Invitation

You are cordially invited to the public defense to obtain the academic degree of

DOCTOR OF BUSINESS ECONOMICS

by Arno Liseune

Using deep learning for animal monitoring to improve animal welfare in dairy cattle

Supervisors:
Prof. dr. Dirk Van den Poel & Prof. dr. Miel Hostens

Thursday, 25 May 2022 at 17h
Faculty Board Room, Tweekerkenstraat 2, 9000 Ghent
Please confirm your attendance no later than 16 May by email to
Arno.Liseune@UGent.be

EXAMINATION BOARD

Prof. dr. Patrick Van Kenhove
Dean of the Faculty of Economics and Business Administration
Ghent University

Prof. dr. Dirk Van den Poel
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Prof. dr. Miel Hostens
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Wageningen University & Research

Abstract

Moving towards a more sustainable agriculture is becoming quintessential in today's world as it is characterized by an increasing population growth, global warming and an immense use of natural resources. Precision Livestock Farming (PLF) technologies have been proposed to catalyze this transition as it allows to vigorously monitor every aspect of the food chain. Yet, as these technologies rapidly advance, the data collected on dairy farms becomes increasingly more complex. This dissertation bridges the gap between novel research and practical applications of animal monitoring systems based on complex PLF data. The study provides the dairy industry with new insights on how to develop accurate monitoring systems in their complex data landscape. More specifically, we uncovered how deep learning algorithms can be applied to build milk prediction and calving prediction systems suitable for practical applications.

In study 1, a deep learning framework is developed to infer all missing milk yields along the lactation curve of a dairy cow. We investigate whether milk yield can be accurately inferred by using all the observed information in the lactation cycle, regardless of the amount of data, the recording time of the data and the time interval between the data. Results show that this framework can be used to accurately interpolate as well as predict missing milk yields. In addition, we find that adding information on herd, parity and health and reproduction events improve the predictions. The framework facilitates animal monitoring as it allows to rapidly detect unexpected milk losses and therefore diseases and to assess the impact of health and reproduction events on the cow's productivity.

In study 2, we propose a framework that predicts the entire milk yield curve of the subsequent lactation cycle. The milk yield curve is generated by using all the observed information in the preceding cycle, including milk, parity, herd and health information. This forecasting methodology allows farmers to compare a cow's actual and expected milk yield over the entire course of the lactation cycle which facilitates animal monitoring in early lactation.

In study 3, we present a deep learning model that predicts the moment of calving. We analyze whether sensor data on behavioral activities such as eating, ruminating, lying and standing can be used to automatically detect the moment of parturition. Furthermore, we investigate whether smart imputation strategies can be used to make calving prediction models suitable for practical applications. The proposed methodology allows farmers to provide timely assistance and optimize their calving management.

Curriculum vitae

Arno Liseune is finalizing his PhD at the Department of Marketing, Innovation and Organization (research group Data Analytics) at Ghent University. His research focuses on applying deep learning algorithms for animal monitoring to improve animal welfare in the dairy industry. Three chapters of his dissertation were published in peer-reviewed journals: Computers and Electronics in Agriculture. Arno presented his research at several international conferences, including the INFORMS annual meeting (Seattle, 2019), INFORMS annual meeting (Washington, 2020) and ICAR Annual Conference (Leeuwarden, 2021).