

A NOVEL METHOD OF MONITORING MOBILITY OF DAIRY COWS

Toby T Mottram¹ Nick Bell²

¹ *eCow Ltd, Design Hub, Glasgow, Scotland UK.*

² *Department of Veterinary Science, University of Bristol, UK.*

Abstract

A pilot study of 20 cows measured the accelerations on the neck of cows as they walked along a passage from a milking parlour. Lamé cows were measured as walking more slowly and with smaller head accelerations. A method of automating measurement of mobility could be developed with this method.

Introduction

Lameness of cows is a major concern in the dairy industry in the UK with milk buyers now attempting to measure lameness on the suppliers farms.

Previous attempts and limitations - Nick

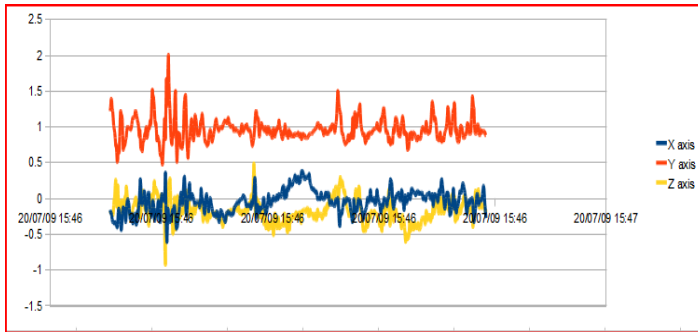
Behavioural measures of how cows partition their time between standing, lying and eating have been ambiguous. However, the introduction of low cost accelerometers has made it possible to propose dynamic logging as a method capable of yielding an objective measure of lameness based on the observation that cows that are lame have a jerky motion of the head. The purpose of this pilot study was to identify whether measurements with an accelerometer can be correlated to mobility score.

Materials and Methods

A collar was constructed to hold an miniature acceleration data logging device (MSR145 20mm x 15 x 52 mm) in a position on a cows neck such that when the animal was standing the X,Y,Z axes were approximately aligned to the plane of the earth. The X axis aligned parallel to the ground to capture forward and reverse accelerations, the Y axis capturing vertical motion and the Z axis the sideways movement elicited by turning motions.

The rate of data capture was set at 50Hz, range up to $\pm 10g$. The collar was placed on 20 cows leaving a milking parlour in series and then removed after a couple of minutes. The time stamp was synchronised with a period with the MSR at rest. Events such as stopping or jumping were recorded. The time stamps in the data were examined to extract 15 seconds for analysis on the period when cows walked alone under their own volition in a straight line for a distance of 20 m as they moved to a holding area where other cows and food was available.

The vertical axis shows the values in g and the abscissa the time with a point for each 0.02 s. The Y axis of movement oscillates about a value of approximately 1 indicating the constant acceleration due to gravity and shows the vertical motions of the head. The forward motion is shown by the X axis. Observation of a cow walking will show that the head moves up and down.



The X,Y,Z data were then subjected to analysis with MatLab to characterise each curve by a few parameters time to travel 20 m, maximum values, number of times the forward acceleration exceeded one standard deviation above the mean, and curtosis. These were then correlated to mobility scores.

Results

The 20 cows ranged in mobility score from 0 to 3. One cow skipped and jumped on her way and gave such high movement scores that her data was exluded from the study. As might be expected the least mobile cows took longer to walk the 20 m whilst surprisingly the curtosis which measures jerkiness of a curve diminished.

	Time	Max_X	Max_Y	curt_x	curt_y	curt_z
Mean	9.7	0.95	2.07	3.95	7.13	5.19
STD	3.85	0.43	1.22	1.12	4.74	3.54
Correlation	0.56	-0.22	-0.56	-0.28	-0.46	-0.61
Regression	0.31	0.05	0.31	0.08	0.21	0.38

A walking cow normally has three feet on the ground at any one instant in time. The feet move in a sequence with the rear foot pushing forward followed by the front on the same side. Accelerations in the x or forward direction are matched by decelerations so that the mean acceleration is zero. A peak in acceleration will occur as the cow begins to thrust forward and will always be matched by later deceleration but probably not at the same rate. The vertical accelerations seem less linked to mobility. When a cow is driven from pasture we have observed cows with jerky motion responding to pain giving high curtosis values. When not driven in this study the lame cows walked slowly presumably to minimise pain and this is shown in the lower maximum.

Conclusions

This pilot study shows that meaningful data can be detected on the neck of the cow and it is possible to relate mobility score to neck movements in an objective manner. The least lame cows move their heads more and the most lame the least. There is inevitably a high degree of variability between cows and almost certainly within cows. Every effort was made not to excite the cows although some sensed the presence of the observer outside the parlour and the very act of attaching the collar will have caused

some disturbance. Behaviour on any single day was never intended as the target and repeatability will be improved by longitudinal studies using wireless collars which remove the interference of the human presence.

References

Bramley, A.J., R.G. Kingwill, T.K. Griffin, and D.L. Simpkin. 1976. Prevalence of *Corynebacterium bovis* in bovine milk samples. Vet. Rec. 99:275.