

New homogenisation strategies in pig production based on the use of liquid feed and incorporating computer vision tools and neural networks for weight control and monitoring

Summary

The main challenge this project addresses is achieving homogenisation in pig production, based on parameters related to daily weight gain (DWG) and feed conversion (FCR). Both parameters depend on numerous factors, including: genetics, quality/quantity of feed; quality/quantity of water consumed; rearing conditions.

Overcoming these challenges will increase the competitiveness of producers, improve the performance of production lines and, as a result, produce a higher quality end product.

The pork industry is very important in Catalonia. According to the Statistical Institute of Catalonia, the pork industry, with around 6,500,000 head of livestock, more than there is cattle, is second only to poultry. Most pigs are fattening pigs which is why this framework was chosen to experiment with smart farming techniques. Pigs are reared on fattening farms. Pig fattening lasts about 4 months. The final weight of the pigs is 110-120 kg at which point they are taken to the slaughterhouse. This project studies various aspects of pig fattening and a set of sensors (cameras) has been installed both on the farm and in the slaughterhouse to obtain data to help evaluate, monitor and improve the process.

A major factor in the pig fattening process is the feed. The classic way of feeding pigs is with pellet feed. However, there are a number of trends towards testing other types of feed, such as liquid feed, which is easier for the animals to digest. A number of initiatives are even considering introducing this type of feed on farms. Therefore, defining a project involving the main stakeholders in the process of farming pigs for meat consumption was considered worthwhile. The cluster developing the project consisted of:

- CATALANA DE PINSOS, SA
- Matadero Frigorífico del Cardoner, SA (MAFRICA)
- Setna
- Computer Vision Centre (CVC)
- Garage Lab (project coordinators)

Objectives

The main objective of the project addressing this challenge focused on improving the yield from pork production using new feeding strategies to monitor growth and fattening curves and ensure regular and homogeneous production, while also incorporating state-of-the-art artificial intelligence technologies, such as computer vision and new deep learning methodologies.

The specific objectives are:

1. Homogenisation of animal growth in the pens.
2. Automation of feeding processes and adaptation to the animals' needs.
3. Homogenisation of the weights of animals entering the slaughterhouse.
4. Integration of data on feeding, genetics, growth and production.

Description of the actions carried out in the project

In the first experiment, 25 fattening pigs were selected at the "La Roquera" farm and their growth during their life cycle was recorded. After these tests, a more definitive set-up was installed at an experimental

farm. A camera was mounted on the scales included in a circuit. To eat, pigs have to pass through the scales, at which point their weight is recorded and an image is taken. This creates a dataset to train a neural network.

Tests with liquid feed were carried out on the same experimental farm. The experimental farms are connected to a place called “the kitchen”, a warehouse where the new feed formulas are prepared. A computer system is used to control and dose the feed that arrives at each farm.

Initial experiments were also carried out in Mafrica to define camera locations and determine the type of cameras used. Once the cameras were installed, datasets were made for unloading the pigs from trucks. Photos were taken with both a thermal and an RGB camera to track the pigs and estimate the soiling levels of the animals.

Final results and practical recommendations

Experiments carried out on a set of 25 animals showed the utility of a system for estimating pig weight by volume. It was concluded that a more complete dataset should be generated to improve the accuracy of the model, hence a circuit was set up to obtain these data (weight and volume) more frequently and automatically.

On the farm, a system of feeding pigs with fermented feed has been set up. The conclusion was that this feeding system has certain advantages, such as improving daily animal growth and their digestion (in particular, reducing the frequency and severity of diarrhoea). Liquid feed waste was also found to be lower than that of normal feed.

The image dataset taken at the Mafrica facility shows that animals can be tracked with a thermal camera under normal conditions. The system produces errors such as when a pig hides its head for too long or if an animal moves too fast. The soiling level estimation system works well but could be improved by incorporating a mechanism to control lighting in the corridor the pigs pass through on the way to the stalls.

Conclusions

The set-up at the “La Roquera” experimental farm showed that a 3D camera can be used to obtain an approximation of the volume of part of a pig, which can then be used to estimate the total weight of the animal.

The liquid feeding system installed at the “La Roquera” experimental farm showed that this type of feed has advantages over pellet-only feeding.

The cameras mounted in Mafrica and the datasets created with them made it possible to implement both a system to track the pigs and one to estimate the soiling levels of pigs arriving at the slaughterhouse.

Leader of the Operational Group

ORGANISATION: CATALANA DE PINSOS, SA

CONTACT E-MAIL: gerencia@catpinsos.com

Coordinator of the Operational Group

ORGANISATION: GARAGE LAB

CONTACT E-MAIL: jordina.arcal@garagelab.cat

Other members of the Operational Group (grant recipients)

ORGANISATION: MATADERO FRIGORÍFICO DEL CARDONER, SA

CONTACT E-MAIL: jordi.marti@mafrica.es

ORGANISATION: SETNA NUTRICIÓN, SAU

CONTACT E-MAIL: joangrau@adm.com

Other members of the Operational Group (not recipients of the grant)

ORGANISATION: Autonomous University of Barcelona

CONTACT E-MAIL: lgranena@cvc.uab.cat

Subject area(s) of application

- Agricultural production system
- Agricultural practice
- Agricultural equipment and machinery
- Livestock farming and animal welfare
- Vegetable production and horticulture
- Landscape / Territorial management
- Pest and disease control
- Fertilisation and nutrient management
- Soil management
- Genetic resources
- Forestry
- Water management
- Climate and Climate Change
- Energy management
- Waste and by-product management
- Biodiversity and environmental management
- Food quality/processing and nutrition
- Supply chain, marketing and consumption
- Competitiveness and agricultural and forestry diversification
- General

Geographical area(s) of application

PROVINCE(S)	REGION(S)
Barcelona	Berguedà, Bages

Dissemination of the project (publications, conferences, multimedia, etc.)

ACCIÓ contacted the Computer Vision Centre because their study on Industry 4.0 and its impact in Catalonia required examples of projects that encompass Industry 4.0. Eventually, they decided to include the use case of the "la Roquera" experimental farm in the study, in conjunction with the IDOM company. The study was presented on Wednesday 7 April 2021 titled "La presentació de les capacitats de l'ecosistema de la Indústria 4.0 a Catalunya" (Presentation of the capabilities of the Industry 4.0 ecosystem in Catalonia).

The AI for Industry (International Congress) organised by Secpho, the Photonics cluster, was held on 29 April 2021. The Vision Centre showed the demo made at the Mafrica facilities: www.cvc.uab.es/portfolio

On 15 October 2020, the project was presented at the Pioneering Fields and Applications (Strong AI) session at the Eurecat Big Data Congress.

On 3 March 2020, the Vision Centre participated in the session “Capacitats 4.0 per a l’empresa a Catalunya [Innovació KM 0]” (Capabilities 4.0 for business in Catalonia [Innovation KM 0]) at the Advanced Factories Fair with Jordi Rebollo.

SETNA participated in the XL Anaporc Congress held on 18-19 September 2019 in Salamanca and took a roll-up of the project.

Project website

<https://www.mafrica.com/noticia6.html>

More information on the project

PROJECT DATES	TOTAL BUDGET
Start date (month-year): June 2018	Total budget: €211,957.60
Completion date (month-year): September 2020 with extension: 28/5/2021	DACC funding: €86,622.67
Current status: Executed	EU funding: €65,346.93
	Own funding: €59,988.00

With funding from:

Project funded through Operation 16.01.01 (Cooperation for Innovation) through the Catalan Rural Development Programme 2014-2020.

Order ARP/133/2017 of 21 June, approving the regulatory bases for grants for cooperation for innovation by promoting the creation of European Association for Innovation operational groups in the areas of agricultural productivity and sustainability and the execution of innovative pilot projects by those groups, and Resolution ARP/1868/2017, of 20 July, announcing the call for the grant.

