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CONSTRUINDO SABERES, FORMANDO PESSOAS E TRANSFORMANDO A PRODUÇÃO ANIMAL

USING SENSORS TO PREDICT GRAZING BEHAVIOR IN CATTLE THROUGH DIFFERENT MACHINE LEARNING APPROACHES

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Grazing behavior is highly influenced by sward structure of the pasture. However, it is a difficult trait to measure in both commercial and research settings, which limits the improvement of grazing management to optimize intake and performance in cattle. The use of sensors has emerged as a powerful tool to assess animal behavior and it could overcome this limitation. The objectives of this study were: (1) to assess different machine learning techniques to predict grazing behavior; (2) to evaluate the best set of variables related to grazing behavior to be predicted using a combination of sensors. Data from an Angus heifer was collected for 25 hours using visual observation, a 3-axis accelerometer and a 2-axis gyroscope. Visual observation was continuous, and sensors were set to send data to the server every second. Three sets of behavior variables were defined: Set 1: grazing (G), ruminating (R; both standing and lying down), idle (I; both standing and lying down), and drinking (D); Set 2: G, R, I, and D; Set 3: G, R and I. The sets of variables were predicted with four machine learning approaches: Bagged Trees (BT), Support Vector Machine (SVM), K-Nearest Neighbor (K-NN), and Linear Discriminant Analyses (LDA). To assess prediction quality, a 5 k-fold cross-validation was performed and overall accuracy, true positives, false negatives and area under the curve (AUC) of the receiver operating characteristics were calculated for each machine learning approach and each set of behavior parameters. The overall accuracy of all machine learning approaches was better for Set 3 (BT: 58.8%, SVM: 54.7%, K-NN: 54.4%, LDA: 45.9%) than for Set 1 (BT: 51.3%, SVM: 48.1%, K-NN: 46.5%, LDA: 41.4%), and Set 2 (BT: 57.9%, SVM: 53.7%, K-NN: 53.2%, LDA: 46.9%). In Set 3, when BT was implemented, the true positive rates for grazing and ruminating behavior were 72% and 59%, respectively. Idle behavior was poorly predicted (26%) by this method. The AUC curves were: 0.77; 0.71; 0.71 and 0.55 for BT, SVM, K-NN and LDA, respectively. The use of simpler set of behavior variables (such as Set 3) yielded high accuracy values to predict grazing time using BT, as well as SVM (69%) and K-NN (73%). The use of machine learning algorithms and the combination of different sensors are promising strategies to develop decision-making tools based on animal behavior that can help producers to manage animals in a rotational grazing system.

Keywords: accelerometer, accuracy, gyroscope, precision farming, ruminating

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