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Simultaneous Individual Animal Identification

The Application of RFID Technology when Using HF Transponders

A technique used for marking individual animals, based on radio frequency identification (RFID) with HF (High Frequency) transponders, was evaluated for its precision in marking rearing pigs at an automatic feeder. The antenna for simultaneously recognising individual animals was integrated into the round trough of the automatic feeder and the HF transponders needed were fixed on the ear tags of the piglets. With a recognition rate of 97.6%, the system offers a practical solution for the future for simultaneous animal identification.

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Keywords

RFID, HF- transponder, piglet

Literature

References LT 08112 will be sent for remand.

The currently used method of identifying animals with plastic markers has the advantage of low costs and easy application. But, plastic ear tags can only be identified visually [1]. RFID permits contact-free identification of objects and subjects by means of transponders using radio transmission. Up until now, low frequency (LF) transponders have been used for automatic animal identification, which has the limitation that they can only be read one at a time [2]. In livestock husbandry, this technology has been utilised, within an enterprise, with cows and sows for identifying single animals (e.g. concentrated feed stuff station) for more than 20 years [3].

In the work presented here, an innovative method of simultaneously identifying individual animals was developed. This approach was investigated utilising RFID technology, combined with HF transponders in a practical situation with rearing pigs. Our main aim was to evaluate the precision of recognition of this novel simultaneous method of animal identification.

Animals, materials and methods

The study was carried out at the Research Centre for Animal Production and Technology, Weser-Ems of the Georg August University, Göttingen, in Vechta. In each case, the period of investigation included the first three weeks of rearing two successive rearing batches with weaned piglets (weaned age: 21 days). The investigations were carried out in two pens (each 8.3 m^2, 20 pigs / pen) of the automatically ventilated air-conditioned experimental pens. In one pen, there was an automatic feeder, made of high-grade steel, controlled by filling level (Pre-Mixer, EFS-System GbR, Essen i. Oldb.) and the other pen was provided with a conventional automatic mash pipe feeder (Lean Machine, Big Dutchman, Vechta).

In order to be able to simultaneously register the pigs at the automatic feeder, both automatic feeders were equipped with RFID technology. Self-made, circular HF antennae (operating frequency: 13.56 MHz) were integrated in the round trough (internal diameter: 25 cm, external diameter: 40 cm) of the automatic feeders. A coaxial cable connected the antennae with a laser device. The laser device used was a conventional high frequency long-range reader (LR 200, Feig Electronics, Weilburg). The long-range reader likewise functioned with an operating frequency of 13.56 MHz and enabled a range of 30 cm, depending on the antennae used. The rate of data transfer of up to 25 kbit/s offered, when an anti-collision process was implemented, a sufficiently high speed of reading in order to be able to simultaneously record several transponders. Anti-collision means keeping all transponders separately, so that communication with individual transponders without false reports is possible. As a control mechanism, the laser device requests all transponders in the reading range to respond after a random period. A time window for responding is made available in such a way that the reply repetition periods for the individual transponders are insignificantly different. If a collision does occur, the procedure is repeated until all transponders have been recognised and have been read [4].

The transponders used for the investigation were HF transponders (operating frequency 13.56 MHz, IN Tag 300I-Code SLi, Sokymat, Granges, Switzerland), which were punctured on the ear tag of the pigs (Allflex, Hamburg).

In order to validate the precision of recognition of the system for simultaneous individual marking of animals with the aid of video recordings, the visits to the trough of selected target animals, as well as of the whole group, were continuously recorded with the help of video cameras. On four selected observation days (1st, 2nd, 14th and 21st rearing days), the frequenting of the trough was evaluated and compared with the data for simultaneous recognition of individual animals. For the observation of target animals, in each case, three piglets from each pen were individually marked and observed continuously over a period of eight hours on each day of observation. As the reception area for the recognition of individual animals extends over a radius of 30 cm around the trough area, the presence of an animal in this

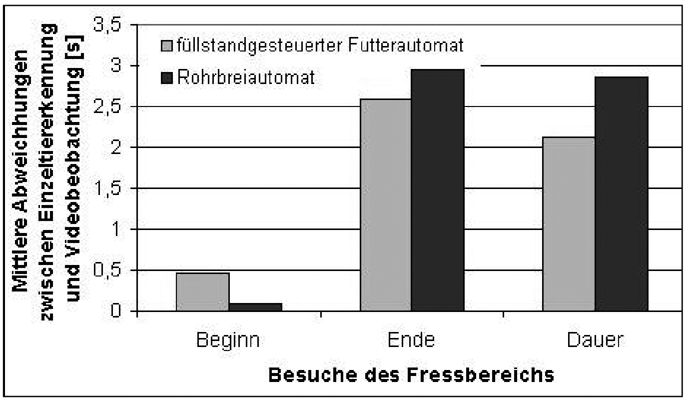

Fig. 1: Average deviation (s) of the average time lag of the visit begin, end and duration of all automatically registered visits, compared to the video observation as a function of the feeding system

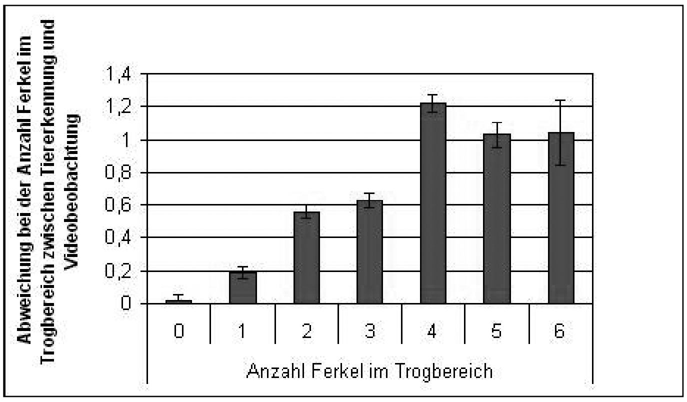

Fig. 2: Average deviation [s] between the number of piglets identified by simultaneous animal identification and video observation respectively, as a function of frequenting the trough area

area was defined as a visit to the tough. Entering and leaving the trough area were documented. In order to assess simultaneous recognition of individual animals, first of all, all individual visits to the trough area were compared with the video evaluation. Then, deviations between the recognition times for the simultaneous recognition of individual animals and video observations were calculated. At the same time, the start of the visit, the end of the visit and the duration of the visit to the trough area were evaluated.

The observation of the groups was carried out over a period of two times 30 minutes per observation day, each time in the morning and in the afternoon. At the same time, the number of animals within the range of the antenna was documented precisely to one second. For the statistical evaluation, mean minute averages were determined and compared with the value determined from video evaluation. In order to assess the influence of frequenting the trough on the precision of recognition of individual animals, seven classes of frequenting were defined (frequenting class 0: there are no animals frequenting the trough to frequenting class 6: there are six animals at the trough).

Results and discussion

The recognition rate for simultaneous recognition of 97.3% was very high. Also, the target animals were recognised at the same time as in the video recordings 33.3% of times. In 64 % of the trough visits, simultaneous recognition of individual piglets was delayed in time with reference to the video observation.

Table 1: Mean (MW) and standard deviation (SD) of the average time lag of the visit begin, end and duration of all automatically registered visits, compared to the video observation

Trough visit	n	Difference between individual animal recognition and video observation	
		MW [s]	SD [s]
Begin	1983	0.28	6.08
End	1983	2.77	7.11
Duration	1983	2.50	8.70

The start of the visit to a trough was registered by the simultaneous recognition of individual animals, on average, 0.28 s earlier than was the case with video observation (*Table 1*). Also, the duration of the visit was, on average, 2.50 s shorter on average than that determined by video recordings. There may be a number of reasons for this: the temporal delay may be explained, amongst other possibilities, by the millisecond precise registration of recognition of individual animals. The times for recognition ran synchronously to the video machine. The analysis of the videos recorded in the time-lapse mode and the transponder registration of the recognition of individual animals within 0.12 s means that it is virtually impossible to have an absolutely precise synchronisation of registration of the beginning of feeding and the end of feeding between the recognition system and video observation. Before the assignment to pens of the piglets, the HF transponders were read individually, and it was established that recognition within a radius of approx. 30 cm from the trough bowl was possible. In the analysis of the video recordings, the size of the radius based on the image perspective only corresponded to an estimate value on the part of the observer. Also, the radius of recognition, on the basis of video recordings, was made difficult when a number of animals were present at the same time at the trough.

Of the instances of simultaneous recognition of individual animals at the automatic feeders controlled by filling level, in total, 97.2% of the 1,004 observed visits were recorded in video observations, and a similar high level was achieved with automatic mash pipes at 97.3% of 1,035 observed visits. Figure 1 summarises the mean deviation in time for recognition of individual animals from the values derived from video evaluation in seconds with reference to the beginning, end and duration of the visit as a function of the feeding system.

It is clear that registration of the beginning of feeding of the target animals at the automatic pipe feeder, with a deviation of only 0.09 s, corresponds more closely with the video observation than is the case with automatic feeders controlled by filling level. This difference between the two feeding systems could be due the material properties of the storage bins, used in the automatic feeders. The storage bin for the automatic pipe feeder is made of plastic, whereas that for automatic feeder controlled by filling level is completely made of high-grade steel. According to [4], metal is an interference factor and so could have a disruptive effect on the speed of reading of the transponders, so that the transponders, on entering the recognition area of the antenna, might be subject to recognition with a delay.

The ability of the system to register groups was tested by an evaluation of the group observations. The number of piglets in the trough area had an influence on the precision of recognition of individual animals. With increased frequenting of the trough area, the precision of recognition declined (*Fig. 2*).

Simultaneous recognition of individual animals registered with frequenting class 1 was, on average, 0.19 piglets fewer than with video observation. The precision of recording of groups declined continuously up to frequency class 4. With this class, on average, 1.22 individual animals fewer were recognised than with video observation. On the one hand, the decline in precision of recognition of individual animals with increasing frequenting of the trough area might be explained by the fact that the angle of the transponder to the antenna is changed with increasing crowding at the trough in such a way that the transponders can no longer be registered by the antenna in the trough. Possibly, the communication path between the transponders and the antenna is also restricted by crowding in the trough area, as the high water content in the bodies of the piglets has a negative effect on radio transmission. When the trough area is highly frequented, the piglets also become very active in their movements. With relatively short visits to the trough or variable activity, the anti-collision system may require too much time for identification of the HF transponders, so that individual piglets may possibly not be recorded.

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