Could Digital Technologies Lead to Improved Lameness Detection on Dairy Farms? - Abstract

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Summary

Lameness is a major and common problem in dairy farms, which is unfortunately still underestimated by most farmers. Regularly and systematically observing the gait pattern of every single cow on a farm is a very time-consuming and error-prone task. Indirect automatic lameness detection could enable farmers to detect lame cows earlier based on their individual behaviour and performance, which are recorded by animal-specific sensor systems. Preceding studies about indirect automatic lameness detection already showed that prediction models could correctly distinguish between lame and non-lame cows with a probability of over 85%. In these studies, pedometers (ENGS Dairy Solutions, Israel) which could register activity, lying and feeding behaviours, were the only employed animal attached sensors.

The aim of the dissertation project "Automatic lameness detection on dairy farms - suitability of digital technologies for recording behaviour and performance data" as part of the experimental field DigiMilch is to refine and further develop these algorithms with data from many different sensor systems installed on eight Bavarian dairy farms.

Individual animal behaviour and performance data recorded by boluses, pedometers, collars and milking robots from different manufacturers are collected on three public research farms and five commercial dairy farms throughout Bavaria. The required reference data to train prediction models in combination with the acquired information by sensor systems consist of locomotion scores performed through video recordings, diagnoses of the claw trimmings and a pain test carried out before the trimming on each claw. According to the applied locomotion score, cows with an irregular, asymmetric and uneven gait are scored as "lame" (score=3), cows without gait alterations, but showing signs like head bobbing, an arched back or a compensatory posture are considered "unsound" (score=2), and animals who do not present any of these features are categorised as "sound" (score=1). This score has been validated by calculating the inter- and intra-rater agreement and by creating a comparable three-step lesion score which rates cows according to their visible lesions and pain reaction in groups from one to three. After finishing data collection on the farms, the data is split in two parts to train and then test specific prediction models with the collected information about claw health, behaviour and performance data of every animal.

To assess the validity of the reference method, the lesion and locomotion score were compared. The analysis of a dataset of 110 cows revealed results (cohen's kappa (K)=0.72, confidence interval (CI)=0.58-0.86, percentage of agreement (PA)=80%), which imply that the agreement between those scores might be moderate to almost perfect. For the intra-rater agreement, the computed PA yielded 93% and the K 0.89 (CI=0.84-0.94), indicating an almost perfect agreement. The inter-rater reliability resulted in a PA=82 % and K=0.72 (CI=0.64-0.81), meaning it was substantial to almost perfect.

The validation of the locomotion score showed that in this study the three-point locomotion scoring system was a reliable reference system for claw health. In order to generalise and confirm the presented results additional comparable data sets from other farms and observers should be examined. Further analysis and modelling with the recorded sensor and claw health data is planned after finishing the data collection. This wider approach with various sensor systems increases the practical relevance of indirect automatic lameness detection and could support farmers in optimising the animal health on their farm with minimal investment.

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