CNN and transformer Object Detection models for occluded cattle head movement

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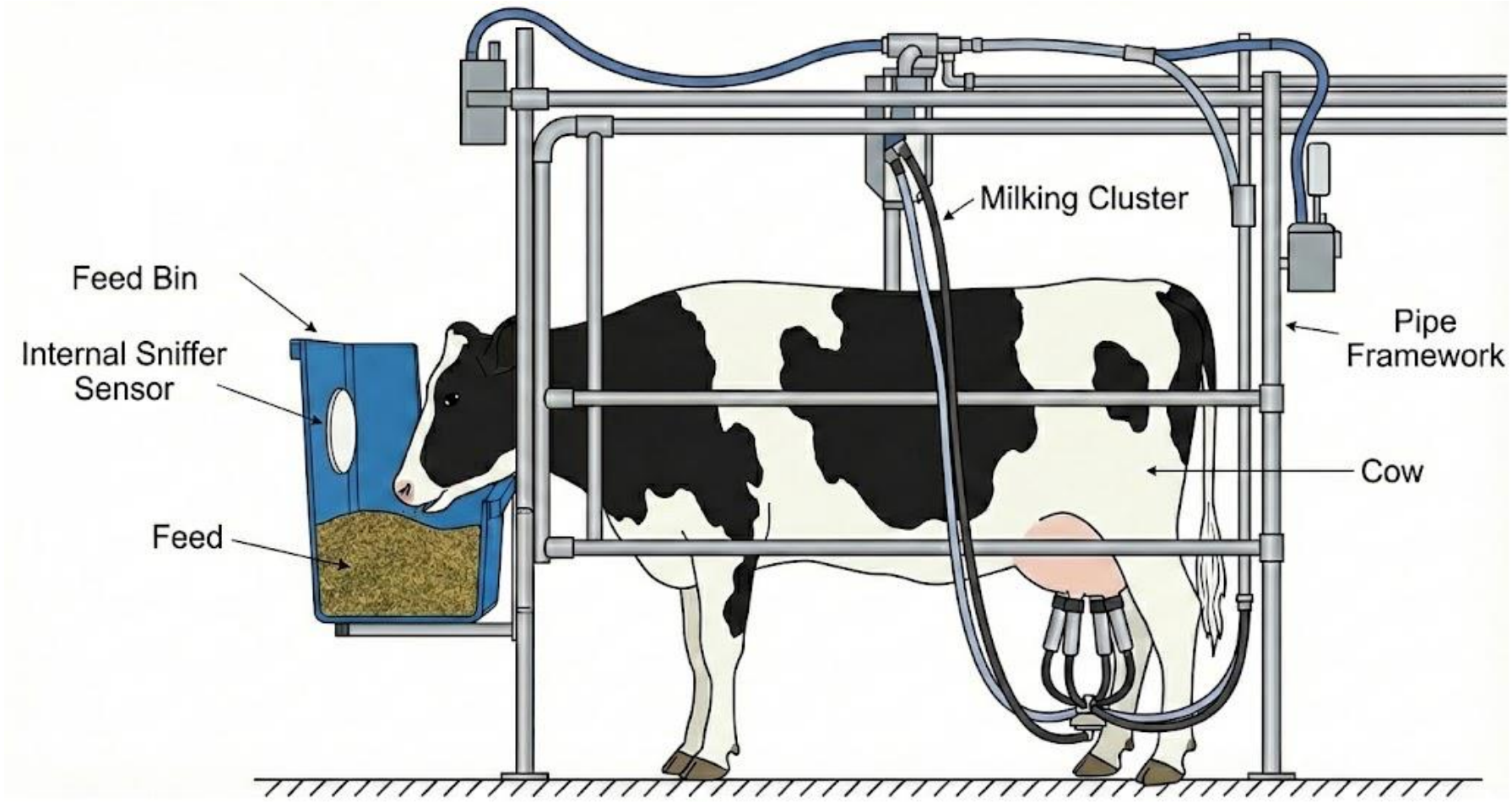
Correlating Head Position with Sniffers Sensor Data



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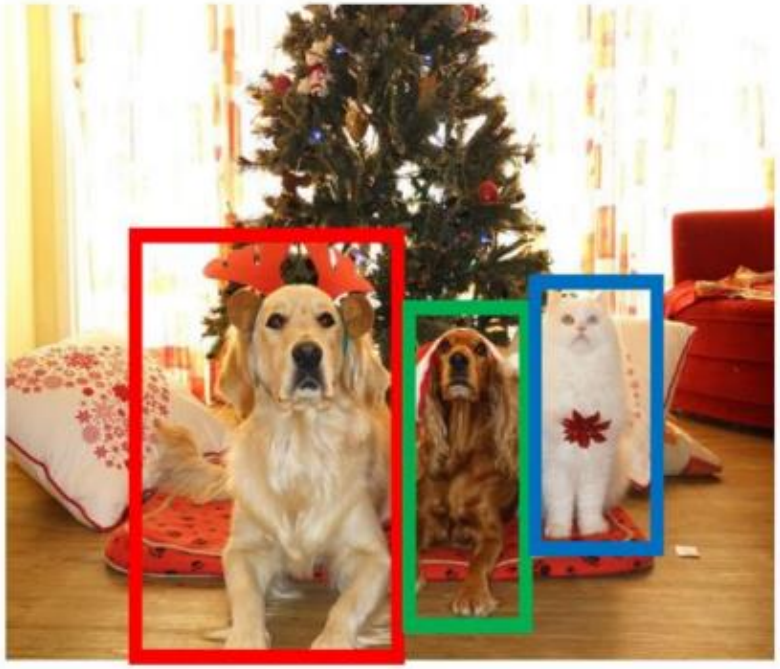
Object Detection: Task Definition

Input: Single RGB Image

Output: A set of detected objects;
For each object predict:

1. Category label (from fixed, known set of categories)
2. Bounding box (four numbers: x, y, width, height)



Why off the shelf Models Failed

2 models evaluated, Yolo vs DETR

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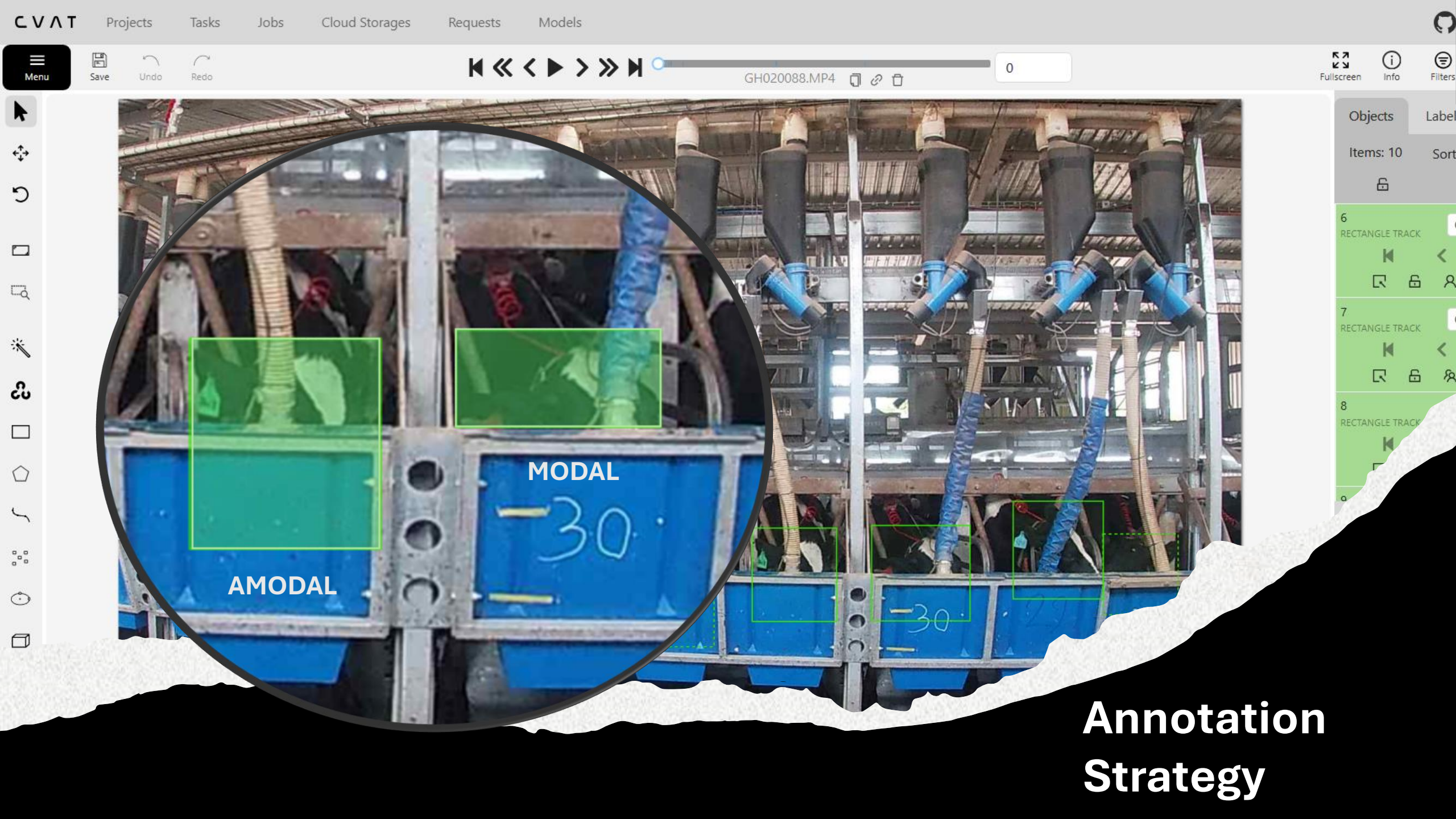
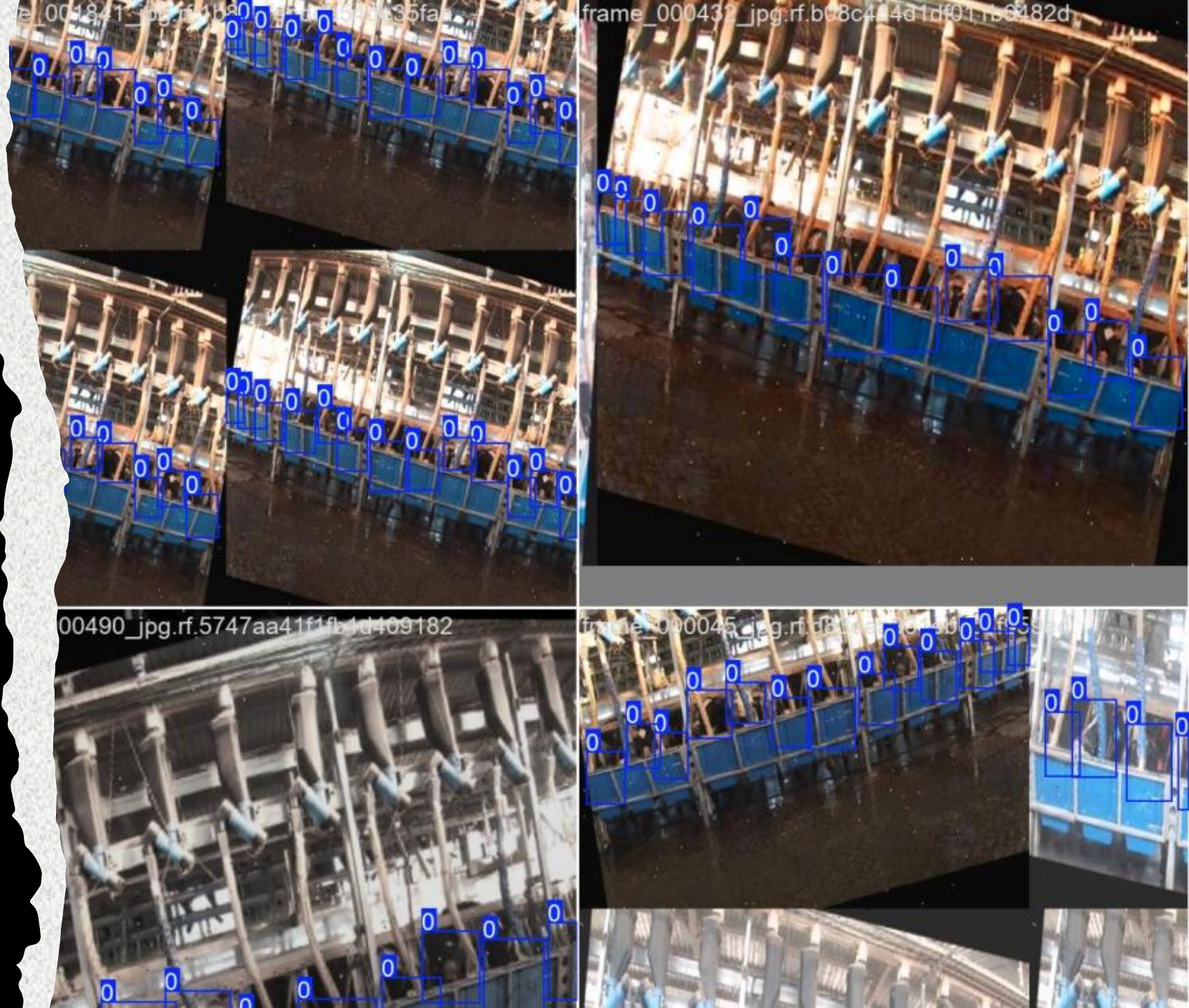
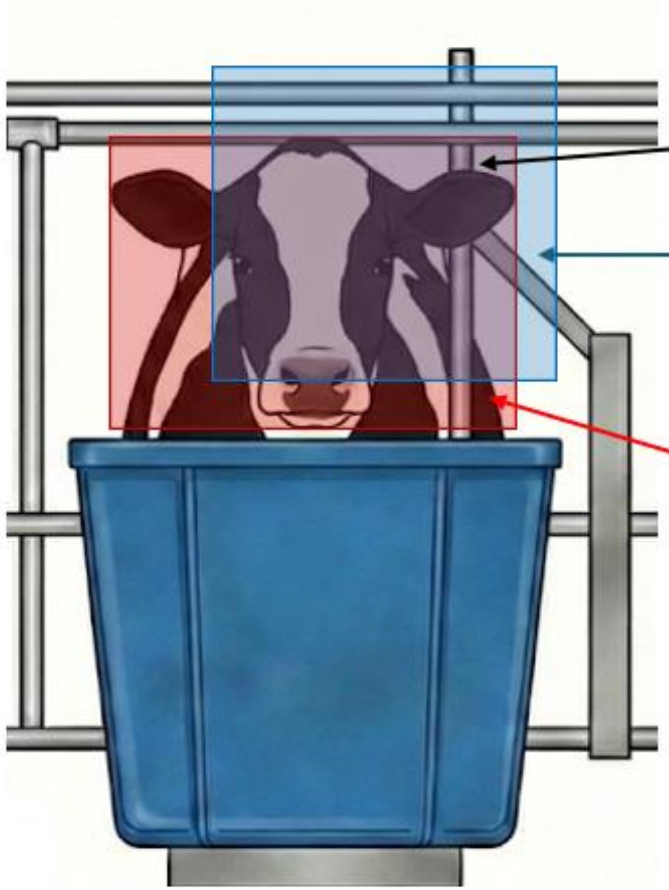

CVAT
Projects
Tasks
Jobs
Cloud Storages
Requests
Models
Menu
Save
Undo
Redo
GH020088.MP4
Fullscreen
Info
Filters
Objects
Items: 10
6
RECTANGLE TRACK
7
RECTANGLE TRACK
8
RECTANGLE TRACK
MODAL
AMODAL
Annotation
Strategy

AUGMENTATIONS



Evaluation Metrics



Intersection (overlap)

Predicted bounding box (blue)

Ground Truth (red)

Union (total combined area)

$$\text{IoU} = \frac{\text{Area of Intersection}}{\text{Area of union}}$$

YOLOv8: mAP@50-95 of 97.0%

RT-DETR: mAP@50-95 of 87.8%

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Inference Videos Comparison

YOLO

DETR

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Inference Videos Comparison 2

YOLO

DETR

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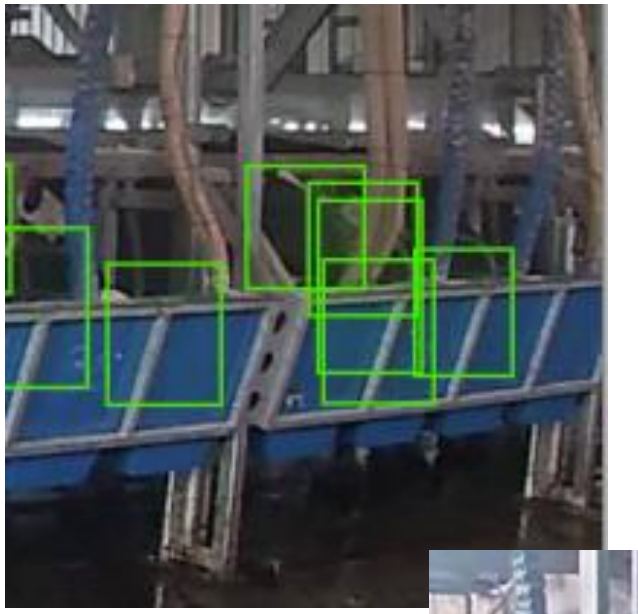

Limitations

- Inflated metrics!
- Doesn't work well on skewed angles

Solutions

- NMS
- Retraining
- Hyperperameter Optimisation (Grid search)

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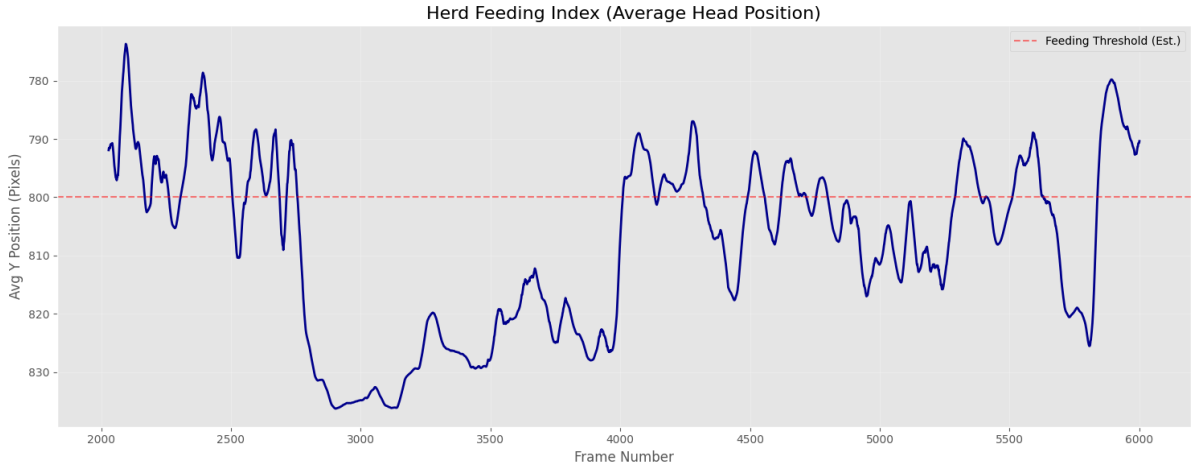

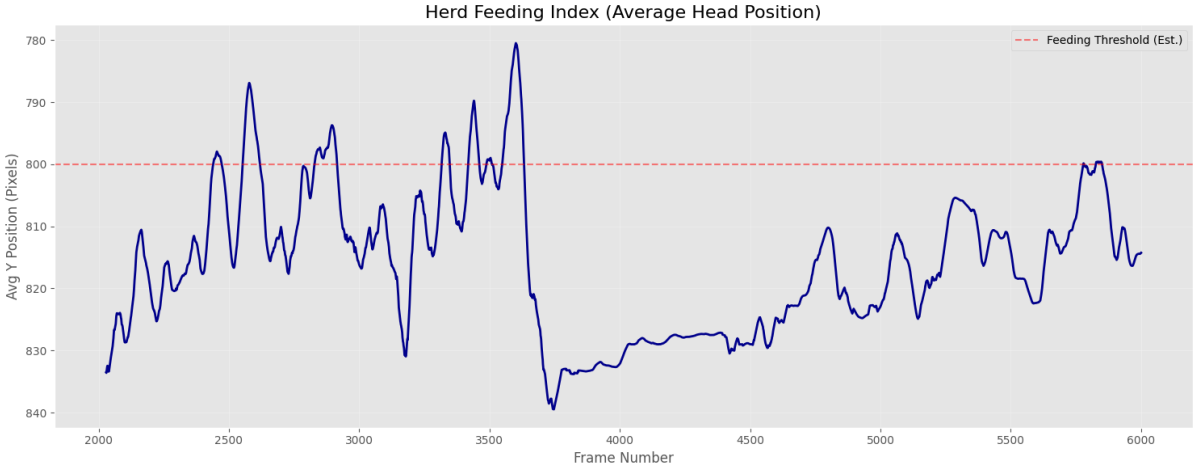

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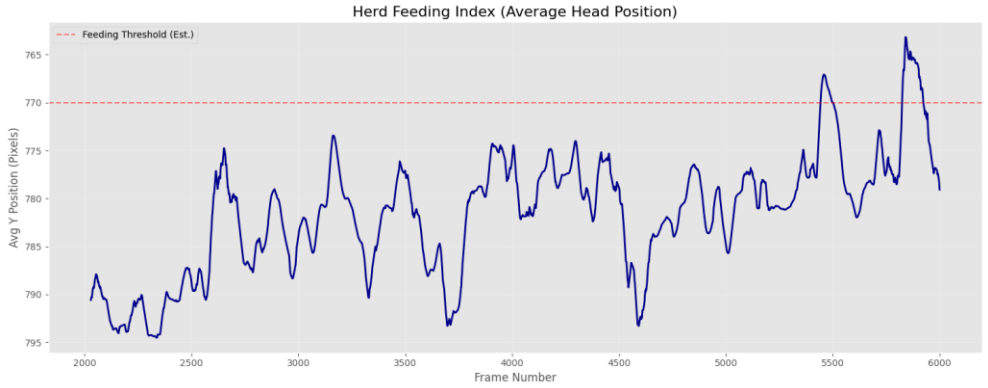

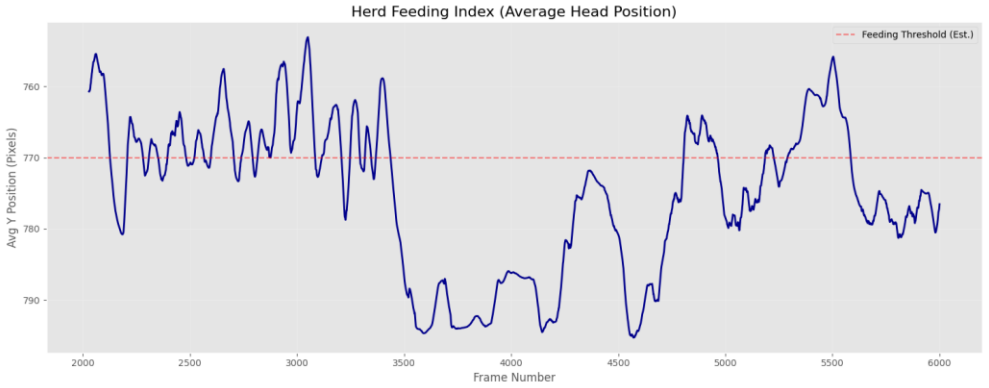

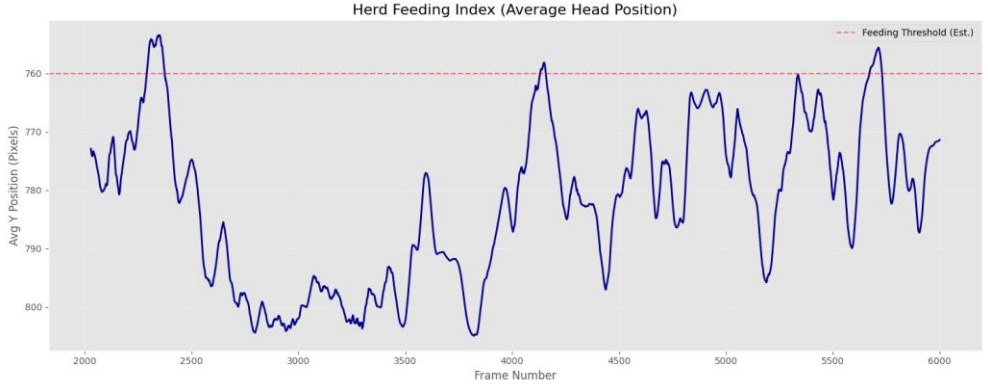

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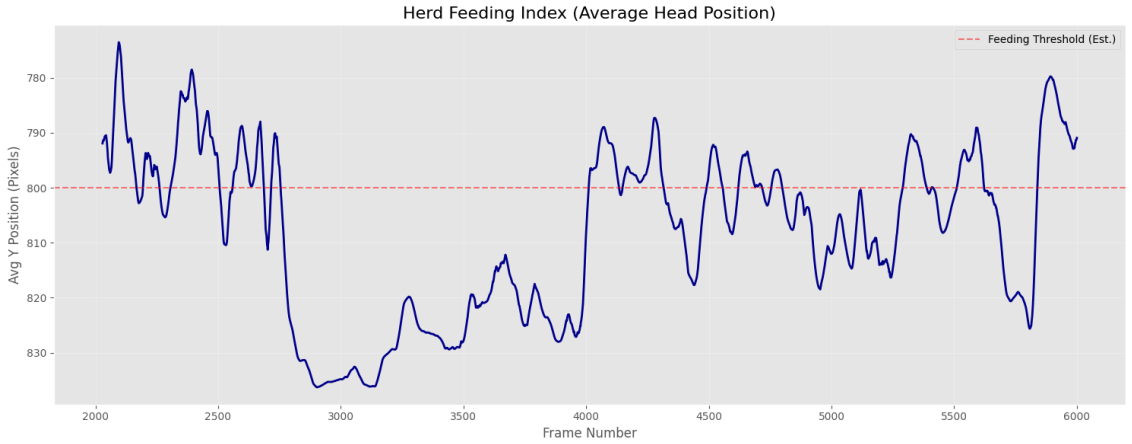

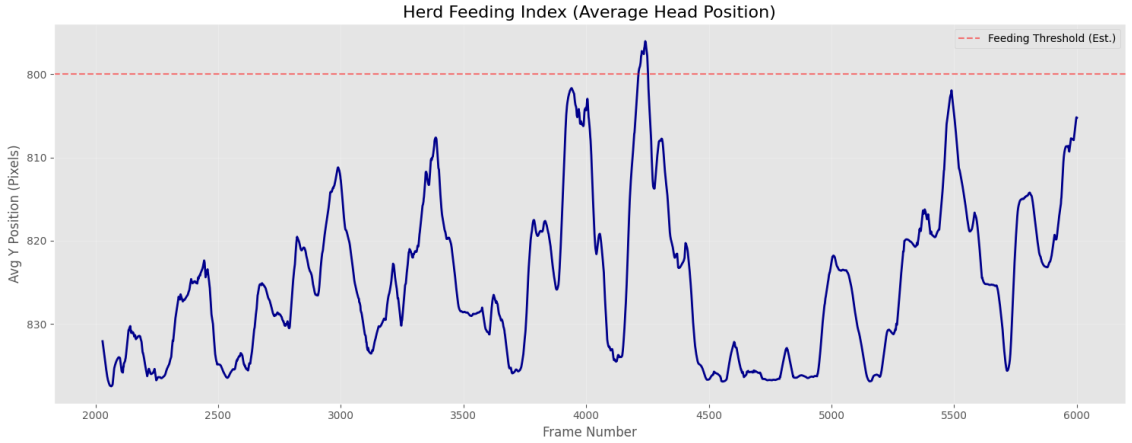

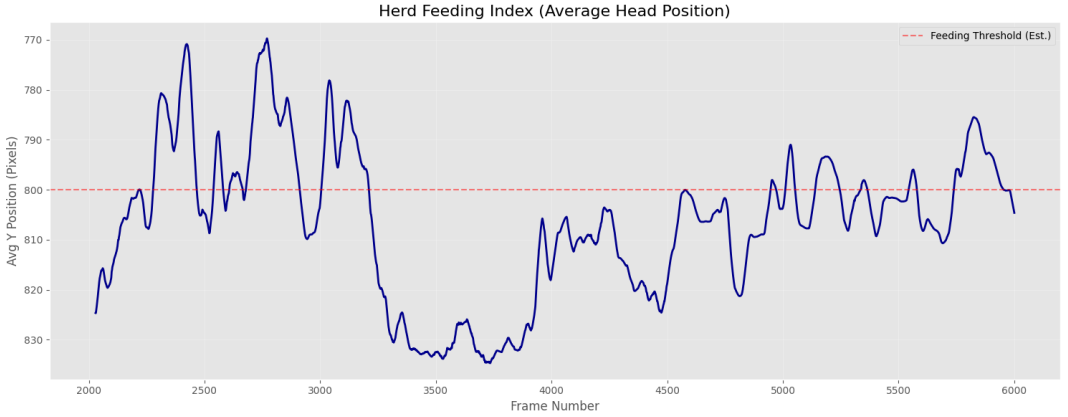

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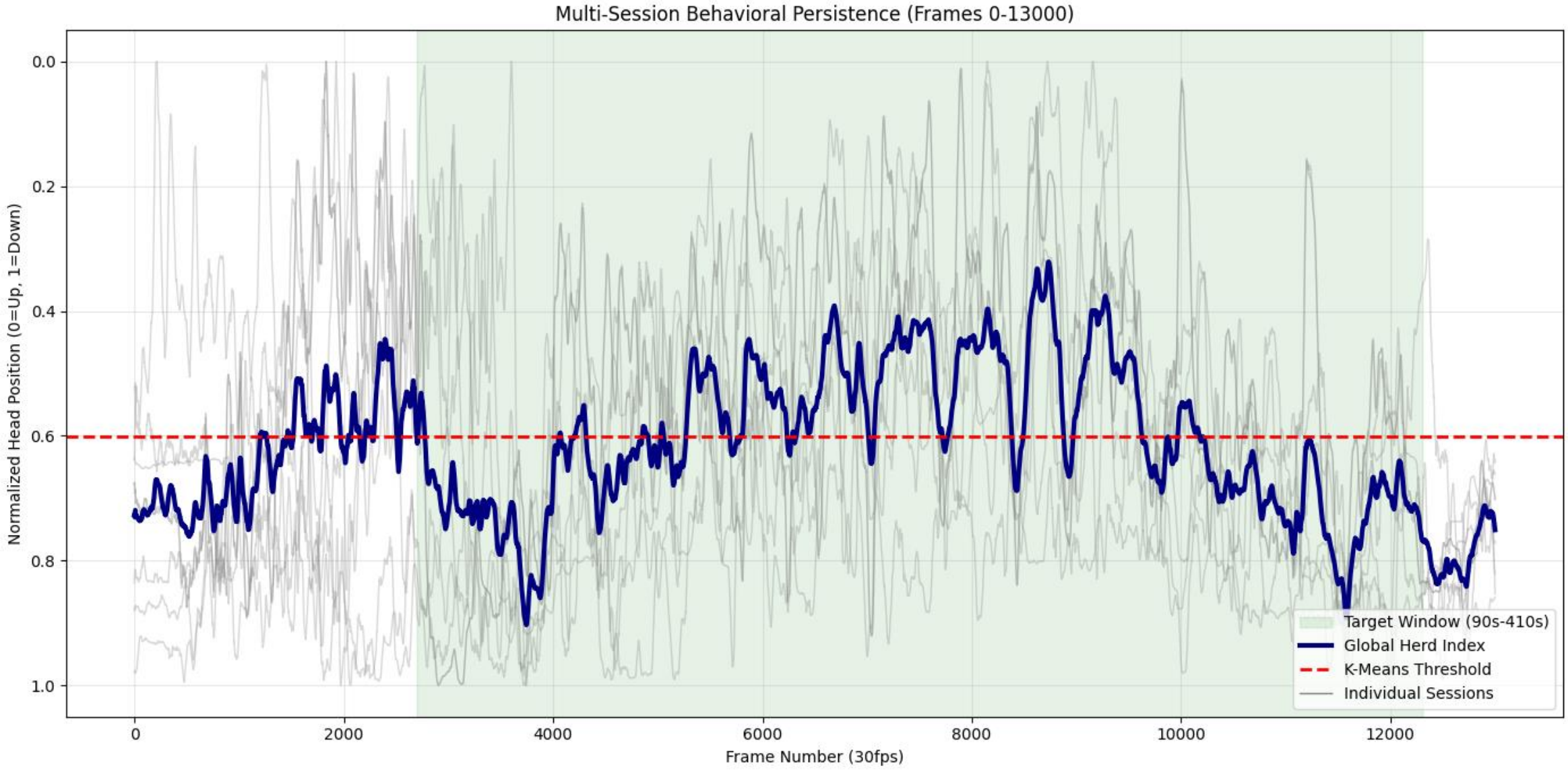

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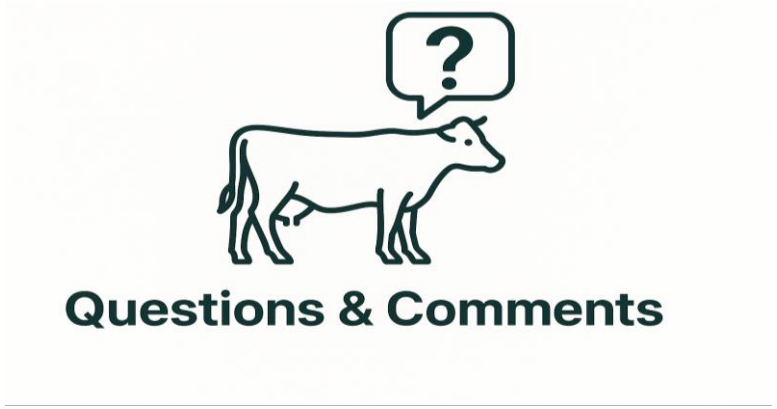
Thank you!



SUMMARY:

- YOLOv8 (CNN) significantly outperformed RT-DETR (Transformer).
- Achieved 97% Accuracy (mAP) with inference speeds 16x faster than the Transformer model.
- Validated the 90s–410s sampling window for capturing methane emissions.

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