LEIA - LOW-END IMAGE ANALYSIS TO CONTINUOUSLY MONITOR GROWTH AND BODY CONFORMATION OF FATTENING PIGS

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Abstract: Variability within a group of animals is an important information which can be used for further optimization of pig fattening. Hence, this project will provide a generic methodology to continuously monitor the differences of growth and body conformation within a group of animals using a set of robust and simple, i.e. low-end image analysis (LEIA) algorithms. The methodology will be breed independent. The verification of the methodology is done under practical conditions with fattening pigs. The project will provide non-dimensional parameters to describe a group's heterogeneity with regards to changes in time. Time-series analyses will be used for the estimation of the future development of variability within the group.

1 Introduction

To improve fattening pig production with regards to animal performance (weight gain, meat quality), welfare and management issues, optimized tools are required to enable timely management responses [WS04]. Those tools would provide process-relevant information like animal weight and body conformation continuously in the course of the whole fattening process. Hands-off methods utilizing 2D image analysis show great potential, e.g. to derive dynamic growth models to optimize nutrient utilization or to monitor meat quality and body conformation. The information gathered could be used to support management decisions like medical treatments or could enable one to deploy the knowledge of variation within a group to improve the shipping of animal groups thereby optimizing both revenues and utilization of pens [Ko01]. Commercial optical sorting scale systems for pigs emphasize this development [Os06].

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2 Motivation and project aims

However, monitoring pigs within a pen still is in an early stage of development. On the other hand, optical scale systems seem to be restricted by laboratory style conditions (e.g. artificial lighting), manual or discontinuous operation of the system in the stable or complex image analysis algorithms.

Hence, this project's aim is to provide a generic methodology to continuously monitor and quantify the differences of growth and body conformation (heterogeneity) within a group of animals using a set of robust and simple, i.e. low-end image analysis (LEIA) algorithms. The methodology shall be breed-independent and is verified under practical conditions with fattening pigs in the pen. The project will provide non-dimensional parameters derived from geometric image features to describe a group's heterogeneity with regards to changes in time. These parameters will be deployable to increase transparency and economic performance of the whole production process. Time-series analyses will be used for the prediction of the development of variability within a group.

3 Experiments

Experimental set-up

An image acquisition system was installed in a research stable featuring two compartments with four equally-sized pens (3.3 x 7.8 m²) holding 30 pigs each. The average weight range observed was 30 kg to 120 kg.

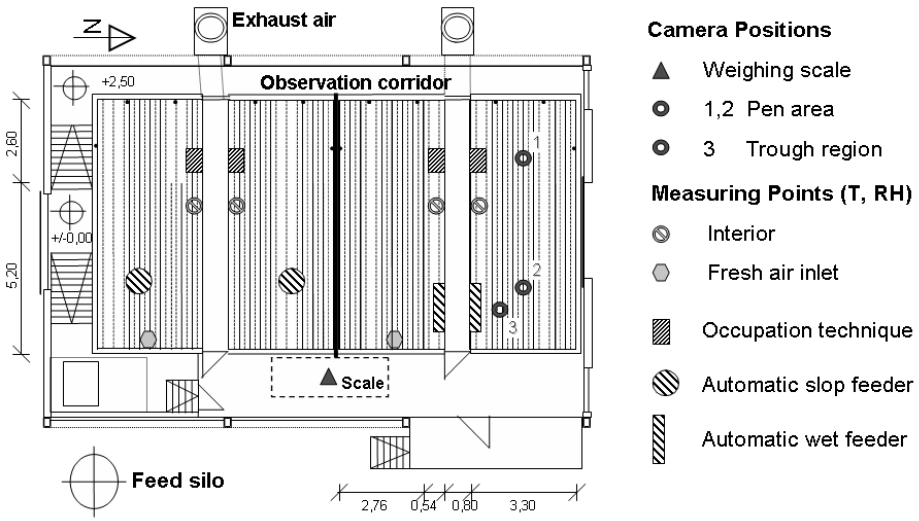

Figure 1: Sketch of research stable

Analogue b/w cameras (pixel resolution: 768 x 576) were mounted top-view within a single pen: camera 1 and 2 to cover the pen area and camera 3 observing the trough region (Figure 1). Another camera was mounted perpendicularly over a weighing scale. Analogue frame-grabbers were used to record image data on a regular computer system.

Data Collection

In the course of one complete fattening period, image sequences were collected along with reference data every week or every fortnight respectively (Table 1). As a reference for image analysis results, every individual pig was weighed and assessed manually while being in the weighing scale.

	Trial Week														
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Weighing and assessment	■	■	■	■	■		■		■		■		■		■
Image sequences															
- Trough camera	■	■	■	■	■		■		■		■		■		■
- Pen cameras	■				■				■				■		

Table 1: Trial schedule

The assessment data comprised parameters describing the individual's body conformation linearly (e.g. overall size, body length and width, muscle exposure, degree of fattiness, fitness, leg weaknesses). Parameters to describe the animal's motion and posture in the scale were registered to be able to determine their influences on image analysis results. During each weighing and assessment, an image sequence of each pig in the scale was collected. Each day after the pigs were weighed and assessed, image sequences from cameras in the pen were recorded in daytime. This enables the comparison of image analysis results from scale and pen with the manually assessed parameters. All data were stored in a database system (LEIA/DB).

First results

The development of the overall animal weight distribution suggests a notable variability from start until finish of the fattening period. Further research has to show whether pigs with low or high weight keep their individual outlier-position in terms of weight or daily weight gain in the course of the whole fattening period. First investigations on this issue do not provide a clear tendency.

The analysis of scale image sequences based on threshold segmentation provides no acceptable correlation between animal weight and back area due to influences of motion and posture of the animal (Figure 2).

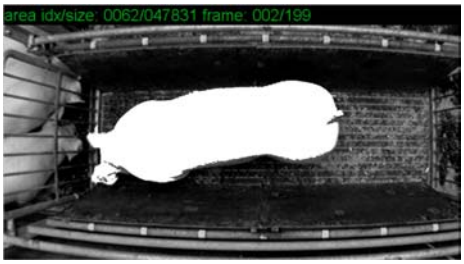

Figure 2: Automatically detected pig

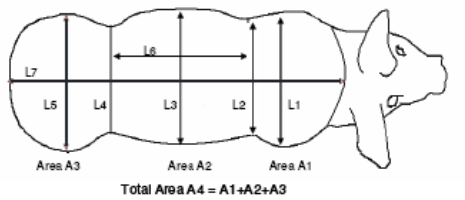

Figure 3: Possible geometric features [DG05]

The elimination of badly segmented pigs (outliers) offers no enhanced results due to motion of the head. Further research will investigate simple shape models along with additional geometric features (Figure 3).

Conclusions and future prospect

Over all, animal weighing and animal assessment were performed ten times each. The LEIA database provides an efficient storage of raw and processed data containing an invaluable resource for further intensive testing and evaluation of certain algorithms and methods to gain geometric features representing group variation. First tests of image analysis algorithms show the necessity to test further geometric features and simple shape models to match group variation.

Acknowledgements

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