How to define good mothering ability using computer vision of free farrowing sows?
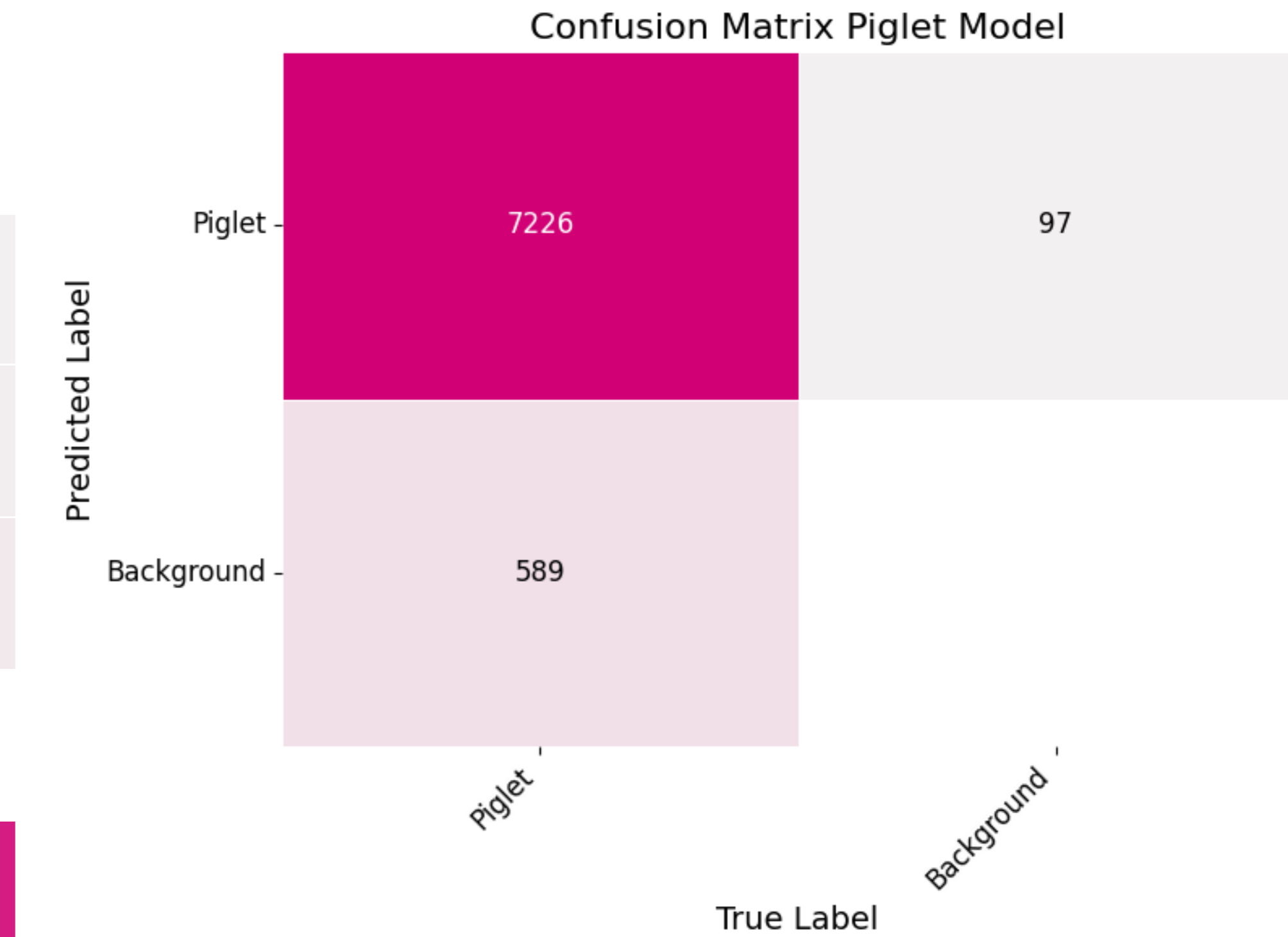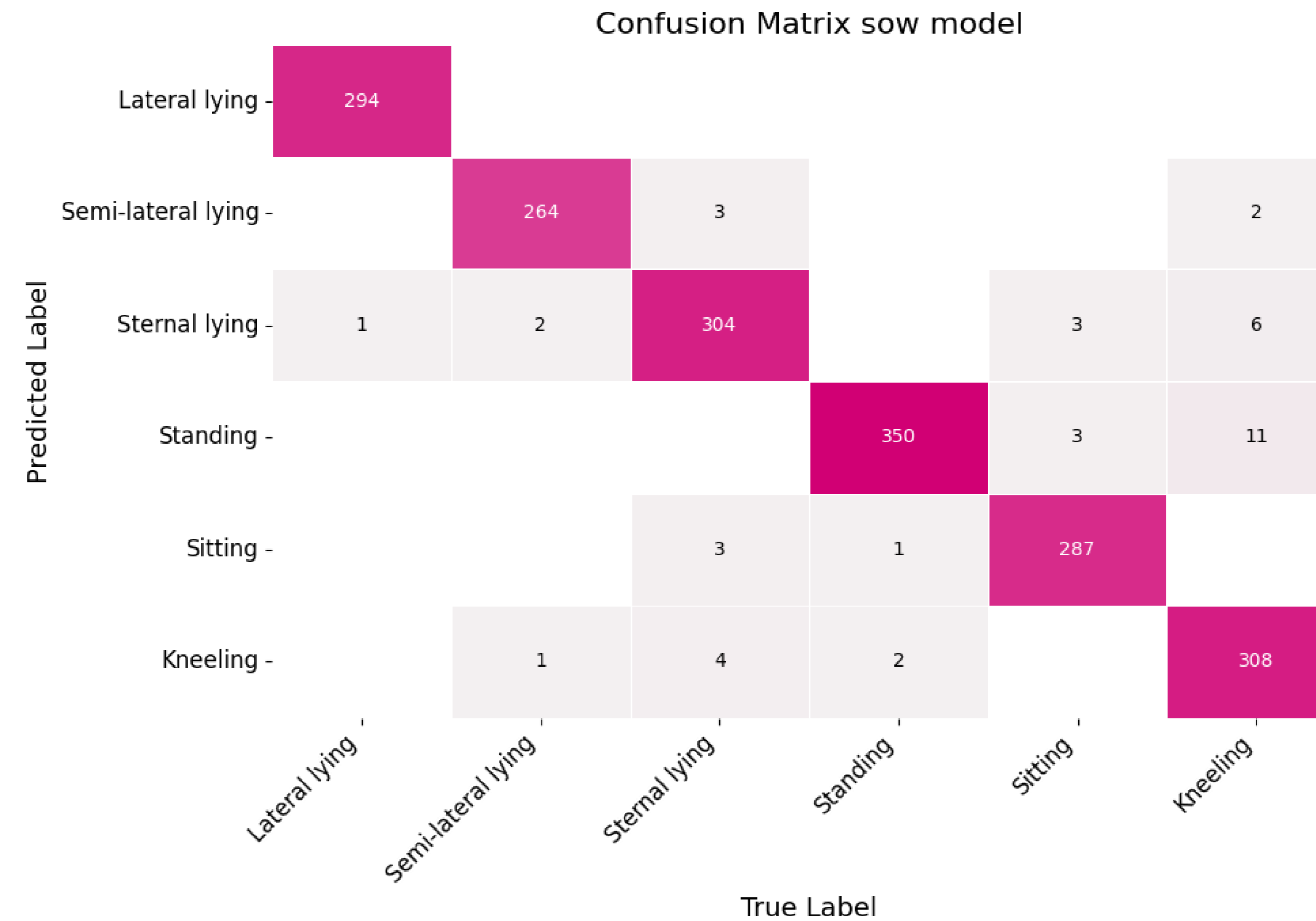
Lisette van der Zande, Victor Lei, Eli Grindflek, Madison Hildebrand, Gabriel Dallago

Background

A cage system is intended to reduce preweaning mortality. However, the welfare of the sow might be compromised as it greatly restricts their natural behavior. Free farrowing systems allow sows to move around in the farrowing pen and this might stimulate nesting behavior, shortened farrowing duration and improved locomotion score and therefore the longevity of the sow. Previous studies suggest that sow behavior influence preweaning mortality, also known as mothering ability. Some movements of a sow are riskier than others, besides increased levels of posture changes could lead to increased preweaning mortality. Nevertheless, literature could not agree on characteristics of maternal ability correlating with piglet mortality. However, previous studies are depending on manual observations and are therefore low in number of observations and biased by human observations. This study investigates mothering ability of sows in free farrowing systems in large quantities and unbiased by using computer vision.

Material and methods

Forty cameras were installed above free farrowing pens in Manitoba, Canada. A total of 18,443 frames were annotated, where the posture of the sow was segmented. We classified six postures: Lateral lying, Semi-lateral lying, Sternal lying, Standing, Sitting, and Kneeling. The piglets were annotated using bounding boxes. A total of 80,004 bounding boxes of piglets were created. Frames without any visual piglets were used as background frames in the piglet model. Two YOLOv8 models were trained, one for the sow posture and one for piglet detection. 80% of the annotated frames were randomly selected for training. The remaining 20% was used for testing and validation.

Confusion Matrix sow model

Confusion Matrix Piglet Model

	Instances	Precision	Recall	mAP
Lateral lying	295	1,000	0,997	0,995
Semi-lateral lying	267	0,983	0,989	0,991
Sternal lying	314	0,969	0,968	0,980
Standing	353	0,969	0,992	0,985
Sitting	293	0,986	0,980	0,988
Kneeling	327	0,984	0,934	0,969
Piglet	7815	0,983	0,922	0,959

Conclusions

The models trained to estimate sow posture and piglet location are accurate models. Therefore, these models could be used to analyze videos in a free farrowing system. Continuous behavioral observations are possible using these models. Allowing 24/7 observations to characterize maternal ability of the sow correlations with piglet mortality.

Topigs Norsvin

How to define good mothering ability using computer vision of free farrowing sows?
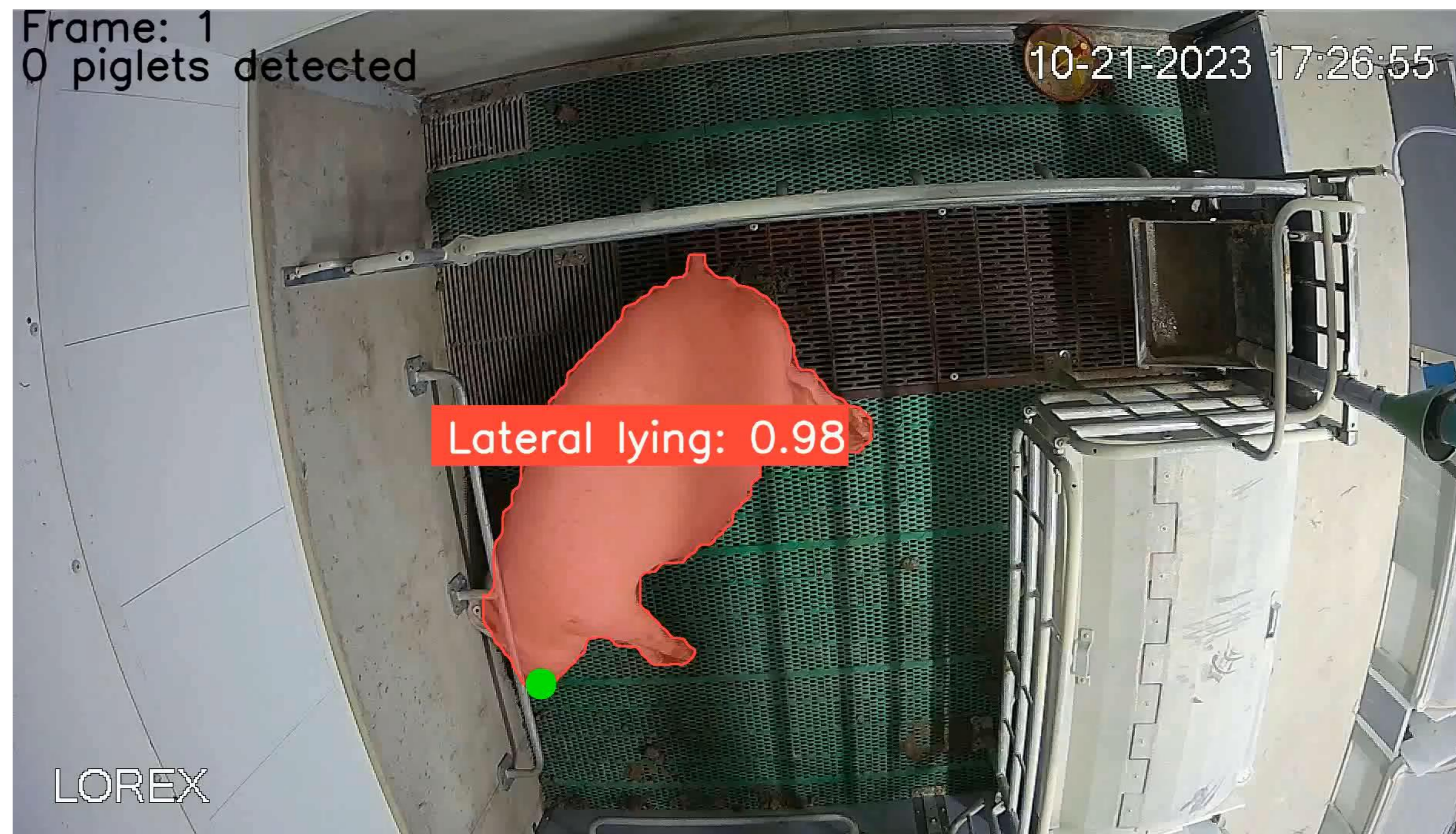
Lisette van der Zande, Victor Lei, Eli Grindflek, Madison Hildebrand, Gabriel Dallago

Background

A cage system is intended to reduce preweaning mortality. However, the welfare of the sow might be compromised as it greatly restricts their natural behavior. Free farrowing systems allow sows to move around in the farrowing pen and this might stimulate nesting behavior, shortened farrowing duration and improved locomotion score and therefore the longevity of the sow. Previous studies suggest that sow behavior influence preweaning mortality, also known as mothering ability. Some movements of a sow are riskier than others, besides increased levels of posture changes could lead to increased preweaning mortality. Nevertheless, literature could not agree on characteristics of maternal ability correlating with piglet mortality. However, previous studies are depending on manual observations and are therefore low in number of observations and biased by human observations. This study investigates mothering ability of sows in free farrowing systems in large quantities and unbiased by using computer vision.

Material and methods

Forty cameras were installed above free farrowing pens in Manitoba, Canada. A total of 18,443 frames were annotated, where the posture of the sow was segmented. We classified six postures: Lateral lying, Semi-lateral lying, Sternal lying, Standing, Sitting, and Kneeling. The piglets were annotated using bounding boxes. A total of 80,004 bounding boxes of piglets were created. Frames without any visual piglets were used as background frames in the piglet model. Two YOLOv8 models were trained, one for the sow posture and one for piglet detection. 80% of the annotated frames were randomly selected for training. The remaining 20% was used for testing and validation.

Frame: 1
0 piglets detected
10-21-2023 17:26:55
Lateral lying: 0.98
LOREX

	Instances	Precision	Recall	mAP
Lateral lying	295	1,000	0,997	0,995
Semi-lateral lying	267	0,983	0,989	0,991
Sternal lying	314	0,969	0,968	0,980
Standing	353	0,969	0,992	0,985
Sitting	293	0,986	0,980	0,988
Kneeling	327	0,984	0,934	0,969
Piglet	7815	0,983	0,922	0,959

Conclusions

The models trained to estimate sow posture and piglet location are accurate models. Therefore, these models could be used to analyze videos in a free farrowing system. Continuous behavioral observations are possible using these models. Allowing 24/7 observations to characterize maternal ability of the sow correlations with piglet mortality.

Topigs Norsvin