Identification of Behaviour of Weaner Pigs in the Early Phase of Aggressive Interaction for the Development of an Automatic Monitoring System of Pig Aggression

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Abstract. Aggressive behaviour among pigs results in negative consequences, reducing health and welfare of animals as well as production output of a farm. In order to develop an automatic monitoring system that monitors and controls pig aggression, an experiment was carried out. The aim of the experiment was to analyze sequences in pig aggressive behaviour. 52 aggressive sequences were observed during the experiment in on farm observations. Behaviour that started the aggressive sequences the most often was nose to nose interaction. 22 out of 52 aggressive sequences started with this behaviour. Head to head knocking was classified as a second most frequent starting behaviour with 13 head to head knocks starting aggressive interactions. Nose to nose interaction and head to head knocking behaviours in most cases started aggressive interactions between animals. Automatic detection of these behaviours might allow early detection of aggression among pigs.

1 Introduction

The social organization of domesticated pigs, *Sus scrofa*, living under farm conditions is, as in wild pigs, based upon a dominance hierarchy [10]. Hierarchy is established when unacquainted pigs are placed together [13], [4]. This common commercial practice results in intense aggression which extends throughout the first 24-48h after grouping [9]. The reasons for increased aggression level among pigs in confinement are: limited space allowance [15], feeding systems promoting competition [9], barren environment [2], low fibre feed composition [12] and regrouping [9].

The fight breaks out gradually as the pigs investigate each other using a series of specific and often reciprocal behaviours, characterized by nosing, sniffing and gentle nudging. This may then escalate into more vigorous pushing and pressing, bites, head-knocking and mounting. Thus, as the fight progresses, it increases in intensity (i.e., more damaging behaviours occur more frequently later in the fight). A complete un-

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derstanding of aggressive behaviour may help in improvement of livestock management, as well as health and welfare of animals [11].

Aggressive behaviour has a negative impact on health, welfare [10], and productivity of pigs [1]. At present evaluation of health, welfare and productivity is performed by stockmen who routinely gather auditory, olfactory and visual information from their animals. New precision livestock farming technology can aid this task, even with large flocks or herds, thanks to the (r)evolution in sensors and sensing techniques [14]. Therefore there is an opportunity for application of precision livestock farming technology as an automatic aggression monitoring system.

The objective of this paper is to present the development of automatic monitoring system of pig aggression, experimental installation utilized in the development process and analysis of pig's aggressive behaviour.

2 Application of PLF as an Automatic Monitoring System of Pig Aggression

Precision livestock farming (PLF), can be defined as the management of livestock production using the principles and technology of process engineering. It is the principal means by which 'smart' sensors will be used in livestock farming [14]. An integrated monitoring system is one which collects information from a variety of sources, including sensors, databases and knowledge bases, processes the data and provides outputs, which may be recommendations to the producer, or direct process control actions [5].

Fig.1 presents the PLF scheme adapted to automatic monitoring system of pig aggression. The scheme is being realized by model predictive control. This does not prescribe a specific control strategy, but rather a range of control methods, which use continuous feedback of the process output (as in other control strategies), make an explicit use of a dynamic model of the process to predict the process response, and use this model to calculate the control signal by minimizing an objective function [14].

The first step in aggression monitoring system development is the development of an automatic monitor which by dynamic analysis of the inter-individual interactions between animals, will be able to detect aggressive attacks automatically and identify the aggressor(s) and the receiver(s) in a group. The second step is to develop a control strategy. Control strategy has to be realized by utilization of actuator (i.e. sound, smell) that changes pig behaviour, lowering aggression level.

In order to develop monitoring system and control strategy for pig's aggressive behaviour in depth analyzes of these behaviours is necessary. To obtain data necessary in product development process an experimental installation was constructed and an experiment carried out.

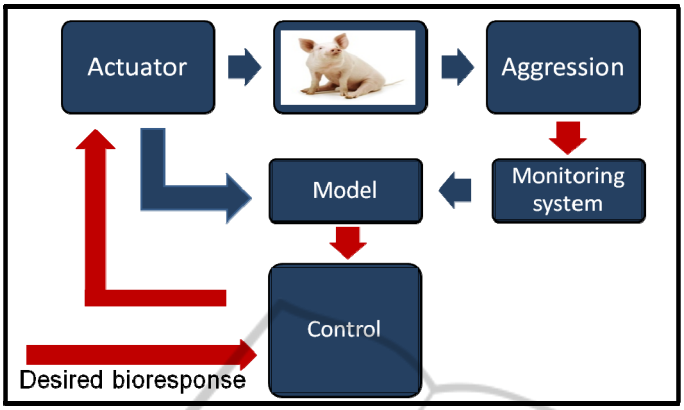

Fig. 1. Schematic overview of key components of automatic monitoring system.

3 Materials and Methods

3.1 Ethological Observation Installation

Behaviour of one pen of 11 pigs was observed on farm by experts in pig's behaviour and recorded with video camera (Fig.2). Recordings were done using an *Allied Vision Technologies*® camera *model F080C*. The camera was placed above the observed pen in central position (in top view), at the height of 2.3m, connected to a computer which recorded the images with a frame rate of 11 fps, resolution of 1032 x 778 pixels and in colour.

The video recordings and visual observations were carried out in the same time, in the period of 3 days after the pigs were mixed. On the first day of the observation 35 minutes (16:50 – 17:25) of videos were recorded. On the second day 3 hours and 30 minutes (13:00 – 16:30) and on the third day 3 hours (11:00 – 14:00) were recorded. Behavioural recordings were carried out on 11 pigs of 23 kg on average kept in a pen of 4m x 2,5m with partially slatted concrete floor and solid pen walls. The feeder bin in the pen had 2 feeding places.

In parallel with video recordings there were on-farm visual observations performed. The requirements for visual observation were reached in an installation consisting of a sheet of strong paper hanging in the front of the pen and a platform placed behind the paper wall. The observers were sitting on a platform (around 150 cm above ground level) in a comfortable position, high enough to be able to see the whole surface of the pen. At the height of the observers' eyesight there was an opening cut in the sheet of paper (40x30 cm). The size of the opening was calculated to be big enough for the observer to see the whole area of the pen, but simultaneously, relatively small so pigs couldn't see too much movement behind the paper. The usage of such a paper wall was motivated by the fact that too much movement around the pen could cause distraction of the pigs and changes in their behaviour. During the real time labelling, behaviours were presented in a database with the time and the sequence of events that occurred inside the pen.

On farm observations data and videos recorded during the experiment were used to specify agonistic behavioural patterns occurring among pigs.

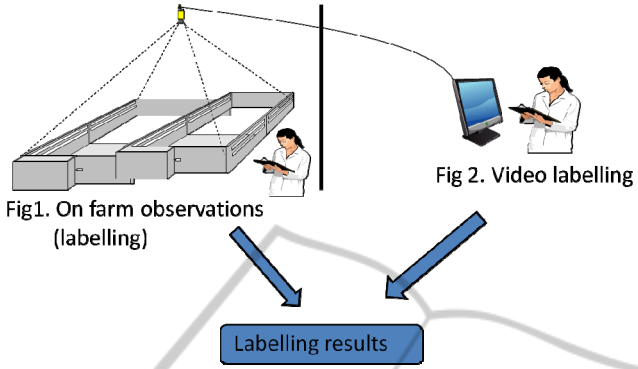

Fig. 2. Labelling process.

3.2 Pigs Behaviour

Data obtained by experts during on farm observations were used to specify the order in which aggressive behaviours occur. Labelling of recorded videos gave more detailed information and allowed to analyze the pigs body postures, relation of body positions, activity and occupation indexes. Comparison of the on farm observations and the video recordings was also performed (Fig.2).

Behaviours observed during on farm observations were recorded in an ethogram. The ethogram contained following behaviours [6], [3]:
Nose to nose: The nose approaches the snout or head of the receiver.
Head to head knock: Hitting with the snout against the head of the receiver.
Inverse parallel pressing: Pressing of shoulders against each other, facing opposite directions.
Neck biting: Biting of the opponent pig directed towards the neck.
Body biting: Biting of the opponent pig directed towards the body.
Mounting: Jumping on another pig with legs directed forward.
Ear manipulation: Holding receiving pig's ear in the mouth.

4 Results and Discussion

4.1 On Farm Observations

52 aggressive sequences were observed during 3 days of the experiment. Behaviour that started the aggressive sequences the most often was nose to nose interaction. 22 out of 52 aggressive sequences started with this behaviour. Head knocking was classified as a second most frequent starting behaviour with 13 head knocks starting aggressive interactions. Neck biting started 7 out of 52 aggressive interactions.

The behaviours that started the aggressive sequences the least often were: inverse parallel pressing (4 out of 52), mounting (2 out of 52), body biting (2 out of 52), and ear manipulation (2 out of 52) (Fig. 3).

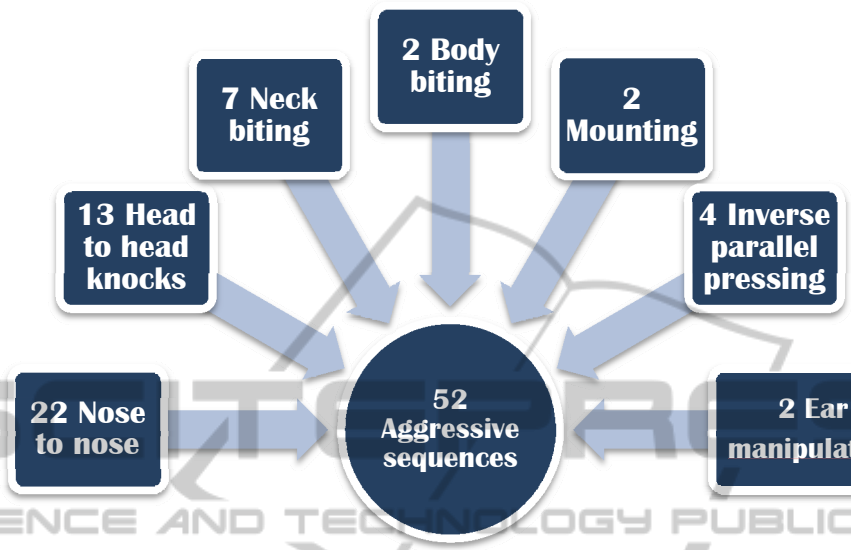

Fig. 3. Behaviours that started the aggression.

4.2 Discussion

In our experiment sequences of aggressive behaviour mostly started with nose to nose interaction, which is similar to Jensen's findings [7-8].

The second most frequently occurring as starting behaviour was head to head knocking behaviour. The behaviour classified by Jensen [8] as one of the behaviours always occurring after nose to nose interaction, in our experiment was often (13 of 52) an aggression initiating behaviour.

Neck and body biting behaviours occurred less often at the beginning of aggressive sequences which complies with findings of other scientists [7-8], [11]. McGlone [11] showed in his study that mutual bites occur during the late phase of the fight; therefore these behaviours usually don't initiate aggressive sequences.

5 Conclusions

In the development of an automatic monitoring system of pig aggression it is necessary to identify behaviours that can be recognized by the system and monitored continuously. Nose to nose interaction and head to head knocking are behaviours identified as occurring at the beginning of aggressive sequences. Therefore automatic detection of these behaviours might allow early detection of aggression between pigs.

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