

Usage of Tri-Axial Acceleration of the Hind Leg for Recognising Sheep Behaviour

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Measuring the leg position and its motion could indicate strong distinction between sheep's lying, standing and gait types which could define sheep behavior and their welfare state. The objective of this study was to analyze the position and locomotion of the sheep's hind leg using attached accelerometer and to interpret the gathered data from the accelerometer for differentiation of lying, standing and various gait types. Six sheep were used in this experiment. HOBOPendant G tri-axial acceleration data logger was attached on the lateral side of the metatarsal region on the left hind leg. The logger was set for measuring acceleration and inclination of x, y and z axis, on fast mode logging interval (0.03sec.). Each sheep and the appropriate left hind leg were recorded with video camera. For the standing position the acceleration of the x axis was in range 0.8 and 1 g ($\bar{x} = 0.937 \pm 0.035$) and the sum vector was from 0.85-1.3g ($\bar{x} = 0.988 \pm 0.006$) with the time interval longer than 0.7 seconds. For the lying position the z axis acceleration was considered as a most reliable axis ≈ 1 or $-1g$ depending of the lying side. The single step analysis of walking and running showed distinctive patterns of the x-axis acceleration during stance and swing phase. The frequencies of acceleration values of x-axis and sum vector showed significant differences in the category 0-1g for walking (x-axis, $\bar{x} = 65.56 \pm 8.37$ and sum vector, $\bar{x} = 37.74 \pm 5.92$), trotting ($\bar{x} = 35.87 \pm 7.07$; $\bar{x} = 16.41 \pm 6.16$) and running ($\bar{x} = 22.24 \pm 4.86$; $\bar{x} = 4.91 \pm 3.03$). The value category 3-4g for walking ($\bar{x} = 3.39 \pm 1.5$; $\bar{x} = 4.97 \pm 2.15$), trotting ($\bar{x} = 9.99 \pm 4.15$; $\bar{x} = 16.31 \pm 4.95$) and running ($\bar{x} = 19.65 \pm 4.05$; $\bar{x} = 30.09 \pm 2.19$). Average time duration of the steps during walking, trotting and running was 0.47 ± 0.07 ; 0.31 ± 0.02 and 0.25 ± 0.02 seconds, respectively. Accelerometers provide detailed real time analysis of the leg position in sheep's natural environment. Defining thresholds based on the frequencies of acceleration values are the most reliable approach for acceleration analysis. The defined thresholds for sheep can be used for behavioral research and sheep locomotion, as well as a tool for herd and sheep behavior and animal welfare assessment.

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