Experiment 1
The feasibility of utilizing digital images to determine body condition score (BCS) was assessed for lactating dairy cows at the Scottish Agricultural College Crichton Royal Farm. Two measures of BCS were obtained by using the primary systems utilized in the United Kingdom (UK-BCS) and the United States (USBCS). Means were 2.12 (±0.35) and 2.89 (±0.40), modes were 2.25 and 2.75, and ranges were 1.0 to 3.5 and 1.5 to 4.5 for the UKBCS (n = 2,346) and USBCS (n = 2,571), respectively. Up to 23 anatomical points were manually identified on images captured automatically as cows passed through a weigh station. Points around the hooks were easier to identify on images than points around pins and the tailhead. All identifiable points were used to define and formulate measures describing the cow's contour. For both BCS systems, hook angle, posterior hook angle, and tailhead depression were significant predictors of BCS. When the full data set testing only the angles around the hooks was used, 100% of predicted BCS were within 0.50 points of actual USBCS and 92.79% were within 0.25 points; and 99.87% of predicted BCS were within 0.50 points of actual UKBCS and 89.95% were within 0.25 points. In a reduced data set considering only observations in which the tailhead depression angle was available, adding the tailhead depression to models did not improve model predictions. The relationships of the calculated angles with USBCS were stronger than those with UKBCS.

Reference

Experiment 2
An image-processing model was designed that calculates a parameter to assess body shape. The model was implemented, and its outputs were validated against ultrasonic and thermal camera measurements of the thickness of fat and muscle layers, and manual body condition scoring of 186 Holstein-Friesian cows. The thermal camera overcomes some of the drawbacks of a regular camera; the hooks and the tailhead nadirs of a thin cow diverged from the parabolic shape. The correlation between thermal camera's measurements and fat and muscle thickness was 0.47. Mean body condition scorings were 2.18, 2.15, and 2.23, with no significant difference found across the assessment methods.

Reference

Experiment 3
The feasibility of including a body shape measurement in automatic monitoring of body condition was evaluated. The hypothesis tested was that the body shape of a fatter cow is more round than that of a thin cow and, therefore, may better fit a parabolic shape. The more prominent hooks and the tailhead depressions of a thin cow tended to diverge from the parabolic shape. An image-processing model appraised body shape. The novelties in this study compared to the previous ones (Halachmi et al., 2008; Bewley et al., 2008) were: (1) completing the full-automation of the system and (2) more accurate reference, not ultrasound. The model was implemented and its outputs were validated against manual body condition scoring (BCS) of 186 Holstein-Friesian cows. Pearson correlation between the thermally sensed BCS and the manual BCS was 0.94.

Reference