EU-PLF

Deliverable 1.3

Report about potential of selected technologies to measure new KIs

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Content

INTRODUCTION

Task 1.3 investigated the application of a number of PLF technologies to assess specified new Key Indicators (KIs) and their gold standards in dairy and broiler production. The work focussed on existing technologies and the further development of their application for on farm use and implementation.

More specifically, the technologies chosen for field tests in the project (CowView, eYeNamic) already provide services to farmers, and it was investigated if additional information regarding KIs could be extracted from the data produced by these systems. The data were used to investigate changes in the organisation of activities, resting patterns, and spread of animals in relation to a disturbance. Moreover, the use of data to generate early signs of diseases and other welfare disorders was investigated. The new indicators produced were compared to measurements from the Welfare Quality® protocols or to other gold standards.

Task 1.3 was designed to address specifically dairy and poultry. This report thus describes in full three (two for dairy, one for poultry) new PLF developments for the automatic assessment of KIs. Additionally, twelve more PLF technologies for poultry and pigs are described to assess animal specific KI in a list at the end of this report. For a full description on the working of these PLF technologies, the list includes a reference to a scientific publication related to the topic.

DAIRY COWS

In EU-PLF, the CowView system from GEA is used for real time positioning of dairy cows. The position of the cow is allocated to the different zone/structures in the barn (cubicles, feeders, corridors, etc.) with a precision of 0.5 m. The activity of a cow is inferred from its allocation and its movements:

- the cow is considered to be resting (standing or lying) if it is found in a cubicle,
- the cow is supposed to be feeding if it is classified within the feed bunk zone,
- the cow is supposed to be standing in the alley way if it does not move in the alley zone,
- the cow is assumed to be walking in the alley way if it moves in the alley zone.

Early warning for diseases

Biological rhythms are essential for life. While diurnal animals are more active during the day, nocturnal ones are more active at night. This pattern is species specific. There is evidence that the circadian rhythm of activity is disrupted under chronic stress. For instance, in rodents (nocturnal species), more activity is observed during the dark period and less during daylight when animals are submitted to repeated stressors or inescapable light electrical shocks (Stewart *et al.*, 1990, Solberg *et al.*, 1999). We also noticed in cattle that the circadian variations of activity were less marked two days before the occurrence of symptoms of pneumonia (Veissier *et al.*, 1989). These latter results were obtained by serendipity, during an experiment on the stabilisation of activity rhythms after the animals were turned in from pasture to indoor conditions during which an outbreak of pneumonia occurred in the course of the observations. These results were never confirmed, since they require extensive effort when based on continuous direct observations.

We investigated if we could detect a circadian rhythm of activity of dairy cows in commercial settings using a real-time positioning system and if this rhythm depends on the state of the animal.

Material and methods

Investigations in commercial farms: spontaneous events

Data were collected for five months from 3 commercial farms with, respectively, 205, 238, and 439 cows equipped with the CowView system. They consisted of hourly accumulated activities per cow as determined by the CowView system (time spent resting, standing, walking, feeding) and all events recorded by the farmer (interventions on the herd, oestrus, lameness, mastitis, accidents, calving, respiratory problems, diarrhoea,…).

To determine activity levels and their variations during the day, we need to attribute a weight to each of the four activities distinguished. Those weights were calculated according to the method proposed by Veissier et al. (Veissier *et al.*, 2001). Briefly, the weights are obtained from a factorial analysis of correspondences with hours of the day as rows and time spent in each activity by all animals as columns (variables). This analysis was run separately for the 3 farms and taking into account only days when no abnormal activity was detected (i.e. the time spent by each animal in each activity was within 95% interval confidence = no outliers). On the first axis of the analyses, the four activities obtained the following weights:

	Farm 03[1]	Farm 01	Farm 06
Resting	-0.23	-0.11	-0.15
Standing	0.07	0.11	0.13
Walking	0.12	0.10	0.11
Feeding	0.46	0.14	0.34

For each cow and each day, we then calculated its level of activity per hour. Then we calculated the average activity level (for that cow on the given day) and the size of circadian variations in activity (the standard deviation between hours). Finally, we ran an analysis of variance to relate the average activity level of a cow on a given day and its circadian variations to the events recorded by the farmer (Proc Mixed procedure of SAS for repeated measurements).

Experiment: Induction of subacute ruminal acidosis

An experiment was carried out on 28 cows at the INRA experimental facility of Marcenat (France). We induced subacute ruminal acidosis (SARA) on 14 experimental cows and compared them to 14 control cows. Control and SARA diets contained 10 and 30% starch respectively. On the experimental cows, the SARA was started after 3 weeks on the control diet (Period 1), with a transition of 1 week

[1] within the project the farms were anonymised. The same codes are used by all partners of the EU-PLF cow group

between the two diets, the SARA diet was distributed for 3 weeks (Period 2), then cows were put on the control diet again for the next 3 weeks (Period 3).

We monitored cow activities (with CowView), rumen pH (with bolus eCow), and rumen fermentative parameters (VFA, NH3, Lactic acid). As for investigations on commercial farms (see above), we calculated the activity level of each cow per day and hour. The following weights were used: -0.35 for resting, 0.31 for standing, 0.36 for walking, and 0.54 for eating. We also used Proc Mixed procedure of SAS for repeated measurements.

Results

Investigations in commercial farm: spontaneous events

On the 3 commercial farms we could detect circadian variations of activity. The activity level was low at night (from 20:00 to 22:00 until 07:00 to 09:00), and two peaks of activity were observed, around morning and evening meals.

We observed different patterns of activity when cows were about to be seen in oestrus by the farmer, affected by lameness or mastitis, or about to calve. As an illustration, on Farm 06 (Figure 1) we observed that:

- in case of oestrus, the level of activity was increased all day long the day before oestrus,
- in case of mastitis, the level of activity was increased especially at night,
- in case of calving, the level of activity was increased especially in the morning,
- in case of lameness, the average level of activity was not affected but the circadian variations were far less marked.

Table 1 summarises the results from the 3 commercial farms on the average activity level and its circadian variations in relation to these four events. The average activity level was increased in case of calving and oestrus; it was increased, stable or decreased in case of mastitis; and it was decreased or stable in case of lameness. The index 'circadian variations of activity level' seemed more sensitive (more cells are coloured on Table 1) and in all case, except 2 days before oestrus, a decrease is observed, meaning that cows have a more evenly distributed activity during the day. These changes are observed the day before the event and in some cases two days before.

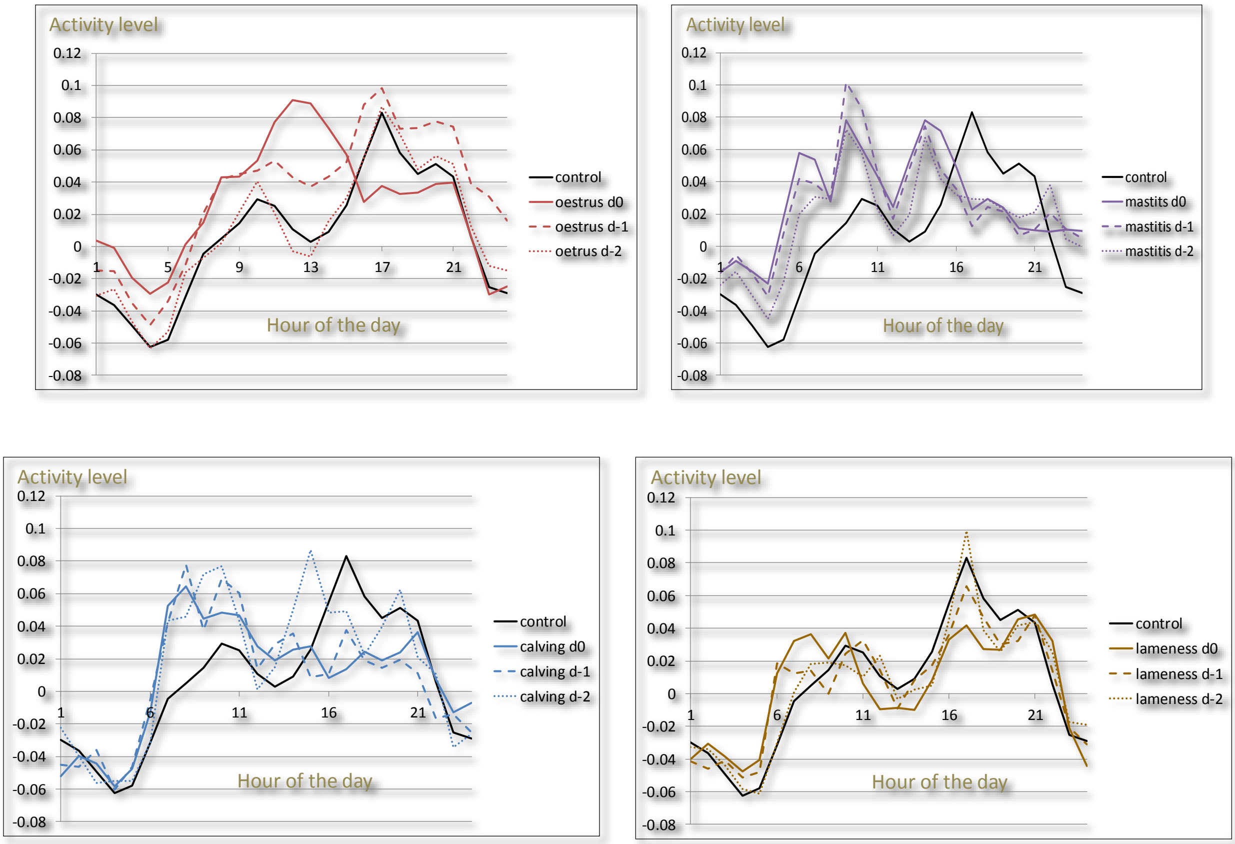

Figure 1 Changes in activity pattern in cows on the day of an event, the day before, and two days before. The data are from Farm 06. Four events are considered: oestrus, mastitis, calving, and lameness.

Table 1 Change in activity patterns of cows. For each cow on each day we calculated the average level of activity and circadian variations (standard deviation of activity level). The data from d0 (day when the farmer notices the event), one day before (-1), and two days before (-2) are compared to control days.

	Average activity level									Circadian variations								
	Farm-03			Farm-01			Farm-06			Farm 03			Farm 01			Farm 06		
Day	-2	-1	0	-2	-1	0	-2	-1	0	-2	-1	0	-2	-1	0	-2	-1	0
oestrus																		
mastitis																		
calving																		
lameness																		

increase   decrease compared to normal days. The colour intensity shows the differences between events

Experiment: Induction of subacute ruminal acidosis

The profile of Volatile Fatty Acids in the rumen confirmed that the experimental cows underwent SARA during Period 2 (significantly more propionic acid compared to control cows). During that period, we observed marked changes in behaviour: cows undergoing SARA were less active than control cows, especially after the morning meal (Figure 2) and they also spent more time licking salt.

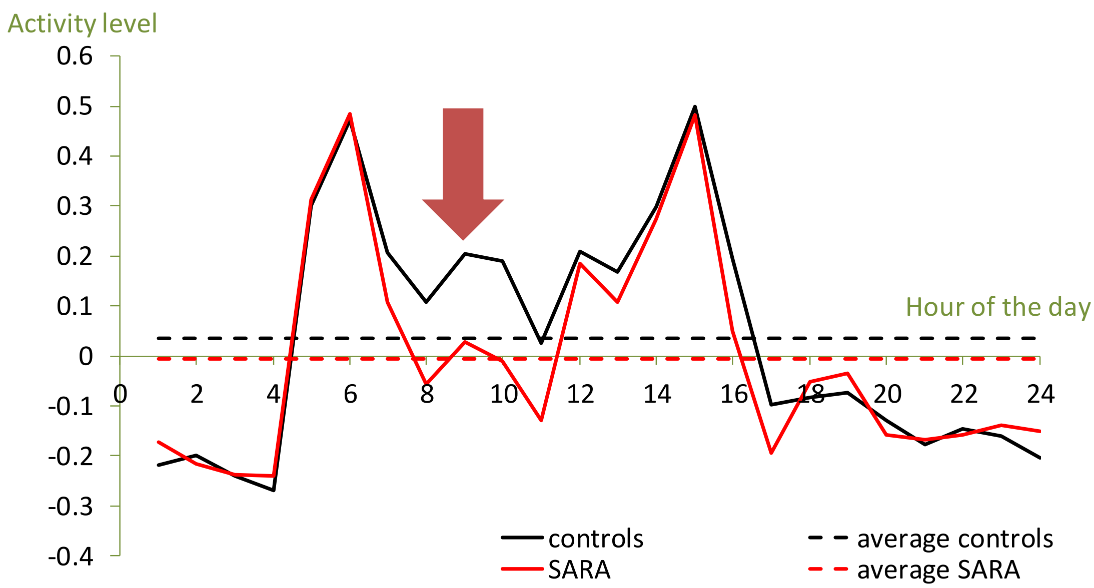

Figure 2 Activity level of cows undergoing SARA compared to control cows. The activity level is derived from data provided by CowView. Data from Period 2 are shown

Comfort around resting

The gold standard for comfort around resting is an assessment according to the Welfare Quality® protocol by a trained assessor. Briefly, in this protocol, we focused on:

- Mean time needed to lie down,
- Percentage of animals colliding with housing equipment during lying down
- Percentage of animals lying partly or completely outside the lying area.

The way these measures are done are described in details in the Welfare Quality® assessment protocol (Welfare Quality®, 2009).

Calculation of Welfare Quality® score: For each measure, we consider 3 levels from a welfare point of view: normal (no problem), moderate problem, serious problem. The limits between the categories are defined for each measure (Table 2).

Table 2 Limits between welfare categories on each measure

	Normal	Moderate problem	Serious problem
Time needed to lie down	≤ 5.20 s	5.20 s < ≤ 6.30 s	> 6.30 s
Percentage of animals lying partly or completely outside the supposed lying area	≤ 3%	3% < ≤ 5%	> 5%
Percentage of collisions with housing equipment during lying down	≤ 20%	20% < ≤ 30%	> 30%
Cleanliness: % of animals with dirty lower legs	≤ 20%	20% < ≤ 50%	> 50%
Cleanliness: % of animals with dirty udder	≤ 10%	10% < ≤ 19%	> 19%
Cleanliness: % of animals with dirty hindquarters	≤ 10%	10% < ≤ 19%	> 19%

This assessment is obviously time consuming and can therefore only be applied as a 'spot measure' i.e. with large intervals. An assessment based on continuously gathered data would provide 1) the farmer with daily information for the monitoring and management of comfort around resting and 2) a quality control scheme (and trough that the consumer) with reliable information relevant to the welfare of the cows. Thus this part of Task 3.1 focusses on the development of new KIs to assess comfort around resting.

Material and methods

Validation of the CowScout logger

The CowScout logger is a new tool (by GEA) to measure standing and lying of the cow. Together with the CowView system this would potentially generate relevant additional data in relation to the cows' comfort around resting.

Thirty cows at a farm in Sweden were fitted with CowScout loggers. To validate the CowScout loggers precision in determining lying and standing in dairy cows, the cows were also fitted with a validated commercial activity logger (IceTag).

The data from these cows (more than 1000 days in total) were then merged for analysis. The CowScout system reports standing and lying in 15 min batches and the data from the IceTag logger reports standing and lying in 1 sec interval. Therefore, the IceTag data were first summarized into 15 min interval in order to match the CowScout data. A Spearman correlation analysis was then applied to the data.

New KIs for comfort around resting based on CowView

To analyse the potential of CowView to generate relevant information regarding comfort around resting, CowView data were collected to analyse parameters of resting behaviour (bouts, time between being in the cubical etc.) and relate to the Welfare Quality® assessment of comfort around resting as described above. CowView data were gathered and Welfare Quality® assessments on four different farms in Sweden, Denmark, The Netherlands and Germany.

Results

Validation of the CowScout logger

The Spearman correlation analysis showed that lying measured with the two loggers correlated very well (Table 3). The lower (but very significant) correlation regarding steps can be explained by the fact that the CowScout logger and the IceTag logger probably records steps differently.

The CowScout logger will be further validated using visual observations of video recordings as the gold standard.

Table 3 Spearman rank correlations between data from CowScout and a validated logger (IceTag)

Variable	Correlation coefficient	P value
Lying	0.94	< 0.001
Standing	0.94	< 0.001
Steps	0.55	< 0.001

New KIs for comfort around resting based on CowView

The four farms that were assessed using the Welfare Quality® protocol showed clear differences in the quality of comfort around resting. This is relevant to test if such differences are picked up with data from CowView. Further Welfare Quality® assessments will be performed on farms in Israel and France and combined data will be used to analyse relations between parameters of resting behaviour (bouts, time between being in the cubical etc.) and the Welfare Quality® assessments of comfort around resting.

BROILERS

In EU-PLF, the eYeNamic system from Fancom is used. This system uses top view video cameras to monitor the behaviour of the broilers. Analysis software continuously translates the video images into an index for animal activity and distribution. Four cameras are installed in the broiler houses used within EU-PLF to cover the whole length of the house.

Human-animal relationship

Compared to other livestock species, broiler chickens have very little physical contact with the stockman. Notwithstanding the lack of intensive physical contact, studies have shown that the relationship between the birds and their caretaker has an effect on both productivity- and welfare parameters (Hemsworth et al. 1994, Barnett et al. 1994, Cransberg et al. 2000, Waiblinger et al. 2006). A way of assessing the quality of the human-animal relationship in a broiler flock is a combination of an avoidance distance test and a touch test, where the birds' response to an approaching human is measured. Such a test was developed and evaluated in the Welfare Quality® project which was launched in 2004 with the aim to develop standardized ways to monitor and improve animal welfare in livestock production (Blokhuis et al. 2010, www.welfarequality.net).

Performing an assessment of the human-animal relationship according to the Welfare Quality®-protocol is resource demanding, both regarding time and money. The assessor needs to be trained and travel around between livestock units, which also could be considered to be a bio-security risk. In the case of broiler chickens the assessment is performed in the end of the rearing period, which means that there is no time to improve the situation if necessary. Improvements can be made to prevent the same problem to appear in future flocks, but the harm is already done in the present flock. The usage of an automatic method, with the ability to assess the human-animal relationship continuously, would be a solution to the above mentioned problems.

The aim with the work in Task 1.3 was to evaluate the possibility to use automatic measurements of activity- and distribution, carried out using the eYeNamic-system (Fancom BV, The Netherlands), to assess human-animal relationship in commercial broiler flocks.

Materials and methods

General

The data were collected from 5 commercial broiler farms in Italy, The Netherlands, the United Kingdom and Spain. The procedure was performed three times during the production period of each flock, at the age of 3, 4 and 5 weeks. Measures of activity and distribution were automatically generated using the video based eYeNamic system. The human-animal relationship was measured using the Avoidance Distance Touch Test as the gold standard.

Testing procedure
Automatic recordings from the eYeNamic system were collected during 10 minutes before the start of the experimental procedure until 15 minutes after the assessor left the stable (see below). The system delivered data on activity and distribution of the animals with a frequency of 3 recordings per minute.

The camera used for this experiment was hanging on the ceiling close to the entrance. No disturbance was allowed in the broiler flock during this period. After 10 minutes the assessor entered the stable, walked along the long side of the stable (close to the outside wall), turned at the short side of the stable and walked in a straight line through the middle of the stable below the camera (Figure 3). After the walking through procedure, the flock was left alone without any disturbance for 15 minutes.

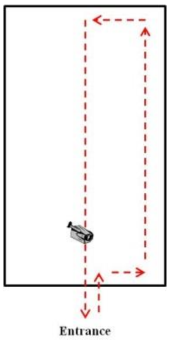

Figure 3 The procedure of walking through the broiler flock.

The Avoidance Distance Touch Test was applied by the assessor. He/she approached a group of at least 3 birds, sat down for 10 seconds and counted the number of broilers within an arm's length. The assessor then counted the number of birds that actually could be touched. This was sampled 21 times in every assessment session. See for details Welfare Quality® (2009).

Results
Figure 4 is displaying one representative example of the changes in the activity index over time during an assessment period (example is from week 3). The two striped lines indicate when the assessor entered and left the bird flock. For the period between the lines it is clearly visible that the presence of a human disturbs the flock and increases the activity of the animals. But it is also important to remember that the eYeNamic system doesn´t distinguish bird pixels from human pixels, which means that the activity index during the walking procedure includes the movement of the human. Therefore the focus to find a correlation between human-animal relationship and the activity index will be on the time before and after the presence of a human. The period from the point where the human leaves the stable until the activity decreases to the levels before the disturbance is of high interest to investigate further.

Figure 4. A representative example of activity pattern of the broilers during the experimental procedure. The striped lines indicate when the assessor entered and left the stable.

Figure 5. A representative example of the distribution index during the experimental procedure. The striped lines indicate when the assessor entered and left the stable.

A representative illustration of the distribution index during the experimental procedure is presented in Figure 5 (week 3 of age). The striped lines represent the time where the human entered and left the stable. As shown in the figure, the distribution of the broilers seems relative stable when the human is entering and walking along the long side of the building. A clear drop in the distribution index is shown at the moment when the assessor leaves the stable. This could be explained by the fact that the human is passing directly below the camera at that moment, forcing the broilers to move away. The amplitude of the drop in the distribution index at the time when the human passes below the camera is of high interest to analyze further the potential of using that measure to assess the human-animal relationship. A high decrease would indicate that the animals move away further from the human than in case of a small decrease. Such differences could be an indicator of the level of fearfulness.

Regarding the avoidance distance touch test, these preliminary results shows (Figure 6) that a low proportion of animals approached could be touched at 3 weeks and a higher proportion at 4 and 5 weeks. This could be interpreted as the human-animal relationship is improving during the rearing period, but may also be affected by the increasing size of the birds which decreases the available space to actually move away from the human.

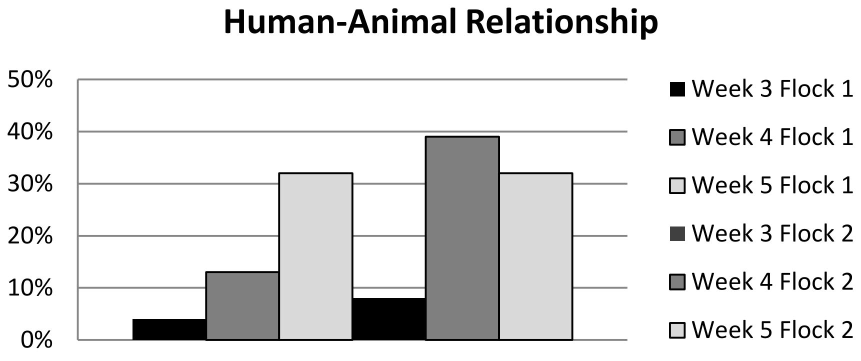

Figure 6. The proportion of animals that could be touched during the avoidance distance touch test, during three assessments and two flocks.

Similar changes over time as for the human-animal relationship can be seen in the activity index and distribution index, with less distinct responses to the walk through and less variation later in the rearing period. This could be an indicator that the automatic assessment to estimate the quality of the human-animal relationship should be carried out at an early stage for more accurate results. However, the effect of age and stocking density needs to be investigated in more detail before such conclusions can be made.

Formal analyses of data are in progress.

ADDITIONAL PLF TECHNOLOGIES

Several other PLF technologies were investigated in relation to Key Indicators. They are listed in Table 4**.** For each technology, a short description and a scientific reference are provided in case the reader wants a more detailed description of the relation between KI and PLF technology.

Table 4. Overview of other PLF technologies in relation to Key Indicators for Pig, Poultry and Calf farming

#	Animal	Key Indicator	PLF measure	Short description	Scientific reference
1	Poultry	Growth	Peak frequency sound analysis	The results explained how the frequency of the sounds emitted by the animals, were inversely proportional to the age and the weight of the broilers; specifically the more they grow, the lower the frequency of the sounds emitted by the animals is.	• FONTANA I., TULLO E., BUTTERWORTH A., AND GUARINO M. An innovative approach to predict the growth in intensive poultry farming. *Computer and electronics in agriculture.* • I. FONTANA, E. TULLO, A. PEÑA FERNÁNDEZ, D. BERCKMANS, E. KOENDERS, E. VRANKEN, J. MCKINSTRY, A. BUTTERWORTH, D. BERCKMANS, AND M. GUARINO (2015) Frequency analysis of vocalisations in relation to the growth in broiler chicken. *Precision Livestock Farming '15*, pages 174-182. • FONTANA, I., TULLO, E., BUTTERWORTH, A. and GUARINO, M. (2014). Broiler Vocalisation to Predict the Growth. *Measuring behaviour Conference. Wageningen*. The Netherlands.
2	Poultry	Foot Pad Dermatitis & Hock Burns	Activity and Distribution index THI-index	According to the results obtained, it seems that monitoring the deviations in activity and distribution patterns of bird flocks in each individual camera placed on the house can give an indication about the welfare status, obtained by on-farm assessments, of the birds on its vicinity. Deviations in the activity patterns seem	• E. TULLO, I. FONTANA, A. PEÑA FERNANDEZ, D. BERCKMANS, E. KOENDERS, E. VRANKEN, S. N. BROWN, A. BUTTERWORTH, H. GUNNINK AND M. GUARINO (2015) Risk factor for foot-pad dermatitis and hock burns in broiler chickens. Precision Livestock Farming '15, pages 792-800. • A. PEÑA FERNÁNDEZ, E. TULLO, V. EXADAKTYLOS, E. VRANKEN,

				to be correlated with hock burn lesion scores, while unexpected changes in the distribution pattern seem to have a higher impact in foot pad lesions scores, when these activity and distribution patterns are monitored at individual camera level at the house.	M. GUARINO, D. BERCKMANS (2015) Broiler activity and distribution as behaviour-based welfare indicators.Precision Livestock Farming '15, pages 208-217. • ISAH 2015 conference Analysis of behavioural patterns in broilers using camera-based technology. A. Peña Fernández, V. Exadaktylos, E. Vranken, D. Berckmans
3	Poultry	Gait Score	Number of weight measurements	In each poultry house, multiple weighing scales are installed to monitor the bird growing process. When birds hop on and off the weighing platforms, bird weight is automatically registered. Birds with gait problems will have difficulties to jump on the weighing platforms. The hypothesis was that flocks with high gait scores have low number of weight measurements.	• E. KOENDERS, L. ROOIJAKKERS, T. VAN HERTEM, E. VRANKEN, D. BERCKMANS, D. BERCKMANS (2015) Towards the development of a practical visualisation tool for farmers and other stakeholders. Precision Livestock Farming '15, pages 513-522.
4	Poultry	Emaciation	Visualisation tool	All registered data in the poultry house is collected on a web based data server. A visualisation tool is used to present these data to the farmer. Deviations of feed supply from the reference curve and low uniformity of bird weight may result in a large proportion of emaciated birds in the flock.	• E. KOENDERS, L. ROOIJAKKERS, T. VAN HERTEM, E. VRANKEN, D. BERCKMANS, D. BERCKMANS (2015) Towards the development of a practical visualisation tool for farmers and other stakeholders. Precision Livestock Farming '15, pages 513-522.
5	Poultry	Dust	Dust monitor	In one poultry house, the dust and emission levels are monitored for several flocks. This study makes a	• DEMMERS T.G.M., TONG Q., ROOIJAKKERS L., and KOENDERS E. (2015) Monitoring dust concentration in broiler

				comparison between the automated PLF measures on dust and the reference measures.	houses. Precision Livestock Farming '15, pages 525-530.
6	Poultry	Stress	Sound analysis	Broiler vocalisations convey information about their current state of health and welfare. A call density algorithm was developed. Preliminary results show that the vocalisations during the dark periods contain important information on animal stress levels.	Preliminary results presented at the Open Training Session at Fancom BV, Panningen, the Netherlands
7	Poultry	Thermal Comfort	Temperature, Relative Humidity and CO_2-monitoring in visualisation tool	Climate control is an essential part of animal production systems. An undesired climate will not only affect the production level of the flock, but also animal welfare and emissions in the house. The visualisation tool provides a continuous monitoring of the main climate variables temperature, relative humidity and CO_2-concentrations, which will allow the farmer to optimize climate control in his houses.	• E. KOENDERS, L. ROOIJAKKERS, T. VAN HERTEM, E. VRANKEN, D. BERCKMANS, D. BERCKMANS (2015) Towards the development of a practical visualisation tool for farmers and other stakeholders. Precision Livestock Farming '15, pages 513-522 • H.H. Ellen, Klimaatplatform Pluimveehouderij, www.wageningenur.nl
8	Pigs	Lung diseases	Pig cough monitor	The respiratory distress monitor enables the continuous automated measurement of porcine acoustics. Six independent cases show multiple possible applications of the monitoring of cough in fattening pigs: as a system for the early detection and control of porcine respiratory health status, as a decision making support tool	• M. HEMERYCK, D. BERCKMANS, E. VRANKEN, E. TULLO, I. FONTANA, M. GUARINO AND T. VAN WATERSCHOOT (2015) The Pig Cough Monitor in the EU-PLF project: results and multimodal data analysis in two case studies. Precision Livestock Farming '15, pages 147-155. • HEMERYCK, M. and BERCKMANS, D. (2015) Pig cough monitoring in the

				and as a means to investigate the economic impact of a disease.	EU-PLF project: first results. Precision Livestock Farming Applications. • VANDERMEULEN, J., DECRÉ, W., BERCKMANS, D., EXADAKTYLOS, V., BAHR, C., and BERCKMANS, D. (2013) The Pig Cough Monitor: from research topic to commercial product.Precision Livestock Farming 2013, pp. 717–723.
9	Pigs	Resting behaviour	% of time low activity	The eYeNamic system monitors the activity level of the group of pigs in the pen. A threshold on the activity level was defined to identify resting behaviour of the group of pigs. Resting behaviour is an important indicator of health and welfare.	• E. KOENDERS, L. ROOIJAKKERS, T. VAN HERTEM, E. VRANKEN, D. BERCKMANS, D. BERCKMANS (2015) Towards the development of a practical visualisation tool for farmers and other stakeholders. Precision Livestock Farming ’15, pages 513-522.
10	Pigs	Undesired behaviour	% of time high activity	The eYeNamic system monitors the activity level of the group of pigs in the pen. A threshold on the activity level was defined to identify high activity levels in the group of pigs. High activity might be related to aggression. Aggression results often in body wounds. Body wounds were assessed on farm by a human observer.	• E. KOENDERS, L. ROOIJAKKERS, T. VAN HERTEM, E. VRANKEN, D. BERCKMANS, D. BERCKMANS (2015) Towards the development of a practical visualisation tool for farmers and other stakeholders. Precision Livestock Farming ’15, pages 513-522.
11	Pigs	Stress	Pig scream sound analysis	Pig vocalisations convey information about their current state of health and welfare. For instance, pig screams can indicate stressful situations. A method to detect screams based on sound features with physical meaning and explicit rules was developed. The detection method showed that screams contain the following features discerning them from other sounds: a formant structure, adequate power, high	• Vandermeulen J, Bahr C, Tullo E, Fontana I, Ott S, Kashiha M, et al. (2015) Discerning Pig Screams in Production Environments. PLoS ONE, 10(4): e0123111. doi:10.1371/journal.pone.0123111 • Vandermeulen, J., Bahr, C., Tullo, E., Fontana, I., Ott, S., Kashiha, M., Guarino, M., Moons, C., Tuyttens, F., Niewold, T., Berckmans, D. (2015). Using a pig scream sound

				frequency content, sufficient variability and duration.	monitor to give an indication of the pigs'€ s impaired welfare due to feed deprivation. Proceeding of the XVII International Congress on Animal Hygiene 2015. International Congress on Animal Hygiene (ISAH). Kosice (SK), 7-11 June 2015 (pp. 66-68) University of Veterinary Medicine and Pharmacy in Kosice.
12	Calves	Lung diseases	Calf cough monitor	Early recognition of bovine respiratory disease (BRD), allows earlier treatment intervention. Initial results show that periods with increased coughing can be detected by a cough sound detection system and these correspond with BRD incidences.	• VANDERMEULEN, J., BAHR, C., TULLO, E., FONTANA., JOHNSTON, D., EARLEY, B., HEMERYCK, M., GUARINO, M., BERCKMANS, D. Use of an automated calf cough algorithm for the early detection of bovine respiratory disease. BSAS Annual Conference, 14th and 15th April 2015.

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CONCLUDING REMARKS

Dairy cows / CowView

It seems possible to distinguish the state of a cow from the organisation of its activities during the day: a diseased cow seems to be more active (at least at the very beginning of a disease) but its activity is less variable during the day. The same is observed for a cow in oestrus but to a lesser extent. Finally a lame cow seems to have a less variable activity during the day. If these results are confirmed in other settings, they offer the possibility to design models to predict physiological or pathological states of cows from real time positioning. The CowScout logger seems a reliable tool to assess standing and lying in dairy cows.

Broilers

The results so far show a potential for using the activity index and the distribution index obtained with data from the eYeNamic system to assess the human-animal relationship and foot pad lesions in broiler flocks. More data will be collected and analysed from conventional broiler farms to see if a reliable indicator to predict the human-animal relationship can be found. Sound analysis has the potential to monitor bird growth and flock stress levels. The online visualisation tool has shown that the continuous data collection can prevent thermal discomfort and emaciation of the birds through identifying early warning situations.

Pigs

The results in our studies have shown that pig cough sound analysis is a strong indicator for lung diseases in a compartment. The same principle applies for calf rearing as well. The activity index obtained from the eYeNamic system has shown its potential to monitor the resting behaviour and undesired behaviours such as aggression of pigs in a specific pen.

In conclusion, the tools which are available to monitor the position or the activity of animals offer large possibilities to detect anomalies on animals at an early stage, e.g. anomalies in terms of diseases, discomfort, or fearfulness. There is thus a great potential that they help detect and solve welfare problems.

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