



ELSEVIER



NEWS RELEASE FOR IMMEDIATE RELEASE

Media contact:

Brittany Morstatter

+1-217-356-3182 ext. 143

ARPAS@assochq.org

Using unsupervised machine learning to uncover livestock behavior patterns from precision livestock farming data streams

The benefits to using open-ended, model-free approaches to data analysis are detailed in a recent invited review in Applied Animal Science

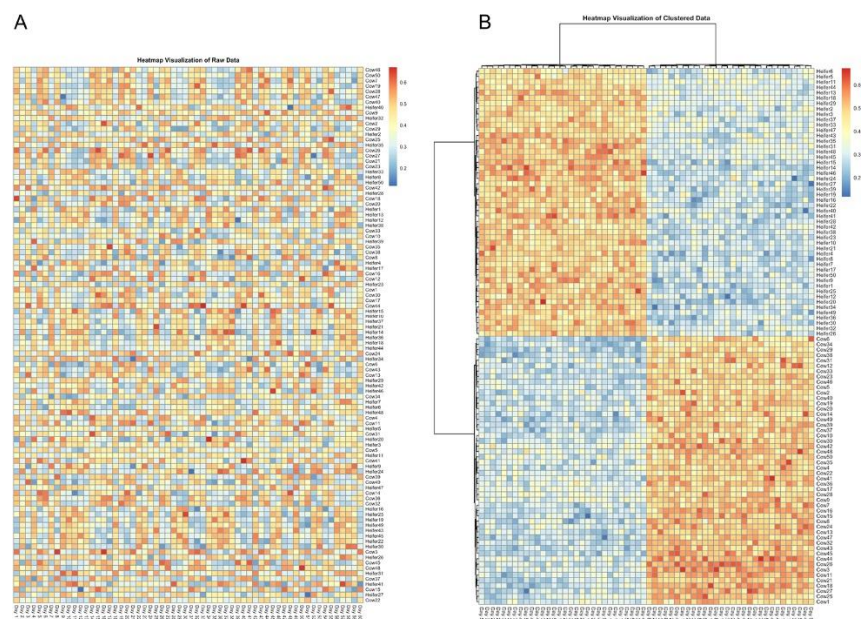
Champaign, IL, April 10, 2023—More and more farms are adopting precision livestock farming (PLF) technologies, which generate data that can be analyzed to make farm-management decisions. Approaches to large-scale data analysis, such as use of machine learning, have become the focus of much animal-science research. “Artificial Intelligence and Machine Learning in Dairy Production Systems” was the title of the American Registry of Professional Animal Scientists symposium held in June 2022 at the annual meeting in Kansas City, Missouri.

A new [invited review](#) in [Applied Animal Science](#) resulted from a presentation that was given at this symposium and investigates the use of unsupervised machine learning in livestock behavior. “This invited review explores the use of model-free approaches for data analysis for PLF systems compared with more traditional model-dependent approaches and explores the potential advantages of more open-ended machine-learning approaches,” said David K. Beede, PhD, Editor in Chief of *Applied Animal Science*.

“Unsupervised machine learning (UML) may provide animal scientists an alternative approach to extracting behavioral patterns from PLF data streams that is better suited to large and complexly structured data sets,” said Catie McVey, PhD (University of California, Davis, CA, USA). The article demonstrates how UML differs from standard statistical methods by presenting three case studies that use simulated data and an empirical study done in a commercial organic dairy.

The first of the case studies demonstrates how easily information can be lost when a simple error produces data that do not match what they are assumed to represent. The authors point out that using a data compression strategy on such data results in loss of information. Linear models are vulnerable to this type of information loss when there are such errors or when the system that gave rise to the data is not fully understood, as is discussed in the second case study. The authors go on to describe several model-free approaches to information compression: supervised and unsupervised machine learning, neural networks, spectral embedding, K-means clustering, and hierarchical clustering. The scientists

outline how these sorts of approaches are able to compress data taken from the chaos and complexity of a farm environment and reveal information that can be hidden or lost with model-based approaches. McVey added, “This simulated case study is then extended to demonstrate how model-based approaches can also overlook causes of compromised welfare when the link between environmental factors and behavioral responses is strong but nonlinear, whereas model-free information-theoretic tools can easily recover and characterize such complex dynamics.”



Caption: This heatmap visualizes data about cow lying time, with day on the x-axis and cow on the y-axis. On the left is the raw data, and no pattern can be observed. By using a model-free approach, hierarchical clustering, to analyze the data and rearrange the rows and columns, a clear pattern can be observed on the right, even without having data on any of the driving factors behind this dynamic. (Credit: Catie McVey).

In addition to using simulated case studies to demonstrate the benefits of using a more open-ended, model-free approach to information discovery, the scientists also analyzed data from the milking parlor in an actual commercial dairy using the [Livestock Informatics Toolkit](#) (LIT). The article describes how the model-free analytics in the toolkit are used to find information on cow queuing behavior patterns that might be difficult to discover with model-based approaches. The algorithms used in this case study have been made available open-source by the authors as a fully documented R package and can be easily downloaded via GITHUB. McVey is also currently pursuing a startup DairyFIT to put these analytical tools directly into the hands of farmers.

“Unsupervised machine learning tools can play a role in helping to develop the most holistic and robust metrics possible from incredibly rich but still poorly characterized noisy PLF data streams,” said McVey.

The article appears in the April issue of *Applied Animal Science*.

Notes for editors

“Invited Review: Applications of unsupervised machine learning in livestock behavior: Case studies in recovering unanticipated behavioral patterns from precision livestock farming data streams,” by C. McVey, F. Hsieh, D. Manriquez, P. Pinedo, and K. Horback (<https://doi.org/10.15232/aas.2022-02335>), *Applied Animal Science*, volume 39, issue 2 (April 2023), published by FASS Inc. and Elsevier.

This article is openly available at <https://doi.org/10.15232/aas.2022-02335>.

Full text of the article is also available to credentialed journalists upon request; contact Brittany Morstatter at +1-217-356-3182 ext. 143 or ARPAS@assoqh.org to obtain copies. To schedule an interview with the author(s), please contact Kristina Horback at kmhorback@ucdavis.edu.

About *Applied Animal Science*

Applied Animal Science (AAS) is a peer-reviewed scientific journal and the official publication of the American Registry of Professional Animal Scientists (ARPAS). In continuous publication since 1985, AAS is a leading outlet for animal science research and is indexed by Scopus and ESCI (Clarivate’s Emerging Sources Citation Index). The journal welcomes novel manuscripts on applied technology, reviews on the use or application of research-based information on animal agriculture, commentaries on contemporary issues, short communications, and technical notes. Topics that will be considered for publication include (but are not limited to) feed science, farm animal management and production, dairy science, meat science, animal nutrition, reproduction, animal physiology and behavior, disease control and prevention, microbiology, agricultural economics, and environmental issues related to agriculture. Themed special issues also will be considered for publication. www.appliedanimalscience.org

About the American Registry of Professional Animal Scientists (ARPAS)

The American Registry of Professional Animal Scientists (ARPAS) is the organization that provides certification of animal scientists through examination, continuing education, and commitment to a code of ethics. Continual improvement of individual members is catalyzed through publications (including the AAS journal) and by providing information on educational opportunities. ARPAS is affiliated with five professional societies: American Dairy Science Association, American Meat Science Association, American Society of Animal Science, Equine Science Society, and Poultry Science Association. www.arpas.org

About FASS Inc.

Since 1998, FASS has provided shared management services to not-for-profit scientific organizations. With combined membership rosters of more than 10,000 professionals in animal agriculture and other sciences, FASS offers clients services in accounting, membership management, convention and meeting planning, information technology, and scientific publication support. The FASS publications department provides journal management, peer-review support, copyediting, and composition for this journal; the staff includes several BELS-certified (www.bels.org) technical editors and experienced composition staff. www.fass.org

About Elsevier

As a global leader in information and analytics, [Elsevier](https://www.elsevier.com) helps researchers and healthcare professionals advance science and improve health outcomes for the benefit of society. We do this by facilitating insights and critical decision-making for customers across the global research and health ecosystems.

In everything we publish, we uphold the highest standards of quality and integrity. We bring that same rigor to our information analytics solutions for researchers, health professionals, institutions and funders.

Elsevier employs 8,700 people worldwide. We have supported the work of our research and health partners for more than 140 years. Growing from our roots in publishing, we offer knowledge and valuable analytics that help our users make breakthroughs and drive societal progress. Digital solutions such as [ScienceDirect](#), [Scopus](#), [SciVal](#), [ClinicalKey](#) and [Sherpath](#) support strategic [research management](#), [R&D performance](#), [clinical decision support](#), and [health education](#). Researchers and healthcare professionals rely on over 2,800 digitized journals, including [The Lancet](#) and [Cell](#); our 46,000+ eBook titles; and our iconic reference works, such as *Gray's Anatomy*. With the [Elsevier Foundation](#) and our external [Inclusion & Diversity Advisory Board](#), we work in partnership with diverse stakeholders to advance [inclusion and diversity](#) in science, research and healthcare in developing countries and around the world.

Elsevier is part of [RELX](#), a global provider of information-based analytics and decision tools for professional and business customers. www.elsevier.com