Pose estimation for behavioural anomaly detection in pigs: comparative analysis of keypoint configuration and neural networks

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EAAP European Federation of Animal Science

Università degli Studi di Padova

Dipartimento di Biomedicina Comparata e Alimentazione

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Agroscope

SCHWEIZERISCHE VEREINIGUNG FÜR TIERWISSENSCHAFTEN
Association Suisse pour les Sciences Animales
Swiss Association for Animal Sciences

MANUAL SCORING LIMITATIONS

Manual scoring is time-consuming and labour-intensive:

- Limited temporal resolution - subtle or rapid events often missed
- Key problems faced by researchers & producers
- How can computer vision help?

HOW CAN COMPUTER VISION HELP?

- Automated, continuous monitoring without human fatigue
- Objective, quantitative metrics for posture and movement
- High throughput: simultaneous tracking of many animals
- Integration with different tools for early anomaly detection
- Can be used in different environments

OBJECTIVE

Keypoint configuration comparison

Evaluate different keypoint configurations for pose estimation

Neural Network Comparison

Evaluate 5 different Neural Networks for pigs tracking

Performance Metrics

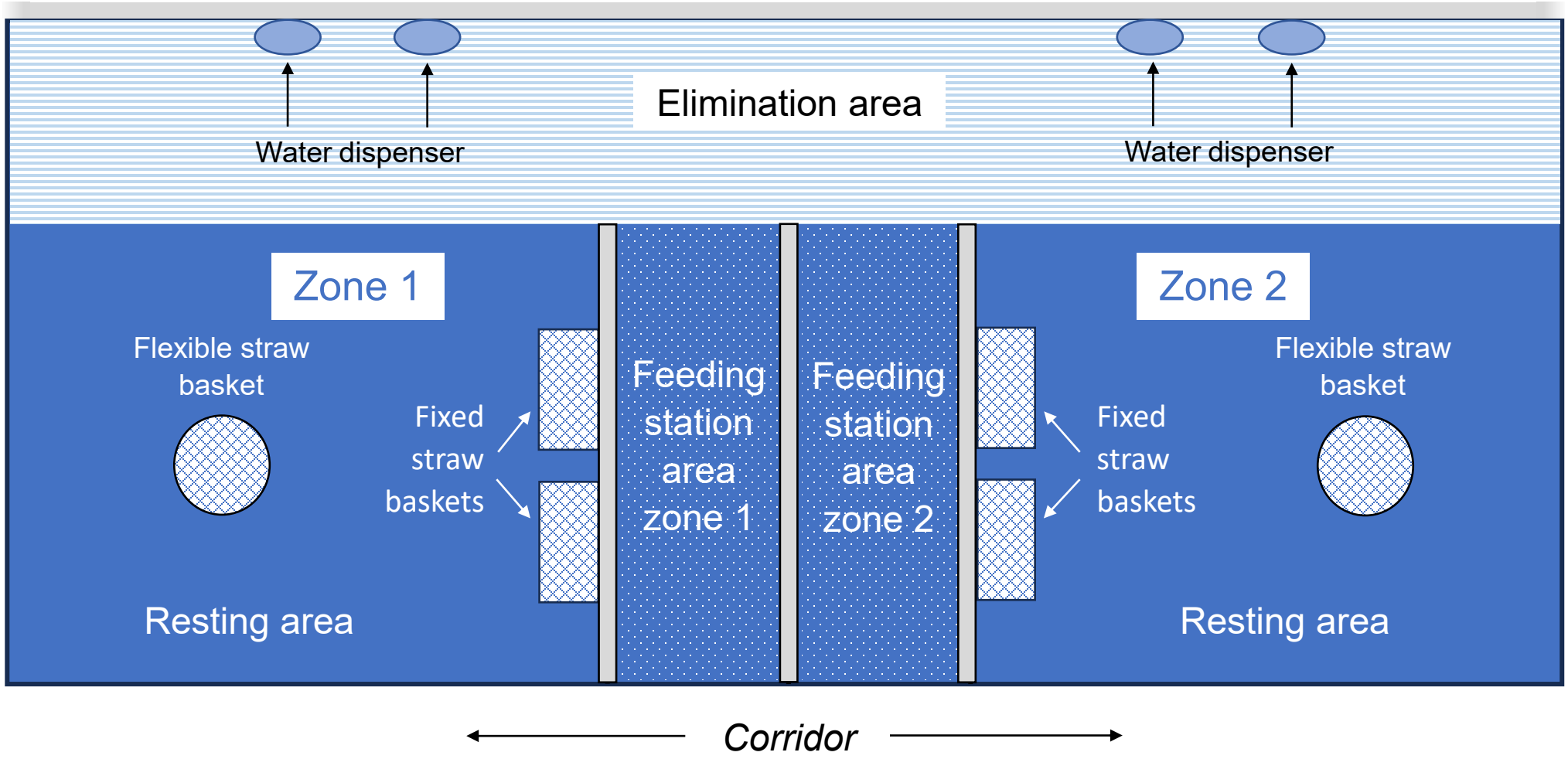
Compare trained models by tracking accuracy, computational efficiency, and robustness

PIGS MARKS

- To enhance individual identification on video recordings, pigs were spray-marked weekly during routine weighing procedures, eliminating the need for additional direct handling.

Total N of marks	Rear marks	Back-rear combination	Front-rear combination
1			
2			
3			
4			
5			

MAP OF THE PEN



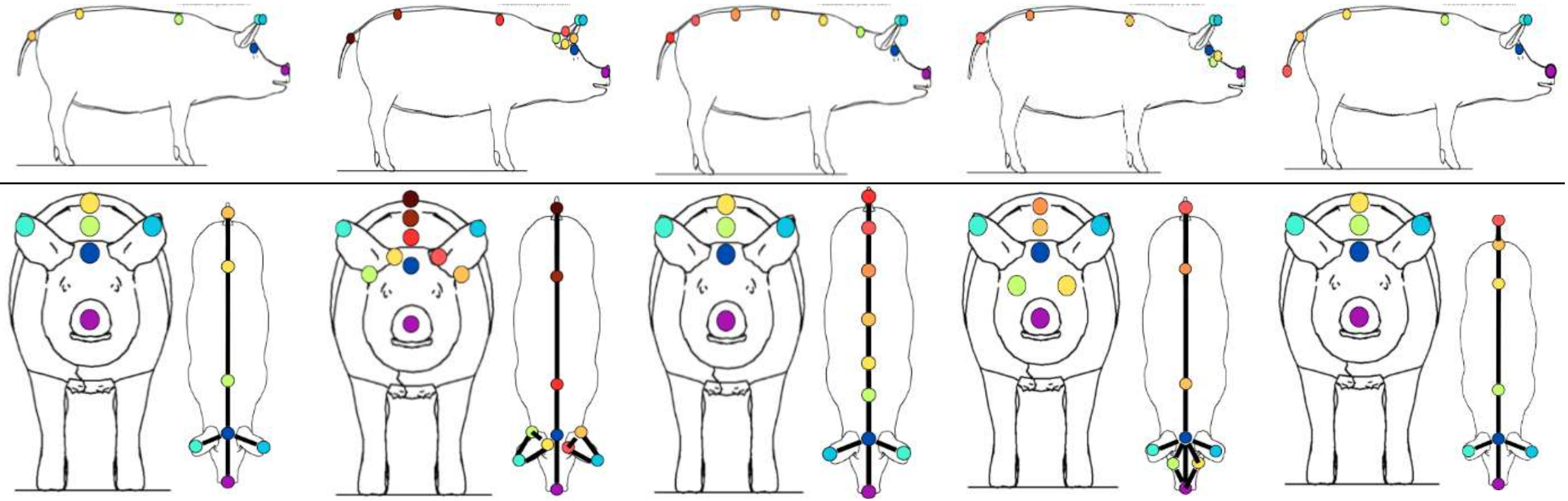
VIDEO ACQUISITION

Recording Parameters

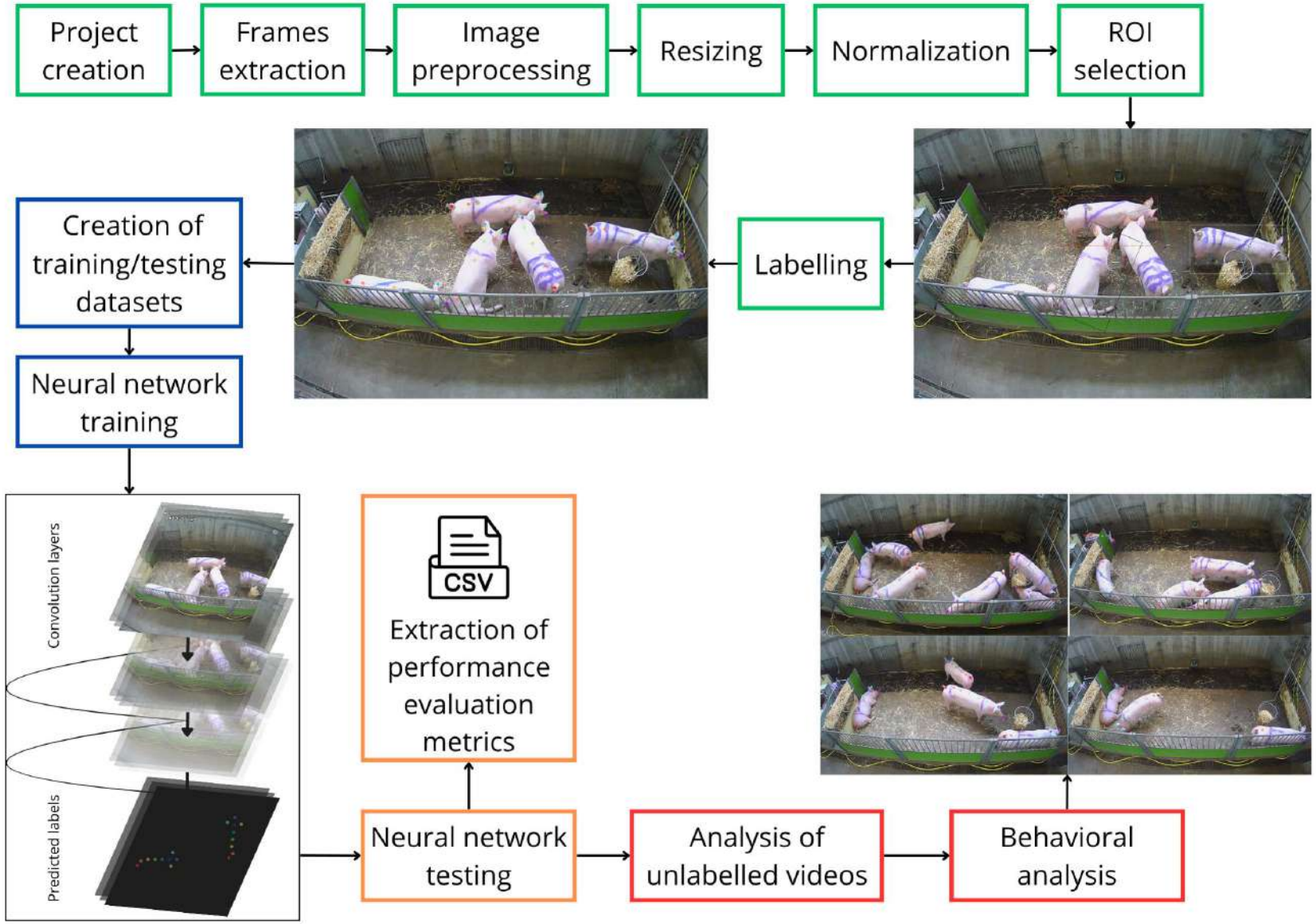
Surveillance cameras installed 2.5m above daily recording from 7:00 AM to 8:00 PM, 15 fps, 320×240 pixels resolution, 15-minute AVI videos.

KEYPOINT CONFIGURATIONS

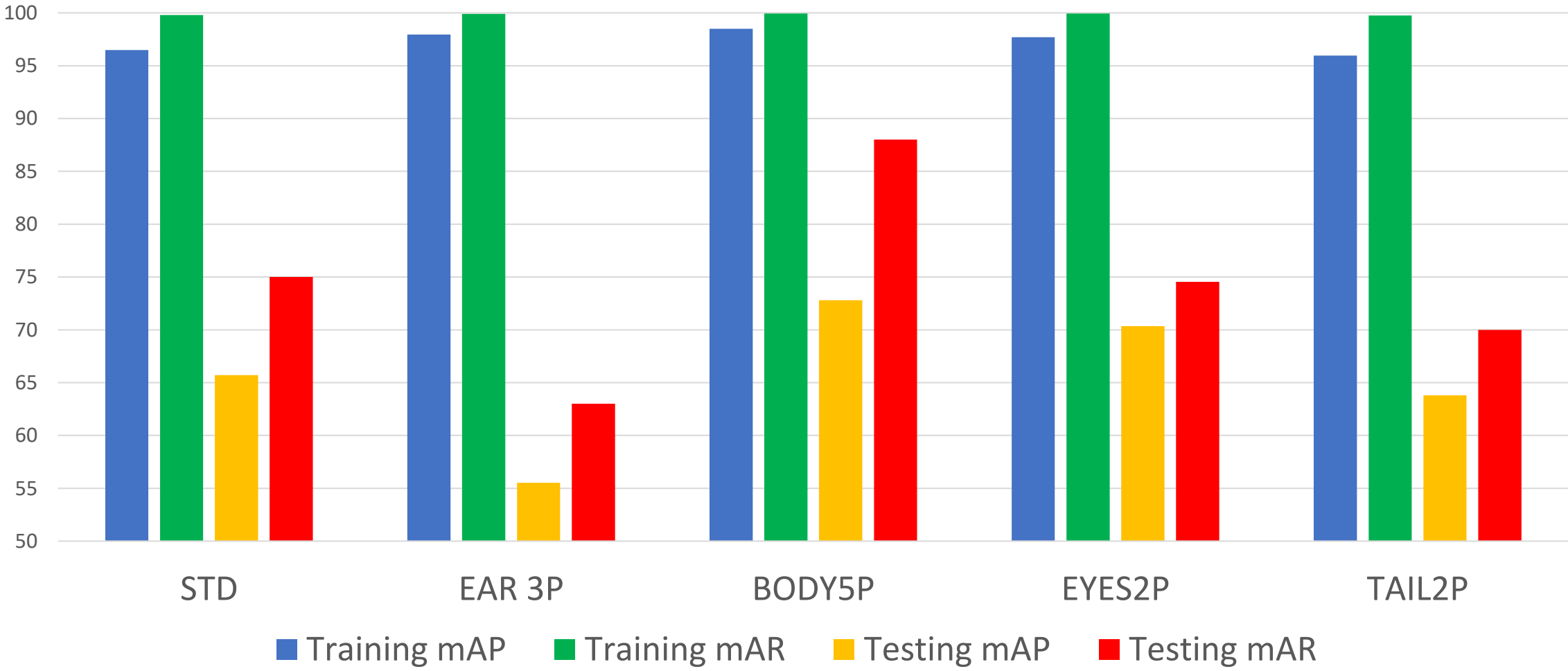
STD EAR3P BODY5P EYES2P TAIL2P



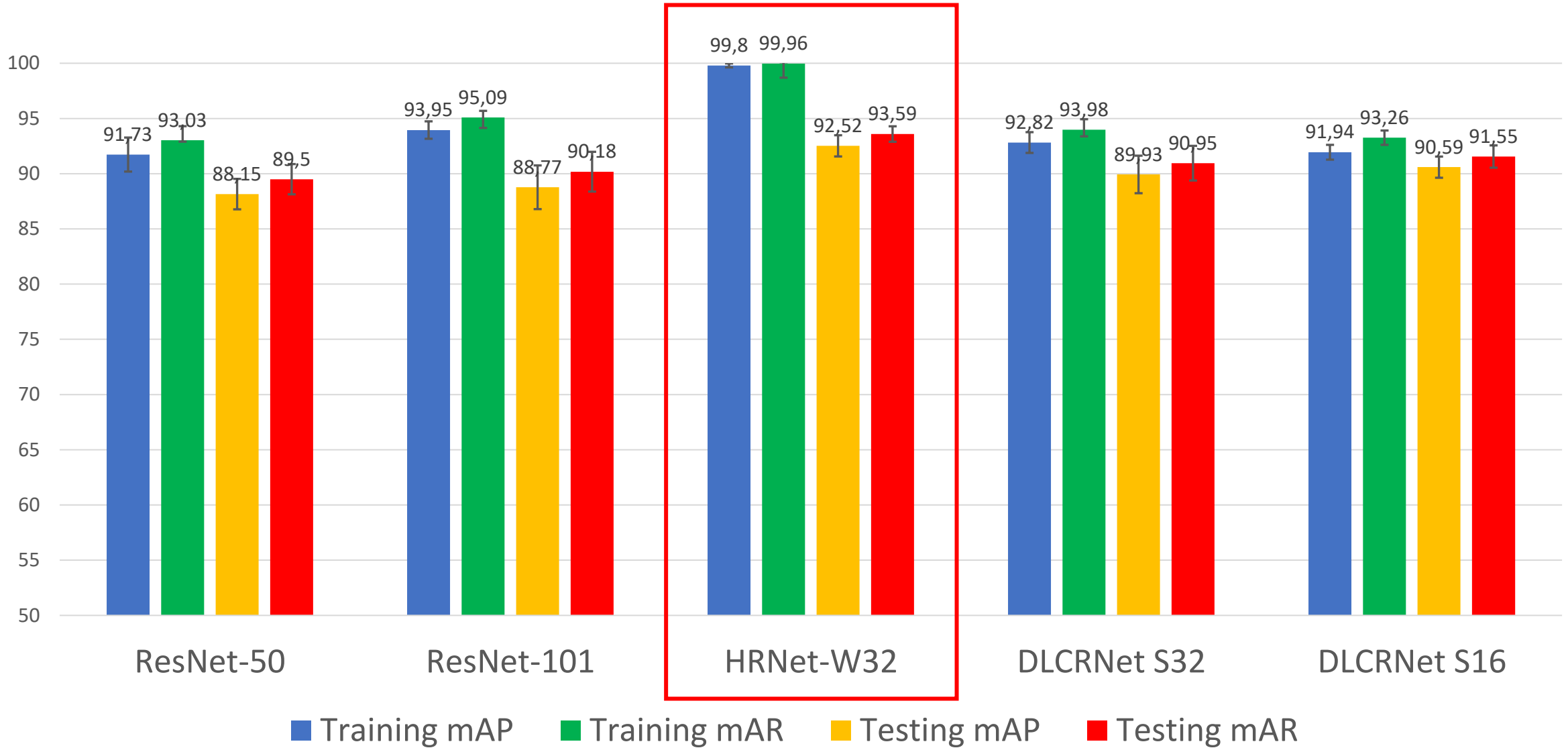
FLOWCHART


Project creation
Frames extraction
Image preprocessing
Resizing
Normalization
ROI selection
Labelling
Creation of training/testing datasets
Neural network training
Convolution layers
Predicted labels
CSV
Extraction of performance evaluation metrics
Neural network testing
Analysis of unlabelled videos
Behavioral analysis

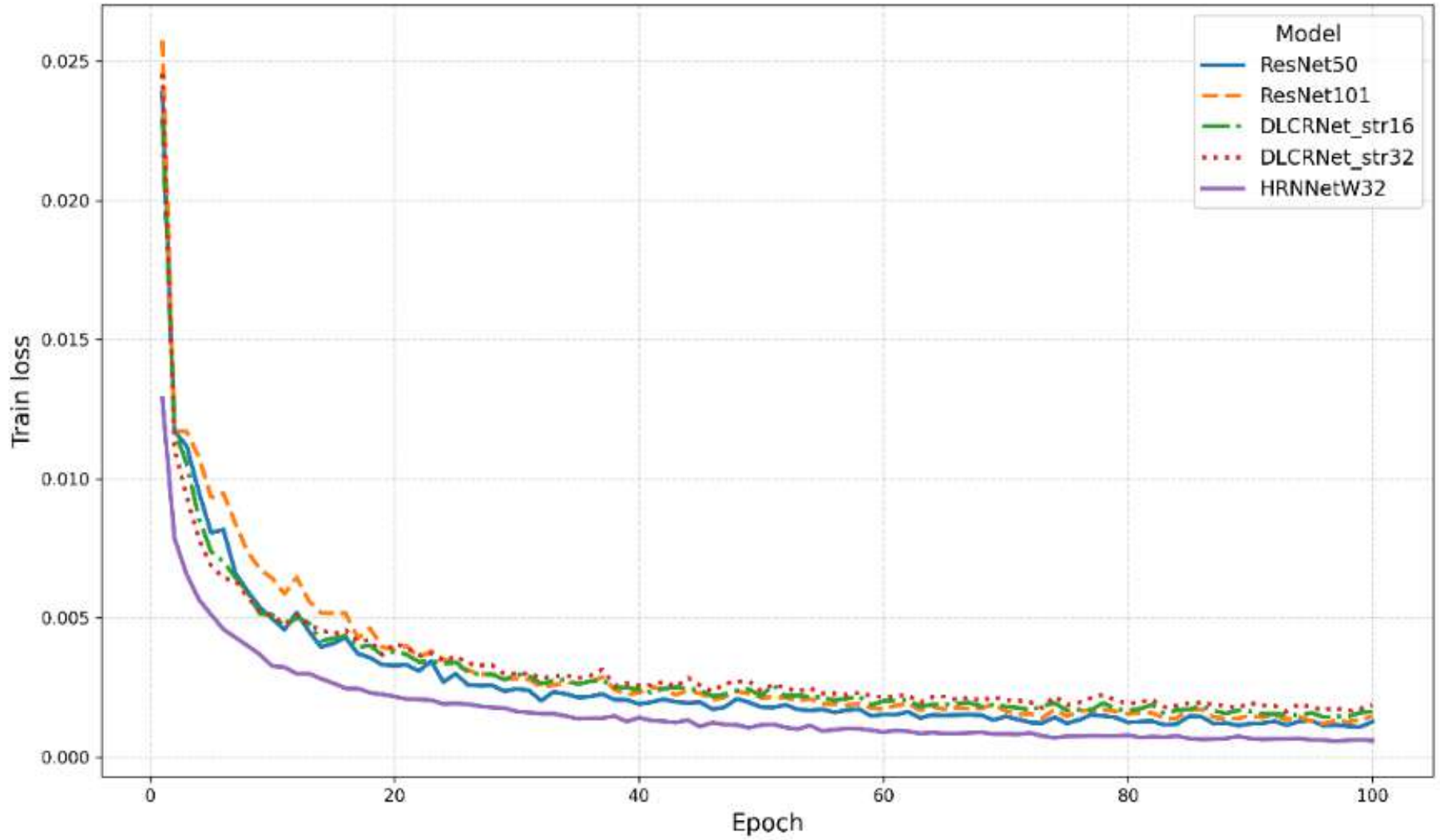
Keypoint configuration comparison



Neural network comparison



TRAINING LOSS COMPARISON

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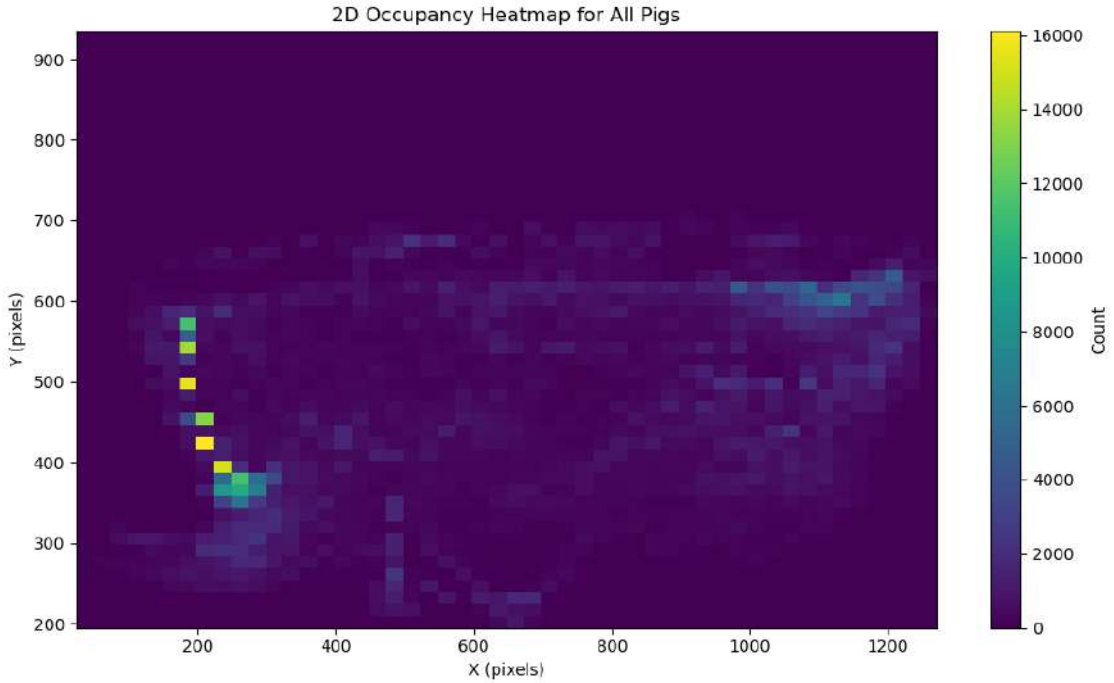
TEMPORAL CONSISTENCY

Bodypart	Dropout, %	Velocity, px/frame	Jerk, px/frame^2
Snout	46.0%	18.83	0.000054
Head	18.5%	24.25	0.000074
Left ear	28.8%	23.57	0.000051
Right ear	32.9%	23.33	0.000085
Body1	18.3%	24.34	0.000053
Body2	25.9%	25.95	0.000048
Body3	31.6%	24.94	0.000033
Body4	27.4%	25.33	0.000083
Body5	29.0%	21.21	0.000028
Tail	31.8%	16.97	0.000054

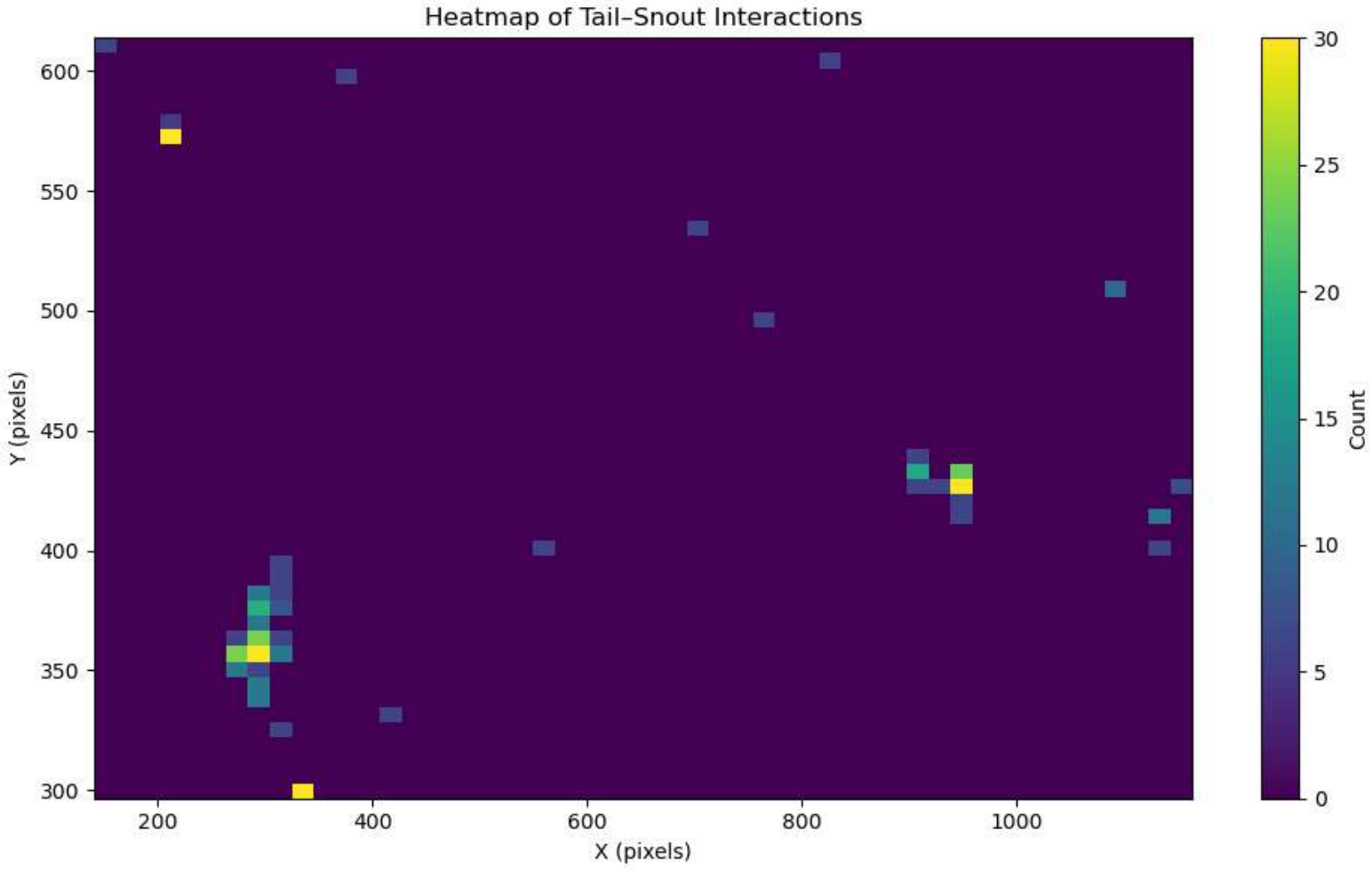
OCCUPANCY HEATMAP



2D occupancy heatmap showing areas of frequent pig activity, with brightest regions indicating highest concentration.

- Left side of pen showed highest concentration of activity
- Distinct vertical yellow strip suggests presence of feeding station

TAIL-SNOUT INTERACTION HEATMAP



Methodological limitations:

- Proximity ≠ intentional interaction; co-occupancy may reflect pen design
- Fixed pixel thresholds ignore body size and camera perspective variability

CONCLUSION

Pose estimation is effective for tracking major anatomical landmarks in pigs under variable lighting and occlusion

Snout and ear key-points remain challenging under heavy occlusion

Lightweight architectures enable near - real-time inference even on limited-resource hardware

Model choice should align with farm needs

Future enhancements: integrate temporal models (LSTM/TCN) and multimodal inputs (depth, audio) to capture complex interaction dynamics

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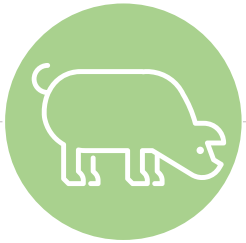

Thanks!