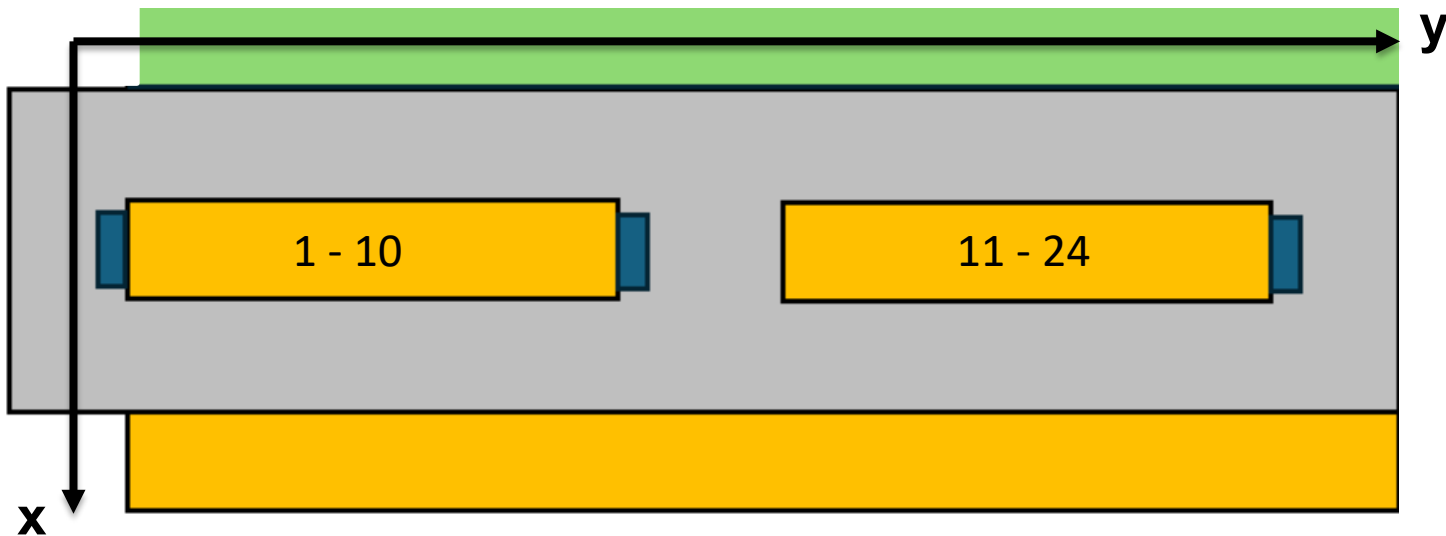
Trough	Dev. x [$\pm$ m]	Dev. y [$\pm$ m]	Missing [%]	Obs.
1 - 11	0.18	0.31	60	105,218
12 - 21	0.21	0.29	54	100,957
22 - 32	0.28	0.21	68	64,828





Results cubicles

Cubicle	Dev. x [$\pm$ m]	Dev. y [$\pm$ m]	Missing [%]	Obs.
1 - 10	0.30	0.26	69	36,004
11 - 24	0.30	0.27	73	70,219



Conclusion & outlook

- Overall accuracy

Dev. x [$\pm$ m]	Dev. y [$\pm$ m]	Missing [%]	Obs.
0.25	0.28	37	379,683

- Tracking depends on receiver coverage
- Obstacles (feeding troughs, cubicles, posts) increase the percentage of missing values ~ 30 %
 - Unproblematic within the same behavior
- Further steps
 - Establish behavioral profiles
 - Identify social contacts



Thank you for your attention!



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Project manager



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