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Automated dairy cow tracking and identification pipeline across 50 cameras to underpin the John Oldacre Centre for Dairy Welfare & Sustainability Research

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John Oldacre Centre for Dairy Welfare & Sustainability

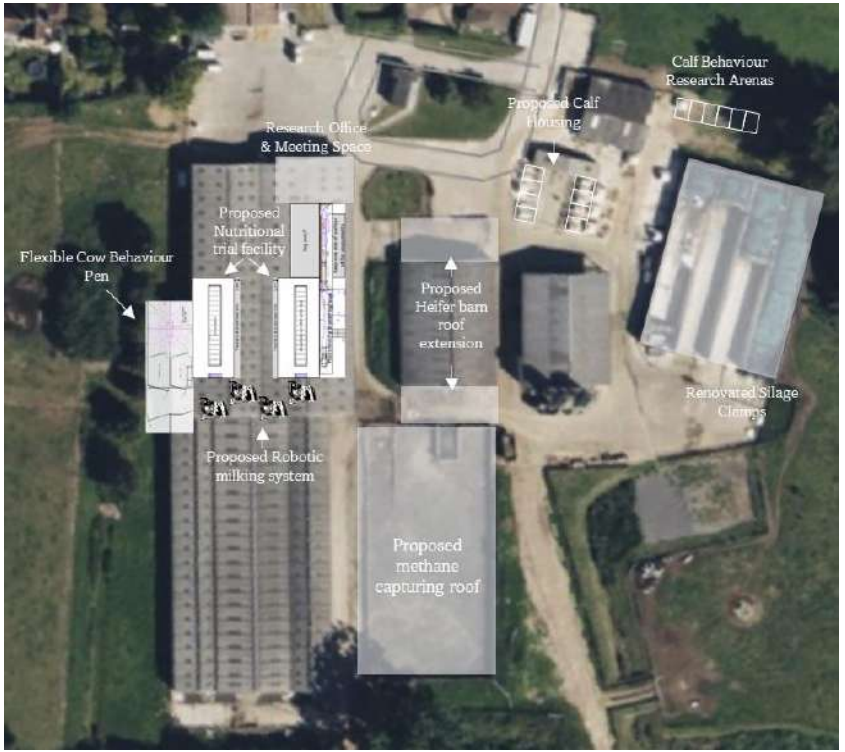
£1M award from the John Oldacre Foundation to supercharge our farm for research

Implemented Research Infrastructure

- Calf Behaviour Research Arenas
- Greenfeed Methane Emission Monitoring devices
- Climate and weather monitoring
- Research wireless network
- ***60+ camera video monitoring system for AI methodology and applications development***

Planned Research Infrastructure

- Flexible Cow Behaviour Pen
- Calf Behaviour & low-labour automatic feeders
- Nutritional trial facility
- Robotic milking system



Behaviour vs disease

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Changes in social and feeding behaviors, activity, and salivary serum amyloid A in cows with subclinical mastitis

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- "Core behaviours" are necessary for immediate survival *e.g. feeding, drinking*
- "Luxury behaviours" are those that have long-term impacts, such as social interactions
- Subclinical clinical infection reduced activity levels, social exploration, reactivity and grooming, and an increase in lying with head on flank

Examples of affiliative/agonistic interactions

Head swipe

Body push

Allogrooming

Proximity

Body condition and mobility assessment on the race

Expert mobility assessment

Expert body condition assessment

Behaviour data collection

Behaviour data collection

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Identity data collection

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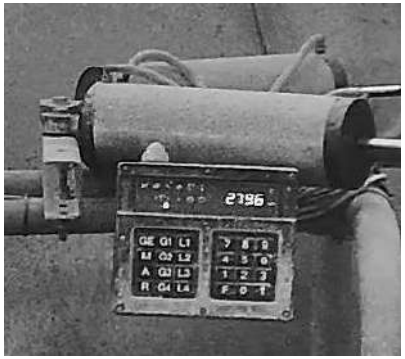
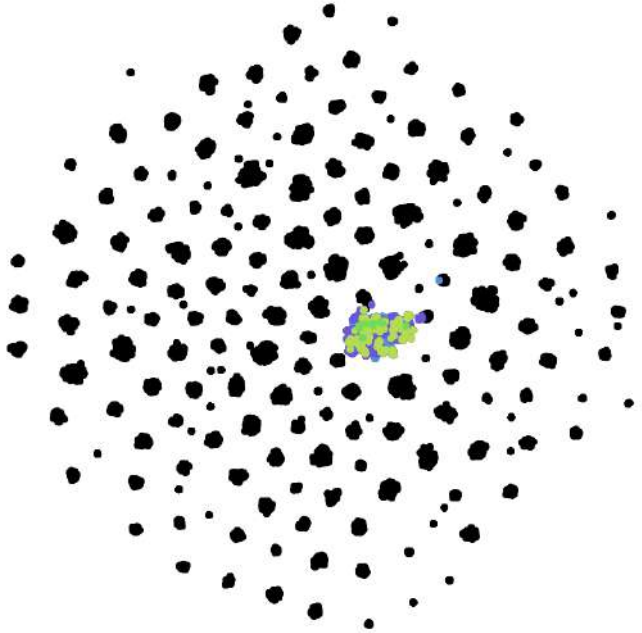
Identity data collection



Deep metric learning for cow identification



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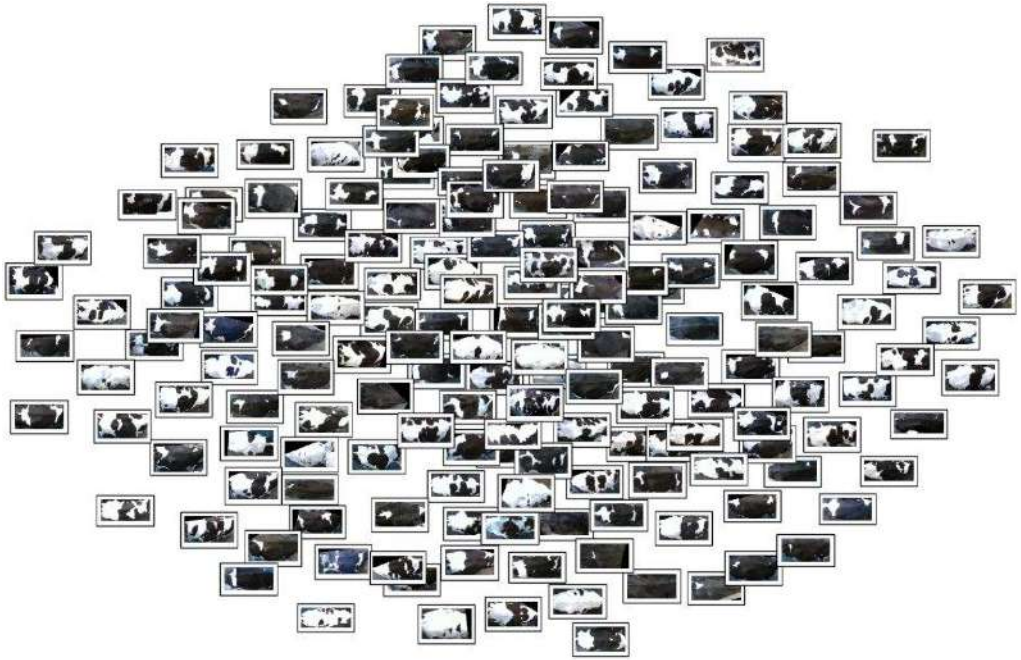
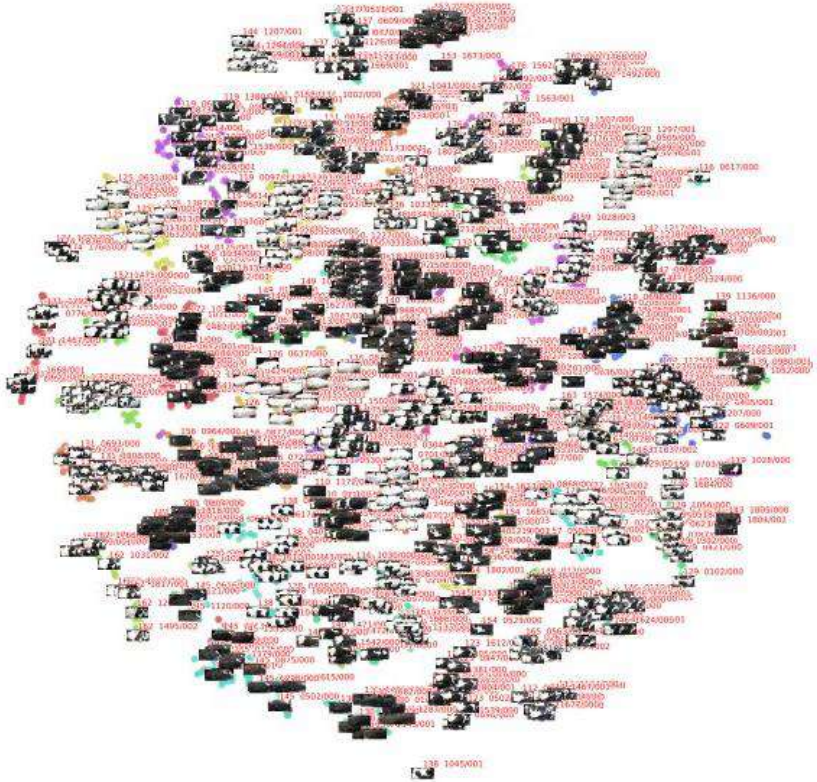


Deep metric learning for cow identification



Tracking for cow identification

Tracking

Cow detection with oriented bounding boxes

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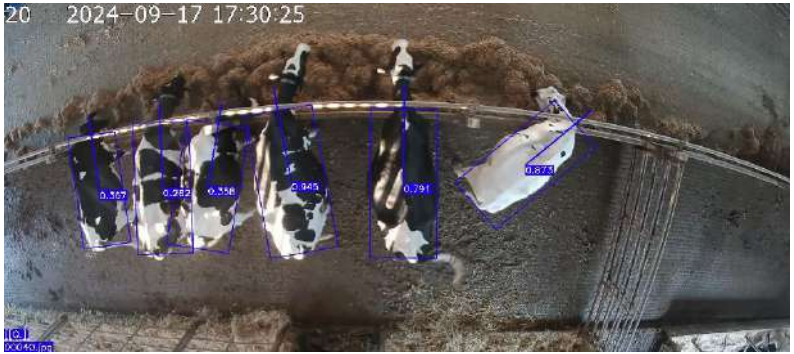
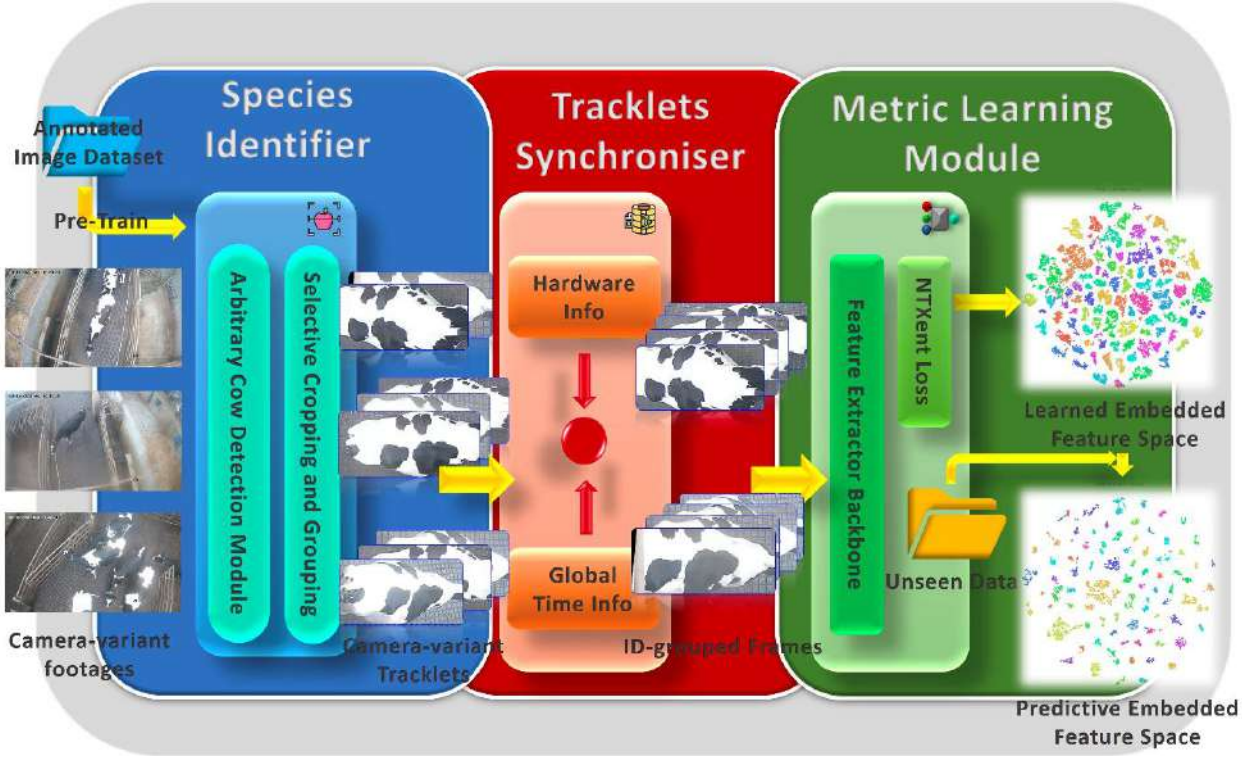
Challenges



Minimising transfer to new cameras/farms



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New cow detector for crowds

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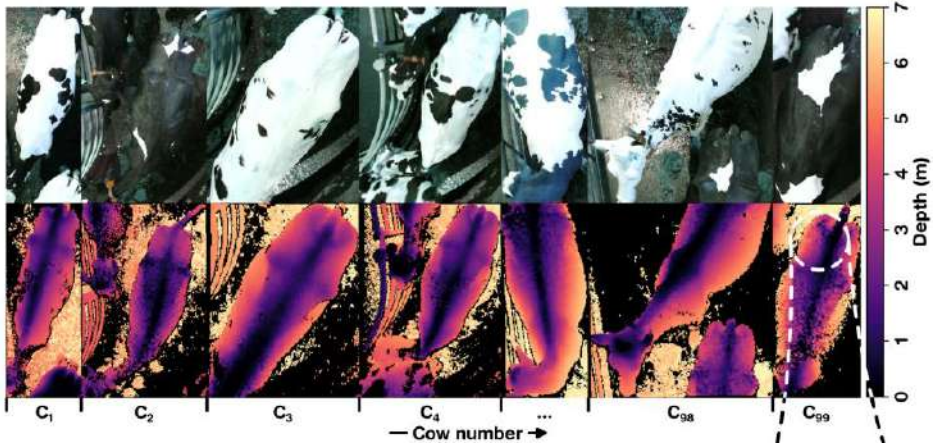
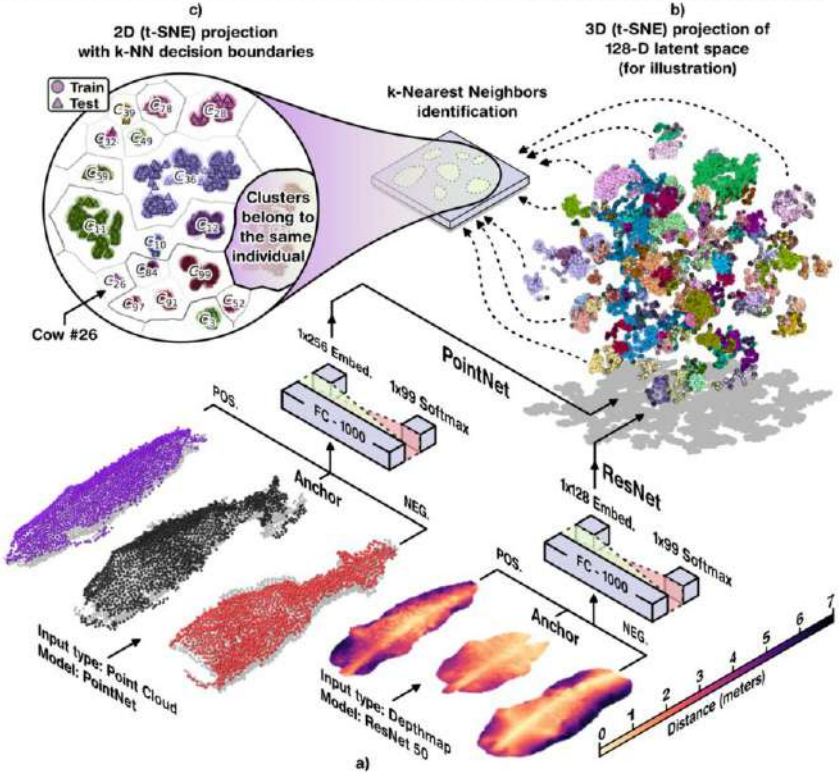
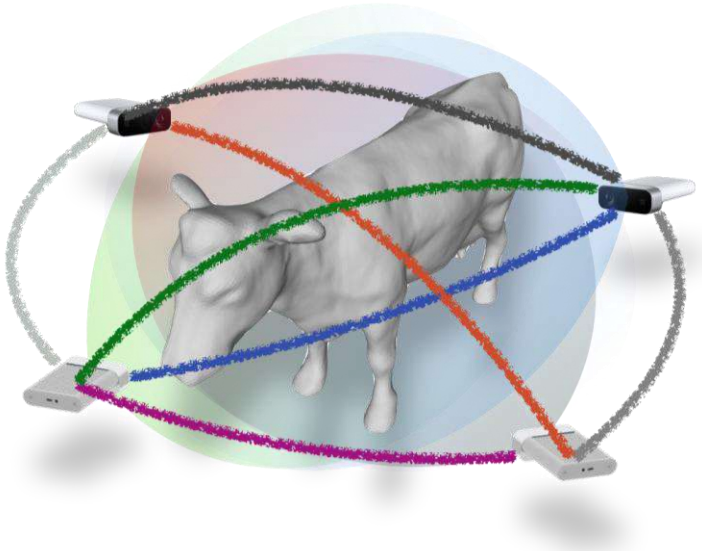
Re-identification using shape

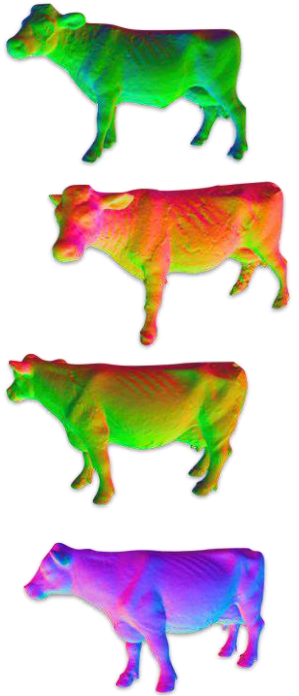


Model	Mean and range	Diff. from baseline
ResNet-50 (Colour)	99.88%, (−0.13, +0.08)	-0.04%
ResNet-50-SCM (Colour)	**99.91%**, (−0.13, +0.06)	0.00%
ResNet-50 (Depth)	**99.83%**, (−0.17, +0.07)	-0.08%
ResNet-50-SCM (Depth)	99.82%, (−0.19, +0.09)	-0.09%
PointNet (2048 points)	**99.09%**, (−0.70, +0.19)	-0.82%
PointNet (64 points)	87.58%, (−1.64, +0.62)	-12.33%



Shape capture with depth cameras





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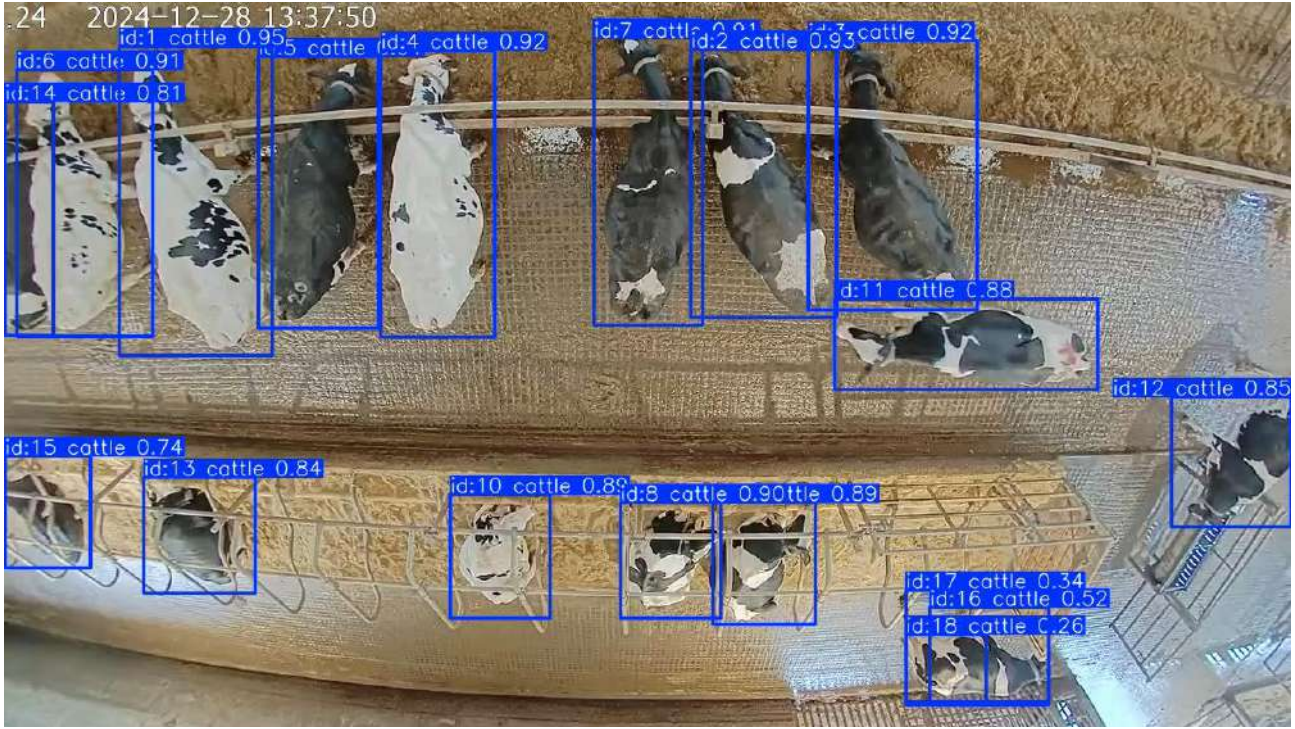
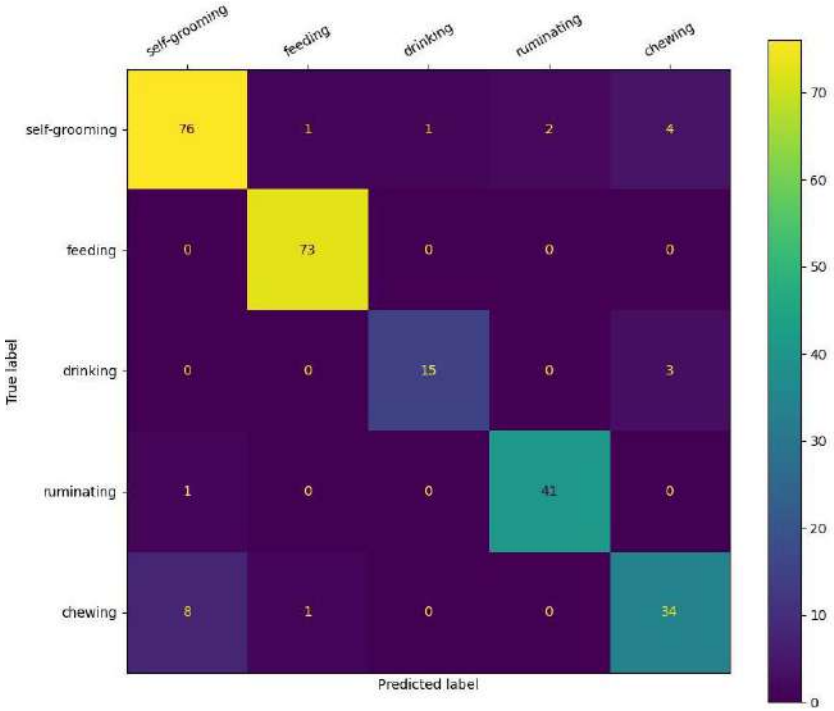
Cropped data for behaviours



Behaviour classification

Cattle Behaviors
- Social Behaviors
  - ***Agonistic***: Head Shaking, Head Butt, Head Swipe, Chasing Up, Head Push, Body Push, Threat
  - ***Affiliative***: Grooming, Head Rub
- Individual Behaviors

Self-grooming, Feeding, Drinking, Ruminating, Chewing, Standing vs Lying …



John Oldacre Centre AI Team: Acknowledgements

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