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Identification Reliability of Moving HF-transponders with Simultaneous Reading

Nowadays the transponders used for automatic animal identification can only be read individually within the reception radius. For specific applications it would be advantageous if several transponders could be read simultaneously. Therefore, the dynamic identification reliability of several HF-transponders was tested, dependent on size, number and velocity of the transponders. An almost 100 % dynamic identification reliability could be realized with all tested variants for velocities up to 2 m/s.

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Keywords

Animal identification, identification reliability, transponder, radio frequency identification

Literature

Literature references can be called up under LT 07203 via internet http://www.landwirtschaftsverlag.com/landtech/local/literatur.htm.

Radio frequency identification technology (RFID-technology) is considered as a key technology, which is continuously improved and steadily conquering new application areas. A possible new application in the area of research is the identification of several hens during their passage through a pop hole. Anyway, the operating frequency of a selected RFID-system will set certain limitations for the intended application. Thus the data transmission rate increases with higher frequencies, but the readability of transponders close to water or metal decreases with higher frequencies [1, 2]. Low frequency systems (LF-systems) are usually operated at 125 kHz or 134 kHz and show a typical maximum reading distance of 0.7 m. At present LF-systems are preferably used for access control, vehicle immobilisation and animal identification. High frequency systems (HF-systems) with a frequency of 13.56 MHz achieve maximum reading distances of 1 m and are currently implemented in access control systems, smart cards as well as in the area of logistics (monitoring of single objects). RFID-systems with ultra high frequencies (UHF-systems) operate at 860 and 930 MHz, achieve typical reading distances up to 3 m and can be used for logistic applications (pallet monitoring, baggage handling). Microwave-systems using frequency bands at 2.45 GHz respectively 5.8 GHz can still read transponders to a maximum distance of 10 m and are presently used for electronic toll systems and in the logistics sector [1, 2, 3]. So-called anti-collision-systems for a simultaneous reading of several transponders at one antenna, using one reader, can basically be used with all RFID-systems. However, when an anti-collision-system is used, the reading rate will be reduced [2]. Since for LF-systems the usual data transfer rate is less than 1 kbit/s and therefore rather low [3], with an anti-collision-system only static applications are promising. HF-systems offer sufficient reading rates for anti-collision-systems with a data transfer rate up to 25 kbit/s [3] and are therefore suited for the identification of several and also moving transponders. UHF- or microwave-systems can also be used together with an anti-collision-system, but due to their high reading distances an exact localization of the transponders is hardly possible. The aim of the study was the evaluation of the identification reliability of moving HF-transponders, to gather basic data for the development of a wide electronic pop hole for laying hens regarding the maximum passage speed and the most promising design.

Material and Method

The experiments were carried out using a test equipment allowing the movement of the transponders along an antenna with an user-defined velocity, distance and angle (*Fig. 1*). The transponders were mounted on a V-belt (20 • 6000, DIN 2215) using up to six carriers (distance between the carriers 1 m). The

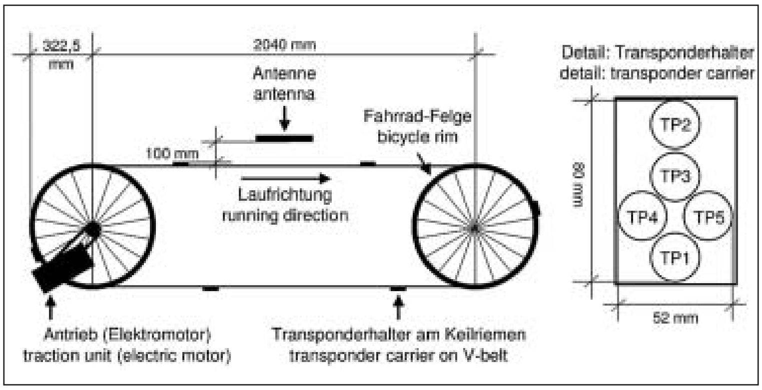

Fig. 1: Sketch of the experimental setup with arrangement of the transponders in the carrier

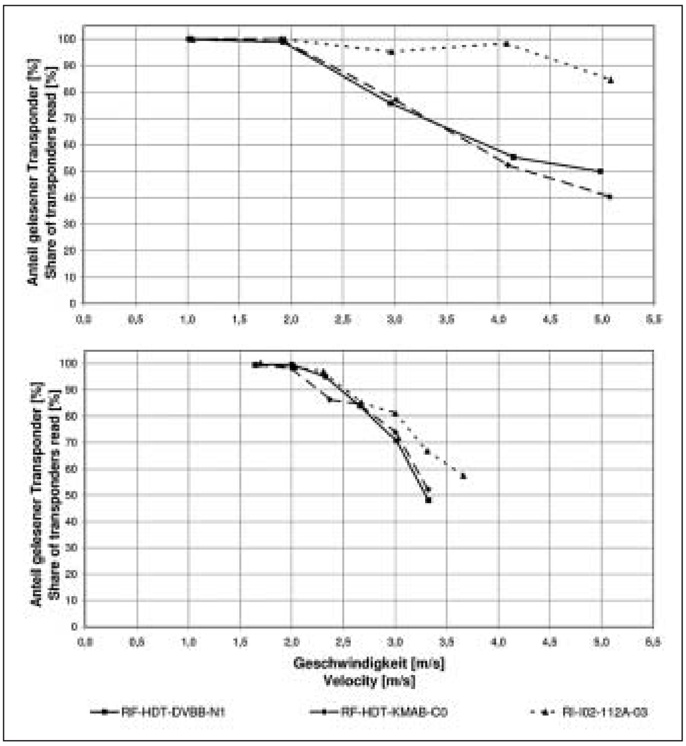

Bild 2: Anteil erkannter Transponder (oben: 1 TP / 6 m; unten 1 TP / 1 m)

Fig. 2: Share of transponders read (top: 1 TP / 6 m; bottom 1 TP / 1 m)

velocity of the V-belt was regulated infinitely variable with an electric gear motor. The test equipment was built in a way that in between the bicycle rims no metal was used. First, only one carrier with one transponder was mounted (1 TP / 6 m) and the reading frequency was measured from ~ 1 m/s to ~ 5 m/s in steps of ~ 1 m/s. Afterwards six carriers, each with one transponder, were mounted (1 TP / 1 m) and the reading frequency was measured from ~ 1.66 m/s to ~ 3.66 m/s in steps of ~ 0.33 m/s. Finally the six carriers were used with one to five transponders per carrier (1 – 5 TP / 1 m, arrangement of transponders see *Fig. 1*). Thereby reader data were collected at velocities from ~ 1.33 m/s to ~ 3.66 m/s in steps of ~ 0.33 m/s.

The following transponders (trade name with dimensions) of the manufacturer Texas Instruments with an operating frequency of 13.56 MHz were used for the investigations: RI-I02-112A-03 (45 mm • 76 mm), RF-HDT-KMAB-C0 (54 mm • 28 mm) and RF-HDT-DVBB-N1 (Ø 22 mm). According to manufacturer's instructions, depending on the reader and antenna, a simultaneous static reading of up to 50 transponders per second is possible for all transponders. The transponders used in the experiment were selected in a way that the reading time for the particular amount of transponders was at a minimum and similar for all carriers. The transponders were transported in the so-called 0° degree position (coil of the transponder antenna is parallel to the coil of the reader antenna) with a distance of 100 mm along a 300 • 300 mm antenna (ID ISC.ANT 300/300-A, manufacturer: Feig) and read from a long-range-reader (ID ISC.LR200, manufacturer: Feig) operated in the ISO-Host-Mode with a power of 4 W. For each velocity step data from the reader were evaluated for five minutes using a PC with a special software.

Results using one transponder per carrier

The experiments showed that the size of the transponder had an important impact on the reading frequency. The larger the used transponder, the higher was the reading frequency with increasing velocity (*Fig. 2, top*) For all transponders a reading frequency around 100 % could be measured until ~ 2 m/s. The reading frequency for the two smaller transponders declined below 90 % already between 2 and 3 m/s, for the larger transponder this happened between 4 and 5 m/s. When the number of transponders was increased to 1 TP / 1 m, the reading frequency for the larger transponder also decreased below 90 % between 2 and 3 m/s (*Fig. 2 bottom*). Altogether the reading frequency of the larger transponder was still above the reading frequencies of the two other transponders. Again all transponders achieved a reading frequency close to 100 % for velocities until 2 m/s. The reading frequency fell below 70 % for all transponders at velocities of more than 3 m/s.

Results using more transponders per carrier

When several transponders were inserted per carrier, all of them could be read simultaneously. For one or two transponders per carrier the reading frequency at ~ 2.33 m/s was still close to 100 %, whereas for three and more transponders it was only around 90 %. A reading frequency close to 100 % was achieved with three and more transponders only until ~ 2 m/s. At ~ 2.66 m/s the reading frequency was almost independent from the number of transponders in the carrier around 90 %. With higher velocities the graphs split again; one to two transponders per carrier were read 10 to 20 % more often than three and more transponders per carrier. The graphs for three and more transponders fell below a reading frequency of 70 % already for less than 3 m/s, whereas the graphs for one or two transponders per carrier fell below that value only for > 3 m/s.

In comparison with a LF-system, it can be noticed, that those achieve an identification reliability of 100 % for velocities until 5 m/s [2, 4, 5], but only one transponder per antenna/reader can be read at the same time.

Conclusions

HF-systems can be used for a reliable simultaneous identification of several transponders under optimized conditions concerning the reading duration respectively the transponder selection for velocities of a maximum of 2 m/s. Due to our own measurements, laying hens can run faster than 3 m/s, therefore it will be necessary to slow down the animals while passing through a wide electronic pop hole, using technical arrangements.

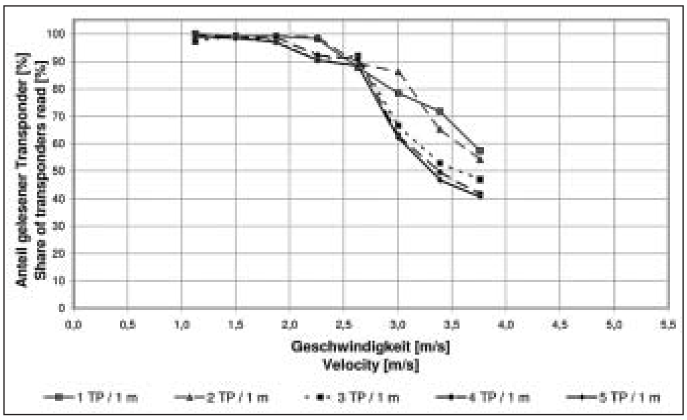

Fig. 3: Share of transponders (RF-HDT-DVBB-N1) read with 1 to 5 TP / 1 m