Interoperable Pig Health Tracking

S. Dasen, P. Liechti, V. Schaffter, P. Theurillat, P. Renevey, C. Moufawad El Achkar, A. Moreira De Sousa, M. Frosio, R. Delgado-Gonzalo, C. Verjus

Livestock farming is a competitive world. While the herd sizes are increasing, it is ever challenging to keep the farm profitable. The FITPIG project aims at improving pig production by reducing piglet mortality, decreasing the use of preventive medicine, and enhancing animal welfare. In the context of the Internet of Food & Farm 2020 (IoF2020), a heartrate monitoring sensor has been developed to help farmers keep up with the health status of their herd.

In most sectors of livestock production, the role of digitalization is growing quickly. Pig production has not always been a frontrunner in this process. Yet, there are plenty of opportunities. The use of a heartrate sensor can help farmers support decisions in the farrowing process, determine when a sow is in heat, and signal health issues.

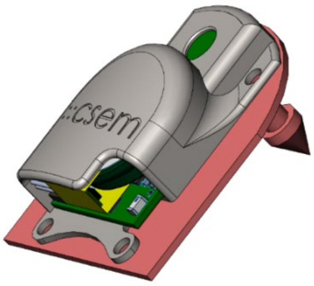

Figure1: FITPIG embedded heartrate monitoring ear tag sensor.

CSEM, certified ISO 13485 for medical device development, has a long experience in wearable photoplethysmography (PPG) sensors on humans to monitor health parameters such as heartrate (HR), breath rate, blood pressure, etc. This technology has been brought in the field of animal monitoring with an embedded sensor integrated into a commercial off-the-shelf identification ear tag for pigs (Figure 1).

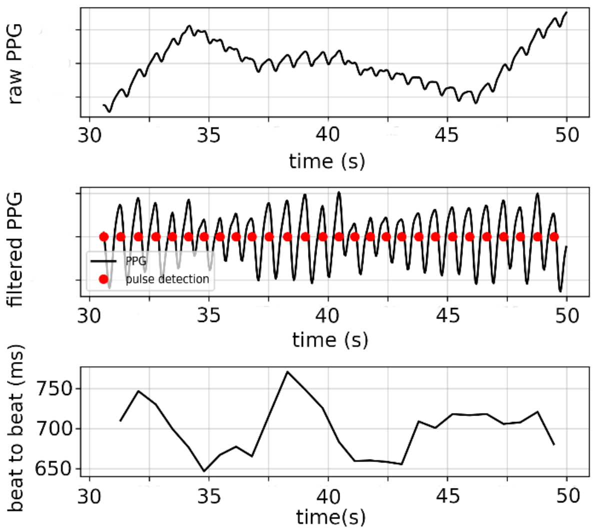

Figure 2: Raw PPG signal (top), filtered signal with pulse detection (middle) and beat-to-beat intervals (bottom).

Two optical bridges (each consisting in a 850 nm near infrared emitter and photodiode receiver) permit to detect beat-to-beat intervals that allow HR calculation (Figure 2). A 3-axis accelerometer is used to control when the PPG acquisition is suitable, to detect motion corrupted segments, and to monitor the daily level of activity of the animal.

PPG also allows the monitoring of breath rate when the animal is still. Figure 3 illustrates a case where a pig has been sedated. It is lying and breathing heavily with small head movements. The respiration component of the signal can be observed.

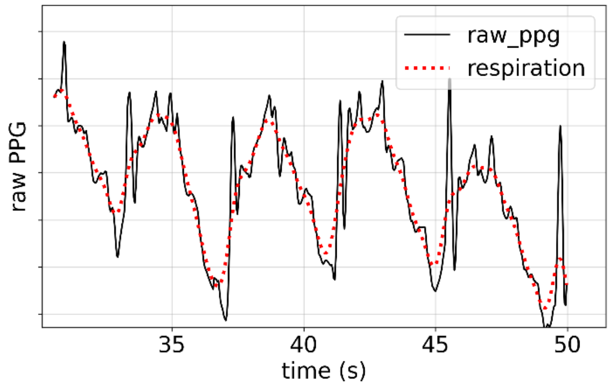

Figure 3: PPG signal from a sedated pig in hyperventilation.

This solution has been deployed first in a farm in Slöv, Sweden (Figure 4). The processed data is collected by a gateway over Bluetooth Low Energy (BLE) and then centralized on the cloud where it is post-processed to identify animals needing a closer attention. As an increase in resting HR is an indicator of fever, an end-user interface allows the farmer and the veterinarian to follow the health of the herd. This technology can also be used for other livestock mammals (e.g., cow, calf, sheep).

Figure 4: Nursing sow equipped with a FITPIG sensor.

FITPIG has demonstrated the feasibility of monitoring HR on a pig using a PPG sensor. Further developments would need an optimization of the power management to remove the heavy and expensive lithium-ion battery.

This project is a use case financed by IoF2020 [1] in the context of the meat trial work package. IoF2020 has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement no. 731884. CSEM also would like to thank Catherine Ollagnier and Guy Maikoff, from Agroscope - the Swiss centre of excellence for agricultural research, for her help and support.

[1] https://www.iof2020.eu/