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# METHODOLOGY DESCRIPTION OF A REAL-ENVIRONMENT COMMERCIAL FARM TO ANALYSE CATTLE VOCALISATIONS

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## ABSTRACT

Animal welfare is an essential concern for our society. Now, various studies show that animal welfare also has an impact on the growth and the reproductive potential of animals, as well as on their productivity. The vocalizations of the cows can be used to infer their well-being, and they can be measured in real-time with acoustic sensors, which have a moderate cost and are connected to the cloud. This article details different test pilots in dairy cattle farms, with the goal of observing cow's vocalizations in various situations: i) labor ii) cow herding, and iii) early detection of respiratory illnesses. The approaches to be carried out are different depending on the herds and the type of cows monitored. This article describes the elements to be considered for a good preliminary deployment of the technology, which will allow the capture of data and recordings in pilot studies. The aim of this work is to provide a good estimation of what a permanent installation should look like for an automatic and continuous detection of well-being through the cow's vocalizations.

## 1. INTRODUCTION

Dairy cattle present higher production shares in terms of livestock environments in Europe, and animal welfare has become a crucial concern for this industry. All research around the welfare of cows, and what may affect their growth and reproduction, and their production of milk, is deeply analyzed [1]. Nowadays it is also a matter of social awareness, which is growing fast, demanding transparency and better animal welfare [2].

Animal-based products will increase their demand in the following years [3], and the possibility of meeting the demands will be challenged by the high-quality standards required in Europe. The study of animal welfare impacts both production and consumer acceptance of the products [4]; many studies show that animal welfare issues cause a stress response, reducing the efficiency in transforming feed into food products, and making them more susceptible to diseases [5]. If animal welfare could be monitored continuously, corrective measures could be implemented as soon as problems are detected, improving the chance of recovery, and ultimately elevating the efficiency of the system. Moreover, vocalizations in cows can be a useful indicator of the onset of calving and potential calving

difficulties, as well as an indicator of the welfare in the dry-off period (cessation of milking).

In this paper, we show an interdisciplinary methodology between acoustic engineers and veterinaries that can be implemented in commercial cattle farms to continuously monitor cattle welfare. The measurements on the farm are done with the following methodology. The final goal is the recording of raw acoustic audio of cow vocalisations – environmental noise or individual vocalisations.

## 2. FARM MEASUREMENT APPROACH

In this section we will describe the two different types of sound monitoring in the farms.

### 2.1 Environmental data gathering

The first measurement approach corresponds to the environmental recordings. This system consists of a professional handheld recorder (zoom H5 [6]) sampling at 44,100 Hz and 16 bits resolution connected to a directional microphone Behringer ultravoice XM1800S [7] hanging from the roof in the calving cow beds. And raw recording data was continuously collected for 5 days (Figure 1).



**Figure 1 – Acoustical deployment sensor in farm (left), just above a light box, the recording box (right).**

### 2.2 Individual data gathering

The second measurement approach pretends to gather vocalizations from a specific individual cow. A recording system integrated with the collar has been designed. The core of the design was a recorder SOROKA 15E [8] that allows recording uncompressed PCM audio at a different sampling rate and resolutions and allows us to work afterwards in the signal processing related to the cows. The recorder is elastically suspended inside a collar through a 3D-printed structure specially designed for this purpose (see Fig. 2).



**Figure 2: The collar with the small recorder suspended inside, to record individual vocalizations during the drying-off.**

## 3. STRUCTURE OF THE DATA RECORDING CAMPAIGNS

To collect raw cow vocalization on the farm without distorting the farmer's management routine, we have deployed an acoustic system on 3 different farms around Barcelona (Spain). In Santa Cristina farm we are monitoring dry-off period cows and coughs in calves, in Llambilles farm we monitor coughs in calves and calving cows, and in Titaguas we monitor coughs in calves. In the past we recorded dry-off cows and calving cows in Malla, and we are now working on the acoustic signal processing of these signals.

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In this section, we detail the focus of each of the analysis, and where are they being monitored.

### 3.1 Recording of vocalizations during calving

The dataset gathered sums up to 135 hours and 30 minutes of calving cows, having recorded the vocalizations of several deliveries indicated by the farmer. In this case, the data of the recordings come from a dairy cattle farm in Malla (Barcelona). Vocalizations in cows can be a useful indicator of the onset of calving and potential calving difficulties. It's important for farmers and veterinarians to monitor cows closely during the calving process, as prompt intervention can greatly reduce the risk of health problems for the cow and increase the chances of survival for the calf.

The recording of the dry-off period (cessation of milking) finished with a total of 100 hours of environmental acoustic recordings of the drying-off cows' site, also in Malla. Moreover, a total of 56 hours and 29 minutes were recorded from one of the three cows using the collar. Vocalizations can be linked with pain due to udder engorgement after abrupt drying and/or stress due to changes in pen mates and diet. It's important for farmers and veterinarians to be aware of these potential sources of pain and stress in cows and to take steps to minimize them whenever possible.

Nowadays, we are monitoring and recording this type of vocalizations in Santa Cristina and Llambilles farms.

### 3.2 Recording of regular lactating cows

The project also considers the recording of regular lactating cows, in order to have raw acoustic audio coming from cows in a real-farm environment, without any illness or specific period – dry-off, etc. We collected data during 200 hours and 56 minutes, which were used as the reference of baseline vocalizations, also on the farm in Malla. Vocalizations can be linked with stress due to social competition. By addressing these sources of stress, farmers, and veterinarians can help to ensure the health and well-being of their cows.

This stage of monitoring and recordings, one of the outputs for the research team is the knowledge of the farm everyday sounds, and its impact on cows' everyday life and lactating process, together with the gathering of these data together with the production data collected by the farmer.

### 3.3 Recording of dry-off period for cows

The dry-off period was monitored and is nowadays being studied in the Malla farm, being one of the most specific analyses since we monitored environmental noise but also individual vocalizations by means of recorders in the collars of the cows. The dry-off period is nowadays being monitored in Santa Cristina farm.

### 3.4 Recording of calves' coughs

Prompt detection of coughing in calves is crucial for early intervention and effective treatment of respiratory problems. Several groups of calves are being recorded and monitored in the two farms where we have sensors deployed nowadays.

## 4. CONCLUSIONS

In the running project (named CowTalkPro - Development of a Sound Sensor in cows to evaluate animal health and well-being), we are monitoring cows and calves from three different farms, looking for problems in calvings, for welfare in dry-off and for early-stage cough diagnose.

Our final goal is to find and detect specific vocalizations that can be associated with the physiological status of dairy cows, as well as vocalizations that might facilitate the understanding of cows during the dry-off, in order ot improve their welfare. In this sense, our goal is to support the farmers in order to anticipate actions to maintain the welfare and health of the animals in the farm based on their vocalizations.

## ACKNOWLEDGMENTS

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