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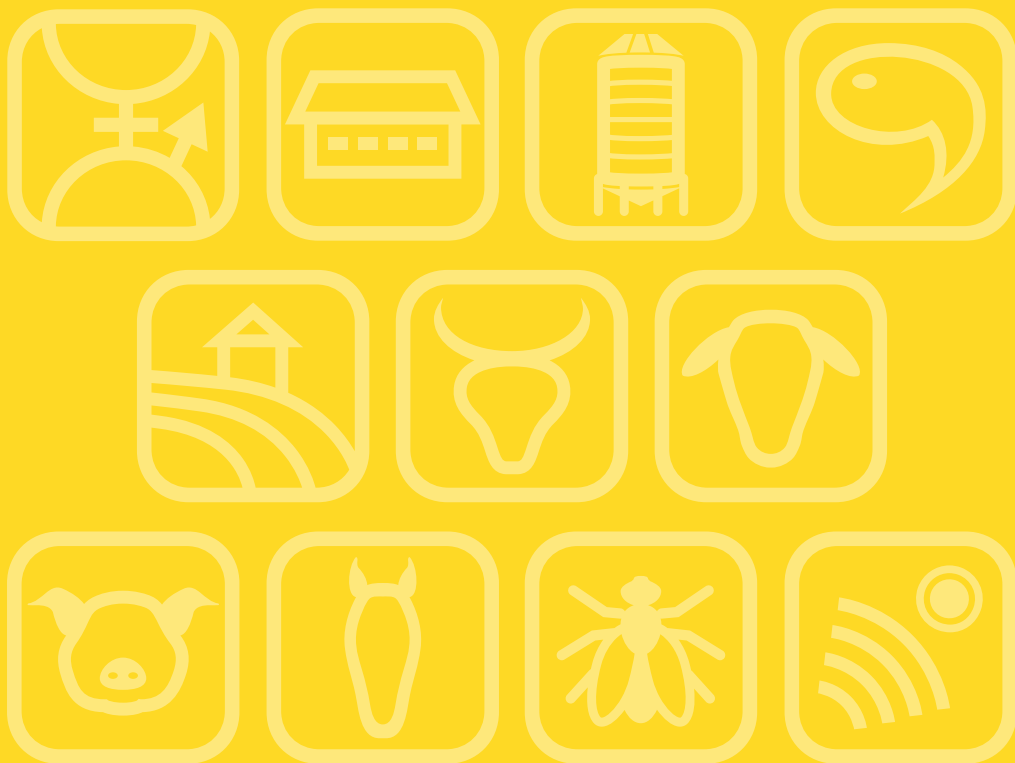
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Evaluation of an automated cattle lameness detection system

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Our aim was to evaluate the performance of an automated lameness detection system (CattleEye Ltd) which is using a 2D surveillance camera mounted over an exit race. A total of 29 whole-herd mobility scoring sessions in 8 medium to large-size herds were performed by 4 experienced veterinarians (VETs) using the 4-grade (0-3) AHDB mobility scoring method. The weekly average score for each cow provided by the system (CE) was also stored and analysed after the end of the study. A total of 27,082 mobility scores were collected and matched to the weekly average CE scores. Agreement between CE and each VET was assessed for the binary transformed scores (0: 0,1; 1: 2,3) using percentage agreement (PA), kappa (κ) and Gwet's coefficients (AC). Moreover, the same VET was present in 17 foot trimming sessions in 3 farms and recorded the presence and severity of sole haemorrhage (SH), sole ulcer (SU), white line disease (WL), toe ulcer (TU), digital dermatitis (DD) and interdigital phlegmon (IP) cases. Lesion records were then matched with the weekly average CE scores, resulting in a dataset of 991 cows. The same VET also mobility scored a subset of 340 cows in 2 farms 1-3 days before foot trimming. Accuracy (ACC), sensitivity (SE) and specificity (SP) were calculated for both CE and the VET; presence (binary) of at least one case of SU grade ≥ 2 , WL grade 3, TU, stage M2 of DD and IP grade 2, was used as the gold standard. Overall PA, κ and AC ranged from 81.5 to 86.3%, from 0.23 to 0.41, and from 0.76 to 0.83, respectively (when agreement between CE and VETs in binary mobility scores was assessed). ACC, SE and SP of CE and VET varied notably among farms, yielding an overall combination of 0.83, 0.40 and 0.88, and 0.80, 0.53 and 0.83, respectively. Based on our results, the agreement between CE and VETs is within the moderate and substantial range, in concordance with that reported between experienced assessors in an initial validation study. Further investigation of farm and cow-level factors that potentially influence the predictive ability of CE in identifying cows bearing foot lesions is needed.

Breath analysis in dairy cattle: going beyond methane emission

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Real-time, non-invasive monitoring tools are continuously being investigated in research and deployed in practice in the dairy cattle industry. So far, breath composition of dairy cattle has been typically monitored for methane emissions only. Although, a growing body of evidence suggests that the potential applications of breath analysis go beyond monitoring methane emissions. The results from our systematic review on using breath analysis to detect diseased cattle showed that research focused on cows before 2000, however, calves have been studied more frequently since then. Ketosis has been the most studied cattle disease using breath analysis so far. Our experimental results showed potential of breath analysis to follow ketosis status in postpartum cows, because a rise in serum β -hydroxybutyrate was significantly related to a rise in breath acetone concentration. We also showed that longitudinal records would be necessary to detect increasing breath acetone levels within individual cows, instead of single spot measurements. In another experiment, we found that a lower respiratory exchange ratio (CO_2/O_2 , V/V%) was linked to a larger decrease in body condition score and higher levels of serum β -hydroxybutyrate in the first six weeks postpartum in dairy cows. We also found a link between breath composition and feed efficiency, using data from automated emissions monitoring stations. As an outlook for the future, breath analysis has potential to be used as a practical, non-invasive, real-time monitoring tool on dairy farms, with a broader scope than monitoring methane emissions. Although, more research is needed to further explore the capabilities of this tool, and engineering solutions are also needed to implement this technique on dairy farms.