

Modeling and labeling of broiler behavior patterns associated to thermal environment conditions by means of image processing and hierarchical clustering

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Abstract

Thermal environment is a key factor in broiler production, since anomalous conditions affect productive response and animal welfare. Broiler behavior to these conditions can be monitored with continuous video/image recording. In this research, authors propose a basic framework divided into two steps to detect broiler behavior patterns to thermal environment. Image processing and hierarchical clustering are used as tools for patterns detection and labeling.

Key words: image processing, hierarchical clustering, broiler houses

Introduction

Brazil is the third largest producer and the largest exporter of broiler meat in the world. However, many Brazilian farms still have problems with ventilation systems and broiler thermal welfare. These problems have a direct impact in weight gain and mortality rate of the broilers.

In this work, we improve what has been done in [1] to study the distribution index of broiler breeders, and use temperature and humidity data in order to detect thermal behavior patterns.

The main contribution of this work is to combine sensors data together with image processing features, to achieve a better labeling of broiler behavior patterns related to thermal welfare.

Results and Discussion

Our methodology is supported by a two-step framework. Step 1 aims the processing of images with computer vision techniques, i.e., given a continuous video database, frames are extracted at each 5 minutes. Then, image distortion is corrected and lightness values are extracted from the images (HSV color space). Gaussian blur is applied to the images and then Otsu's method is used to segregate background and foreground from images. Finally, feature extraction on each image is performed to obtain numerical metrics [1] such as density and distribution indexes over the whole image divided into 21 smaller windows. These features are added to the thermal variables database collected by temperature and humidity sensors and getting a new database to be used in clustering step. This database keeps control on time labelling. Images and sensors data are then used as time-series records to perform the following step.

The second step is based on hierarchical clustering [2] with cosine distance and Ward's algorithm. Clusters represent patterns or episodes

of animal response to the thermal conditions (THI).

Comparison amongst clusters profiles, ideal thermal comfort indexes and images analysis supported by experts allowed labelling and detecting the set of normal and anomalous episodes at the studied broiler facility in an offline way. The framework have been implemented under Python programming language and R-Software libraries to support data mining tasks.

Conclusions

The framework is capable of providing tools to detect several welfare behavior patterns. It can also detect anomalous events in the broiler, such as people getting into the broiler house or light/energy blackouts.

This is a part of a major project. Several tests are still in progress in order to improve the framework capabilities.

Parallel tasks are focused on obtaining a real-time classifier able to detect and report a set of detailed "warnings" by using this approach, machine learning classifiers, rule-based discovery and short-time forecasting.

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[1] Kashiha, M.; Pluk, A.; Bahr, C.; Vranken, E.; Berckmans, D. *Biosystems Engineering* **2013**, *116*, 36-45.

[2] Han, J.; Kamber, M. *Data Mining*; Elsevier: Amsterdam, **2006**.

[3] Vilas Novas, R.; Conti, D.; Martínez, J. M.; Carvalho, T. M. Oral presentation at ASABE Annual International Meeting, New Orleans, LA. **2015**. Session 152190281 (extended abstract accepted).