Classification of cow behaviours using leg- and neck-mounted accelerometers in dairy barns

Said Benaissa[1, 2,], Frank A.M. Tuyttens[2, 3], David Plets[1], Luc Martens[1], Leen Vandaele[2], Annelies Van Nuffel[4], Wout Joseph[1], Bart Sonck[2, 5]*

[1] Department of Information Technology, Ghent University/iMinds, iGent-Technologiepark 15, 9052 Ghent, Belgium
[2] Institute for Agricultural and Fisheries Research (ILVO) - Animal Sciences Unit, Scheldeweg 68, 9090 Melle, Belgium
[3] Department Nutrition, Genetics and Ethology Laboratory for Ethology Faculty of Veterinary Medicine, D8, Heidestraat 19, B-9820 Merelbeke, Belgium
[4] Institute for Agricultural and Fisheries Research (ILVO) - Technology and Food Science Unit, Burgemeester van Gansberghelaan 115 bus 1, 9820 Merelbeke, Belgium
[5] Department of Biosystems Engineering, Faculty of Bioscience Engineering, Ghent University, Coupure links 653, B-9000 Ghent, Belgium
said.benaissa@ugent.be (Said Benaissa)

Monitoring changes in behaviours could provide insight into the reproduction status, health, and overall well-being of dairy cows. Traditional methods based on direct observation of the herd, either live or from video recordings, are becoming increasingly labour-intensive and time-consuming as herd size increases. Thus, automatic behaviour recognition systems using accelerometers, in combination with machine learning algorithms become more important to continuously and accurately quantify cow behaviours. The aim of this study was to automatically classify cow behaviours (i.e., lying, standing, and feeding) based on leg- and neck-mounted accelerometers. Lying, standing, and feeding behaviours of 16 different lactating dairy cows were logged for 6 hours with 3D-accelerometers. The sensors were attached to the hind leg and the collar of the cows. Behaviours were simultaneously recorded using visual observation and video recording as reference. Features were extracted from the logged raw data and classification algorithms (K-nearest neighbours, naïve Bayes, and support vector machine) were used to classify the cows' behaviours. The classification models using combined data of the neck- and the leg-mounted accelerometers classified the three behaviours of interest with high precision (80-99%) and sensitivity (87-99%). For the leg-mounted accelerometer, lying behaviour was classified with high precision (99%) and sensitivity (98%). Feeding was classified more accurately by the neck-mounted versus the leg-mounted accelerometer (precision 92% versus 80%; sensitivity 97% versus 88%). Standing was the most difficult behaviour to classify when only one accelerometer was used with a precision and sensitivity of 70% and 65% for leg-mounted accelerometer and 74% and 68% for the neck-mounted accelerometer. These results suggest that the classification of cow behaviours depends on the position where the accelerometer is attached. The collar is preferable for detecting feeding behaviour, the leg for lying behaviour, and a combination of the two position for an accurate classification of the three behaviours.