Book of Abstracts

of the 1st EAAP Conference on Artificial Intelligence 4 Animal Science

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Zurich - Switzerland
4-6 June, 2025

Welcome to the Artificial Intelligence 4 Animal Science Conference, Zurich, 4-6 June 2025

On behalf of the Organizing Committee, we are pleased to invite you to the Artificial Intelligence 4 Animal Science Conference, taking place from June 4th to 6th, 2025, in Zurich, Switzerland. This event will bring together scientists, researchers, and industry professionals from around the world to explore the transformative role of artificial intelligence (AI) in animal science, covering areas such as precision livestock farming, behavior monitoring, disease prevention, and decision-support systems.

The integration of AI in animal science is evolving rapidly, requiring an interdisciplinary approach that combines expertise in engineering, data science, computer science, biology, and animal science. The aim of this conference is to foster collaboration across disciplines, presenting cutting-edge research, innovative applications, and AI-driven solutions that enhance productivity, sustainability, and animal welfare.

The event is organized in collaboration with leading research institutions and industry stakeholders, ensuring a dynamic exchange of knowledge and expertise. The program will feature parallel scientific sessions and a plenary session, offering participants the opportunity to engage in in-depth discussions and advance both fundamental and applied research. (ai4as.eaap.org)

Zurich, a hub for scientific innovation and technology, provides an ideal setting for this gathering. Participants will have the chance to engage in stimulating discussions while experiencing the city's vibrant culture and scenic landscapes.

We are confident that the Artificial Intelligence 4 Animal Science Conference will serve as a catalyst for new ideas, partnerships, and technological advancements in the field. We look forward to welcoming you to Zurich for an inspiring and enriching experience!

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Frontiers in Veterinary Science (second most-cited veterinary science journal) bridges animal and human health, takes a comparative approach to medical and surgical challenges through innovative biotechnology and therapy. It welcomes contributions related to the assessment, education, prevention, control, diagnosis, and treatment of animal diseases, while also evaluating their impact on human health. Veterinary research today is interdisciplinary, collaborative, and socially relevant, transforming our understanding of animal health and disease. Led by Field Chief Editor Prof. Andres M Perez (University of Minnesota), the journal is Open Access and indexed in PubMed Central, Scopus, and DOAJ, uniting relevant veterinary sciences to enhance animal and human health.

The European Federation of Animal Science (EAAP)

The main aims of the EAAP are to promote, by means of active co-operation between its members and other relevant international and national organisations, the advancement of scientific research, sustainable development and production systems; experimentation, application and extension; to improve the technical and economic conditions of the livestock sector; to promote the welfare of farm animals and the conservation of the rural environment; to control and optimise the use of natural resources in general and animal genetic resources in particular; to encourage the involvement of young scientists and technicians. More information on the organisation and its activities can be found at www.eaap.org.

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The European Federation of Animal Science (EAAP) has close established links with its sister organizations of American Society of Animal Science (ASAS), American Dairy Science Association (ADSAS), Canadian Society of Animal Science (CSAS) and Asociación Latinoamericana de Producción Animal (ALPA) and is also member of the World Association for Animal Production (WAAP).

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Industry members

EAAP started in 2023 a new initiative to create closer connections between European livestock industries and the animal science network. Therefore, the “EAAP Industry Club” was shaped with the specific aim of bringing together the important industries of the livestock sector with our European Federation of Animal Sciences. All companies dealing with animal production (nutri¬tion, genetic, applied technologies, etc.) are invited to join the “EAAP Industry Club” because industries will have opportunity to increase their visibility, to be actively involved in European animal science activities, and to receive news and services necessary to industries. In addition, through the Club, industries will enlarge their scientific network and will receive specific discounts on sponsoring activities

The industries that already joined the “EAAP Industry club are:

The Club gives:

Visibility • Company name and logo at EAAP website and all relevant documents • Slides with name and logo at Official Events • Priority links with EAAP Socials • Invite, through EAAP dissemination tools and socials, people to events organized by your company • Information disseminated through a brand new Industry Newsletter • Networking • Joining the Study Commissions and Working Groups • Suggest topics to be considered for Annual Meetings Scientific Sessions • Organize Professional Panel through the EAAP platforms • Economic Benefits • One free registration to each Annual Meeting and at every meeting organized by EAAP • Five individual memberships at no cost • Many possible discounts (-30%) to increase company visibility through: EAAP Newsletter, EAAP website, EAAP Annual Meetings and workshops • Support young scientist by sponsoring scholarships named by the company • Co-Organize and sponsor webi¬nars.

Make yourself more visible within the livestock industry via the animal science network!

For more information, please contact eaap@eaap.org.

Scientific programme

Session A. Ethics and Industry Adoption of AI in Animal Science: Addressing practical implications and challenges, including bias and data ownership, as well as industry implementations of AI

Date: Wednesday 4 June 2025; 14:00 - 18:00
Chair: Giersberg / De Temmerman

Session B. Emerging AI Applications in Precision Livestock Farming: Innovations in generative AI, digital twins, large language models (LLMs), big data, and robotics

Date: Wednesday 4 June 2025; 14:00 - 18:00
Chair: Chai / Allain / Oczak

Poster Session A and welcome reception

Date: Wednesday 4 June 2025; 18:00 - 19:00

Plenary session

Date: Thursday 5 June 2025; 9:00 - 12:30
Chair: Niu / Maselyne

Poster Session B

Date: Thursday 5 June 2025; 13:30 - 14:30

Session C. Advancements in Data Collection and Integration: Exploring cutting-edge sensors, multi-sensor systems, data labelling, and tools driving animal science innovation

Date: Thursday 5 June 2025; 14:30 - 18:00
Chair: Karatzia / Cabrera

Session D. Efficient AI Modeling and Data Processing: Tools, algorithms, and workflows for scalable AI solutions

Date: Thursday 5 June 2025; 14:30 - 18:15
Chair: Nasser / Pausch

Session E. Advancing Digital Biomarkers with AI: Breakthroughs in animal identification, health and welfare monitoring, behavior analysis, and remote sensing technologies

Date: Friday 6 June 2025; 9:00 - 13:00
Chair: Liu / Maselyne / Oczak

Session F. AI for Research and Farm Management: Leveraging AI to address research challenges in various animal science disciplines and improve informed decision-making

Date: Friday 6 June 2025; 9:00 - 13:00
Chair: Pastell / Niu

Animals: the forgotten stakeholders in AI ethics discourses?

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The development and application of AI-based technologies in general is accompanied by several ethical challenges, such as transparency, fairness, privacy, accountability, and sustainability. To address these challenges, a number of frameworks, guidelines and laws have been formulated in recent years. To build AI systems in an ethical way to benefit society, researchers and developers can draw on methods such as modified Value Sensitive Design approaches. Policy makers may for instance refer to the recently published UNESCO recommendations on the ethics of AI. What these frameworks have in common is that they focus exclusively on the benefits and risks of AI for humans. However, implementing AI in the context of animal science is even more complex. Animals are recognized as sentient beings who can interact and build relationships with humans. At the same time, they are in a vulnerable position as they rely on human care. Subjecting animals to technologies which have the potential to fundamentally change our notions and practices of animal handling and care may therefore be reason for new societal concerns. For a successful implementation of AI-based solutions in the context of animal science, it is important to stay ahead of these concerns and to be able to respond to them. This can only be achieved by analysis of and systematic reflection on the normative questions that may emerge when human-animal relations are mediated, enhanced or disrupted by AI. This presentation will explore approaches to develop and apply AI-based technologies in a responsible way for the benefit of society as a whole – including animals. I argue why this asks for a transdisciplinary approach: including animal perspectives into the design of AI-based solutions requires the expertise of relatively unrelated fields, such as animal science, computing sciences and ethics. In addition, to ensure that technologies are socially robust and contribute to the challenges stakeholders face in practice, it is essential to involve partners from industry, public organizations and governments.

Session A Theatre 2

Stakeholder views on enhancing calf welfare using AI technologies: outcomes from a design-thinking workshop

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Technologies incorporating artificial intelligence (AI) have potential to benefit calves, farmers, and the wider industry 1. Skilled labour shortages may be mitigated e.g. by automated feeding, health monitoring and data systems that highlight the consequences and costs of management decisions at different life stages. Limited youngstock technologies exist, adoption rates are low and greater emphasis on responsible research and innovation is called for 2. This work explored stakeholder views on the role of technology in addressing calf and user needs. A one-day design-thinking workshop (Harper Adams University, UK) was attended by: farmers/calf rearers (18); calf industry representatives (12); veterinarians (9); agri-tech representatives (13); animal welfare representatives (10); and university students (2). Speakers introduced practical aspects of calf rearing and farm technologies, animal- and user-centred design. Participants formed pre-allocated heterogenous groups for discussions defining key needs of human and non-human users, identifying current issues and starting the process of ideation about the contribution of technology to calf welfare on farms. Preliminary results indicate key themes relating to calf needs: optimal feeding, health, and comfort, enrichment, socialisation, naturalness and consistent management. Staff time was in short supply, but technology should complement not replace good stock skills. AI applications could unify and interpret data from various sources, offering lifetime monitoring and replace wearable technologies with remote monitoring to negate effects on animal welfare and hassle of transferring equipment between calves. Thorough understanding of farm contexts and specific user requirements is needed to develop technologies that address real need, are easy to use, and affordable. 1 Palczynski et al 2022 https://doi.org/n6zz 2 Kenny et al 2021 https://doi.org/n6z2

A Collaborative Journey: Developing AI tools to reduce unnecessary animal suffering

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In this presentation, we aim to share the collaborative journey behind the development of AI4Animals, which aims to reduce animal handling incidents in slaughterhouses. Our focus will be on the vital partnerships formed between animal welfare agencies, industry stakeholders, technology partners, and scientists, illustrating how these collaborations were instrumental in bringing the solution to fruition. We will present a technical exploration of our computer vision models, logic layers, edge computing architecture and real-time interventions.Furthermore, we will outline how employee training and co-development has helped maximize the impact of the platform, ultimately reducing the unnecessary suffering of over 1 million animals per month.

Virtual herding for real animals: on the ethical dimensions of virtual fencing and herding

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Insights from animal welfare or environmental science are not easily translated in livestock farming, e.g. in conventional farming systems it can be difficult to allow animals to show natural behaviour. Virtual fencing and herding can help to accelerate the implementation of insights from animal and environmental sciences, e.g. to give animals more choice, reduce emissions or protect wildlife. With ICT and data technology it is possible to facilitate outdoor grazing with benefits for animal welfare and nature inclusive farming. The case of the Collie company that has developed this innovation and is offering it to farmers shows that responsible innovation and implementation require reflection on ethical dimensions. Collie offers smart collars that use sound and vibration cues to guide cows in combination with an app that enables the farmer to guide and monitor cows at any time. Collie is committed that the use of its product has a positive impact on animals, nature ensuring a responsible and sustainable approach. We aim to analyse ethical dimensions related to virtual fencing and herding at three levels. 1. Animal-related questions, such as the balance between autonomy for animals and potential welfare impact of the collars and used cues. 2. Ethical questions related to the human-animal relationship. The use of apps allows farmers to observe animals from a distance. The question is how this can contribute to more focus on individual needs of cows and the dynamics within the herd, deepening the quality of interaction and strengthening the human-animal bond. In addition, what is the impact of this innovation on the traditional identity and craft of farming? How can technology build on and enhance farmer’s experience and practical wisdom rather than replacing them. 3. Virtual fencing and herding can be used for many aims from reducing costs to reducing greenhouse gas emissions, and from increasing animal autonomy to protecting wildlife. It is difficult to combine all aims and do justice to underlying values. Therefore, design choices and careful integration or balancing objectives are needed.

Session A Theatre 5

Call for machine learning guidelines for precision livestock farming

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Machine learning (ML) models have powerful predictive capabilities but are prone to overfitting. The use of ML in precision livestock farming (PLF) has gotten easier with increasing availability of software libraries. The simplicity of the modeling tools hides the complexity of used models, which is both a blessing and a curse. Inconsistency in the reporting of the methods and a tendency to make quite strong conclusions based on limited datasets can be observed. Best practices for the use and reporting of ML methods for PLF should be established. Experimental and observational set-ups in the field differ from those presented in standard textbooks. The proposed guidelines will give recommendations on e.g., the use of cross-validation, diagnosing overfitting, strength of evidence. For cross-validation it is critical to maintain a clear distinction between different dataset splits ensuring that leakage from using observations from the same animals or groups doesn't occur. The strength of evidence obtained should be looked at critically and a justification on what is considered good performance should be given. There is also incurring evidence of performance drops of ML methods when taken from one farm to another. Single farm studies are valid and necessary when it comes to new sensor technologies, however they should not be used to make strong claims. Best practices exist with respect to the application of ML in other life science areas, which can serve as a basis. The proposed guidelines for PLF could increase the quality and consistency of modeling and reporting of research, having a common understanding of best modeling practices and the generalizability of the findings. A first draft for "ML guidelines for PLF" will be presented to be openly discussed with the community.

Session A Theatre 6

Precision poultry farming - experiences based on practical application of Artificial Intelligence

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Intensive poultry production systems are characterized by confined, automated housing technology. Poultry farmers clearly understand the environmental and management parameters that best suit their birds' genetics, use, and age. A more detailed understanding of the interaction between animals and their environment can help optimize the quantity and quality of inputs used in fattening while also adjusting housing technology as needed. Precision poultry technologies can further enhance automated housing technology, which controls the environment and climate in barns. These technologies use artificial intelligence and machine learning methods to analyze visual and audio data collected from poultry flocks. For these IT solutions to achieve their intended goals and provide tangible benefits to poultry farmers, several factors must be addressed, as current farming practices are not yet adequately prepared. Based on several years of on-farm research, this presentation will outline the possibilities, limitations, and challenges that IT developers and poultry farmers face when implementing large-scale improvements in precision poultry farming. It will also explore aspects of management, production, and animal welfare. Finally, the authors will recommend applying AI in large-scale poultry production to overcome the identified obstacles and effectively implement precision livestock farming (PLF) technology.

Session A Theatre 7

Digital Phenotyping System for Precision Livestock Farming: From Image to Insight

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This presentation introduces a highly accurate system equipped with computer vision and artificial intelligence, and demonstrates its various on-farm applications in beef and dairy industry. Possibility of using images for only a limited number of traits from the extensive list of linear type traits (conformation) have been explored. Research has shown that traditionally human-scored body traits such as stature and body length can be used to accurately estimate body weight. Yet, to the authors' knowledge, no system currently is available to automates the scoring of a full range of these traits nor estimates body weight. iClassifier Precision Livestock Farming system (iPLF) was developed using 5,000 images captured from side and back view of over 800 dairy cows. Half of these images were manually annotated, then used to train machine learning algorithms to automate annotation. A variety of ML and deep learning models were tested to generate accurate measurements for all defined traits, such as stature. Later, 40 beef cows were imaged and weighed to assess whether iPLF-generated body dimensions could accurately estimate body weight. Body parts of these 40 cows were also measured using measuring tape and protractor to validate output of iPLF. Results demonstrated that iPLF generated precise measurements (over 95% accuracy) for each body point of 40 beef animals, including height, length, and angles, and produced body weight estimations with over 90% accuracy. The system is currently being demonstrated for the largest dairy and beef breed associations in Canada with the aim to integrate in milking area. This patented technology, protected in six jurisdictions, enables highly accurate body trait measurement and body weight estimation for beef, dairy, and swine. The iPLF system creates new opportunities for research and product development, making it possible to measure novel traits, such as cut yields on live animals, and difficult-to-measure traits like anogenital distance in both dairy and beef.

Session A Theatre 8

Establishing the foundations for a research organisation to leverage AI in animal science

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Animal science, in common with many science disciplines, has an increasing need for modern analytical techniques, such as AI and Machine Learning, to provide science-led solutions to a wide range of problems. In parallel, there are challenges presented by the volume and variability of data generated in research due to increasing frequency of observations, and an increasing number of instruments, such as wearable devices. We also see an increasing need and desire for reproducible and open research. However, many organisations, including our organisation (DairyNZ), have not traditionally had the ability to deliver the needed outcomes. DairyNZ established then implemented the Modern Science Workflows project over four years to transform our capability, infrastructure, and culture in response to these challenges. The project focused on three key areas: infrastructure development, capability building, and business disciplines. Infrastructure improvements included adopting solutions for data warehousing and cloud computing (Snowflake and Posit Workbench), digital data recording and ingestion, as well as communicating via real time and scheduled reporting via the web (Posit Connect). Capability development was achieved through delivering courses in data science (R for Data Science) in collaboration with the University of Waikato and Lincoln University, complemented by internal statistics courses. Business disciplines were reinforced through scheduled meetings (R community), well-documented code examples, and promoting best practices. This includes deploying an organisational code repository (GitHub) to improve code management, collaboration and sharing, and moving towards an open science model. We share and describe the general and specific lessons from our experience in developing modern science workflows. This is to assist other organisations on their journey towards a future where animal scientists are using what are currently advanced techniques like AI in a routine way such that it becomes both common and unremarkable.

Monitoring pig welfare using image classification of pig tails

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Recent advances in computer vision create opportunities to improve animal welfare monitoring. Determining the length and lesions of pig tails enables an integrated analysis of individual pig welfare. Automated tail length classification will enable monitoring of tail docking rates over time. Although routine tail docking in pigs is banned in the EU, this practice is still common across most member states. Tracking tail docking rates across regions, companies and farm types is an important step in focusing preventive measures and law enforcement. Tail lesions are caused by stress-induced tail biting behavior by other pigs, implying a link between lesions and a large range of potential welfare limitations. In this study, tail length and lesions of pig tails were determined from slaughterhouse videos, indicating prior tail docking and tail biting. We aim to assess the feasibility of monitoring tail length and lesions from slaughter line carcasses automatically. Videos of rapidly moving pig carcasses were converted into individual frames and five frames were selected per pig. For roughly 30 thousand carcasses, tail length and tail lesions were visually determined in a completed project by WLR. Tail length was labeled using five categories, from 1 (0-5 cm, short-docked) to 5 (>30 cm, intact) and lesions using three, from 0 (no damage) to 2 (wounds). Currently, we are exploring different approaches to predicting tail length and lesions from frames automatically. We will train a convolutional neural network (CNN) directly on the selected frames, using supervised machine learning. Alternatively, we will segment the frames and isolate the tail prior to applying a CNN that uses only the tail segments as input. One challenge we have encountered is class imbalance: few images are available of medium and long tails and of wounded tails. To overcome this issue, we plan to use synthetic 3d-rendered data as a supplement to the real data to improve class recall rates of our models. An analysis of the performance of our models is currently not yet available. However, we expect to be able to present the results at the AI4AS conference 2025, organized by the EAAP.

Use of sensors, vision technology and AI to assess animal welfare, carcass and meat quality in a pig production chain and processing plant

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The integration of sensor, vision, and AI technologies in the entire pig production chain has the potential to revolutionize the meat processing industry by enhancing efficiency, worker and product safety, and animal welfare. This paper will give an overview of the current and potential new technology applications to improve various aspects of pig production and processing, from farm, pre-slaughter animal handling to the final processing stages at Vion Food in the Netherlands. At cooperating farms climate sensors have been installed to continuously measure CO2, ammonia, relative humidity and temperature. The measurements are presented to the pig producer in a dashboard to optimize their farm management. DNA from sows in specific chains is collected to ensure DNA traceability, and this approach has the potential for other information to be used in the production chain. At the abattoir camera's and AI have been implemented to monitor the treatment of animals during unloading and in lairage. Sound and motion sensors are studied as potential objective welfare monitoring. During exsanguination quality of debleeding could be monitored and blood samples analyzed for lactate or other stress factors. Existing technologies based on ultrasound and fiber optic probe measurements give valuable information about carcass composition and value. In-line tail length measurements have been developed and are tested to include damages, which are automatically processed and reported back to farmers via an online platform. A hyperspectral camera technology has been developed to measure fat quality at line speed and is currently being examined for monitoring microbial characteristics. A NIRS based method is studied to sort final products on the basis of their water holding capacity. Connecting all these production chain data and the opportunity to use AI has the potential to improve efficiency through optimization and predictability, enhancing sustainability, and health and welfare in pig production. By harnessing the synergy of sensor, vision, and AI technologies, slaughterhouses can achieve higher operational standards while promoting sustainability and ethical practices within the meat production industry.

ADAL: Advancing Real-Time Lesion Scoring in Slaughterhouses Using Computer Vision

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The integration of AI in meat inspection is transforming the livestock industry by enhancing meat quality assessment and monitoring animal health and welfare. Traditional methods suffer from subjectivity and delays, creating a demand for real-time, standardized solutions. Farm4trade's ADAL system leverages advanced computer vision and deep learning as a core technology, integrating automated data acquisition along the slaughter line—capturing high-resolution images and sensor data—to detect a variety of lesions (e.g. pneumonia, pleurisy). This study demonstrates ADAL's capacity to address real-time lesion detection challenges while enhancing overall animal health monitoring. Objectives include improving lesion scoring accuracy across multiple types, providing actionable insights for livestock management, and streamlining the inspection process to boost efficiency and traceability. ADAL's pipeline combines automated imaging systems with robust computational analysis. High-resolution photos and sensor data are continuously acquired along the slaughter line. The data undergo pre-processing—including rescaling and augmentation—to simulate varied conditions. Deep neural networks extract lesion features, while a suite of machine learning models (including SVMs, linear models, kernel-based approaches, ensemble methods, and neural networks) optimizes predictive performance. Model evaluation employs metrics such as R^2, MAE, MSE, and RMSE, benchmarked against standard meat inspection criteria, with real-time processing validated in operational settings. Validation shows that ADAL significantly reduces inspection times, thereby increasing throughput and operational efficiency. Standardized lesion scoring enhances meat product traceability, and robust detection across diverse lesion types confirms ADAL's versatility as a core technology for comprehensive meat inspection and animal health monitoring. ADAL exemplifies the transformative potential of AI in meat inspection by standardizing and accelerating lesion scoring and improving animal health and welfare monitoring. Its integrated approach—merging automated data acquisition with advanced analytics—ensures accurate detection of varied lesions, demonstrating scalability and broad applicability in precision livestock farming.

Session A Theatre 12

Validation of Computer Vision Systems for Detecting Meat Inspection Findings Using Latent Class Modelling

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Computer vision systems (CVS) are being developed to detect findings at meat inspection. The question is how to evaluate the performance of such systems. Textbooks would suggest a comparison with a gold standard. However, for meat inspection it would be impractical to compare the CVS results with a thorough pathological examination. As a solution, we suggest making use of Bayesian latent class modelling, wherein the CVS's performance is compared with that of the meat inspectors without assuming that either test is perfect. We applied this approach using a CVS developed by the Danish Technological Institute for detecting pig carcass faecal contamination. Data were collected from a Danish abattoir over 16 days and encompassed 69,215 carcasses. For each carcass, the CVS results were compared with those made by the official auxiliary. Descriptive analyses identified four meat inspection findings that were statistically associated with an increased relative risk of a carcass being test positive. Among these, oil contamination showed a particularly high relative risk (RR = 4.1, $P < 0.001$). This showed that the CVS could not differentiate oil from faecal contamination. The agreement between the CVS and the official auxiliaries was assessed using Cohen's kappa and prevalence and bias-adjusted kappa (PABAK). Cohen's kappa indicated minimal agreement ($\kappa = 0.17$) and PABAK indicated moderate agreement ($\kappa = 0.79$). The sensitivity and specificity were estimated using a latent class model, assuming that the two different ways of detecting carcass contamination were imperfect. The median results showed that the CVS had a sensitivity of 31% and specificity of 98%, compared to 22% sensitivity and 99% specificity for the official auxiliaries. Hence, CVS's strength lies in the ability to detect true contaminations whereas the official auxiliaries can rule out false positives. In conclusion, latent class modelling offers a robust and flexible framework for evaluating CVS, without the need for a gold standard.

Session B Theatre 1

Machine Vision Technologies for Monitoring Poultry Health and Welfare

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The United States is currently the world's largest producer of broiler chickens, producing 9-10 billion chickens annually, and the second-largest producer of eggs, with 110 billion table eggs per year. Poultry production contributes $60 billion in farm gate value each year. However, there are ongoing concerns regarding animal welfare, particularly with fast-growing broiler chickens and the increasing use of cage-free housing for laying hens. Approximately 20-30% of fast-growing broilers experience leg problems, while cage-free hens face doubled mortality and injury rates compared to conventional caged systems. Currently, animal monitoring is carried out manually, which is both time-consuming and labor-intensive. To address these challenges, artificial intelligence (AI) technologies such as machine vision and robotics are being developed for precision monitoring of poultry health and welfare. This summary highlights and discusses the latest AI technologies developed in my lab for poultry monitoring, including YOLO (You Only Look Once), CBAM (Convolutional Block Attention Module), SAM (Segment Anything Model), TAM (Track Anything Model), and a robotic system, and how these innovations are applied to monitor broilers and cage-free laying hens. These new methods have been adopted by commercial production systems, contributing to more sustainable poultry production and breeding.

Session B Theatre 2

Challenge of dairy housing automation through M2M networking: how farmers' experience shapes expectations

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The integration of robotics in dairy housing has led to increased automation in tasks such as milking, feeding, and manure removal. The intelligence of a single machine allows for a high level of autonomy in executing tasks and work processes, driven by data collected from sensors, mostly embedded within that particular machine. However, they are uninformed about the tasks carried out by other machines in the same dairy housing. As a result, the autonomy level of these machines must either be limited or manually switched off to prevent collisions with other machines. Currently, farmers manually regulate various machines in the dairy housing when multiple machines perform their tasks simultaneously, as data exchange between devices is limited. To achieve full autonomy through AI-driven decisions and settings, effective machine-to-machine (M2M) communication is crucial for enabling devices to coordinate their operations by exchanging data. Smaller automated machines (for example manure removal robot), which are often overlooked in M2M communication considerations, may clash with the operations of larger devices if not synchronized. The detailed expectations and experiences of farmers regarding device connectivity in dairy housing systems remain underexplored in the literature. The aim of this study was to capture farmers' expectations and experiences regarding machine networking in dairy housing systems through online surveys. Insights from Bavarian dairy farmers (n=231) show varying expectations based on different housing systems and machine experience. Farmers with less experience with automated machines or robots anticipate lower benefits, such as time savings and greater work flexibility, from machine networking compared to those familiar with automated machines. Notably, the highest expectations for machine networking are seen among users of multiple machines in one dairy housing simultaneously. Overall, the integration of robotics and AI in dairy housing presents promising potential to improve automation and autonomy. Effective M2M communication is key for maximizing efficiency and achieving the expected benefits.

Session B Theatre 3

Towards a morphology estimation of horses from images using a deep learning approach

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Efficient locomotion and proper conformation are key elements of a horse's performance. This assessment is largely based on the judgment of experts. To improve their effectiveness and ensure fairness, it is useful to complement these judgments with objective and repeatable measurements. To compare the conformation of horses, a morphometry protocol was proposed in 2002. It allows reconstituting a 3D morphology for a large number of horses with reduced constraints for data collection. It was applied to highlight some morphological characteristics of high level jumping horses and to describe heritability of conformation. However, this method involves a huge manual operation to identify anatomical points on pictures, not routinely applicable. We propose here a first step towards an automated reconstruction of this morphology. Horses were filmed, held in hand, walking on a straight line, with 4 synchronized cameras, positioned at angles of 0°, 60°, 120° and 180° on the right side of the track axis. Two moments were selected, respectively when the right front and back cannons were vertical. On the 4 images of these 2 moments, 15 and 13 anatomical landmarks, corresponding to forehand and hindquarters, were located by hand by an operator. With triangulation, we computed 3D coordinates for these landmarks. We separated forehand and hindquarters datasets into training and test data. Forehand dataset has 502 train and 245 tests samples; hindquarters dataset has 499 train and 245 tests samples. For each one, we trained a Yolo-Pose 8 model, to retrieve landmarks on 2D pictures. We compared 3D coordinates between manual and automatic annotation: the difference is less than 3.9 cm in 50% and 9.5 cm in 95% of cases. Best results are on vertical axis: error is less than 4.5 cm in 95% of cases. For withers height, the error is less than 1.6 cm in 50% and 4.3 cm in 95% of cases. Worst results were for head landmarks. Even if a non-negligible error remains, this paves the way for semi-automatic image analysis to complement judgment in the collection of phenotypes, for example for the selection of future stallions.

Session B Theatre 4

AI-Powered Conformation Analysis: A CNN Approach for Accurate Horse Morphometry

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Horses' structural characteristics, including body proportions and angular measurements, are fundamental in equestrian sports, as they influence movement efficiency and athletic capabilities. Conformation is widely recognized as a key determinant of performance, playing a crucial role in assessing a horse's potential, physical aptitude, and overall health. Traditional methods for evaluating these morphometric traits rely on manual approaches that can be time-consuming, prone to error, and limited by subjective judgment. Recent advances in deep learning offer a powerful and automated way to predict morphometric parameters from images or other data, providing consistent and rapid assessments of large horse populations. By leveraging deep learning algorithms such as Convolutional Neural Networks (CNNs), it is possible to accurately capture subtle anatomical details that might be missed by conventional methods. This capability not only speeds up the evaluation process but also facilitates large-scale studies on genetic selection, performance optimization, and health monitoring. Despite this, a solid framework to evaluate horse morphometric traits in real time is still missing. In this study, we present a CNN-based tool for accurately predicting morphometric traits in horses. We gathered 800 images of horses in a standardized pose, along with an additional 100 images in which the morphometric traits were manually measured. We then trained a ResNet backbone with convolutional upsampling layers to detect 13 distinct keypoints on each horse. Ten-fold cross-validation yielded a mean average precision of 85%. Next, we evaluated the trained model on the manually measured images. By extracting the predicted keypoints, we derived the morphometric ratios and compared them to the ground-truth measurements, obtaining an average error of 5%. The trained CNN will be deployed in a mobile application for on-site morphometric estimation. Its use will provide breeders, veterinarians, and researchers with robust insights into horse conformation, enabling data-driven decisions for improved breeding programs, athletic performance predictions, and early detection of anatomical abnormalities.

Monitoring respiratory symptoms in weaned piglets using a cough monitor

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Health of production animals is crucial for the welfare of the animals as well as the income of the farmer. Respiratory diseases in weaned piglets are common, affecting welfare and economics. Automatic monitoring of coughing to detect respiratory disease can aid the farmer in managing piglet health. Continuous monitoring of piglet health can help the farmer in early detection of disease and with taking data-driven decisions about ventilation, medication or biosecurity in the farm. A cough monitor for pigs is a specialized device used to monitor the health of pigs, particularly for detecting respiratory diseases early. The system uses acoustic and data analysis technologies to identify coughing sounds, which can indicate respiratory issues such as swine influenza, porcine reproductive and respiratory syndrome (PRRS), or bacterial infections like Actinobacillus pleuropneumoniae. Cough monitors use sensitive microphones that filter sound by using algorithms that distinguish coughing from other farm noises. In our study, a SoundTalks cough monitor was installed in each of six weaned piglet units, recording daily coughing. These monitors are trained with manually labelled farm data to recognize pig cough sounds. Coughing is measured as ReHS (respiratory Health Status), with lower ReHS indicating more coughing. In the units, 266 individual piglets were weighed weekly. Average weight gain and SE of weights were calculated per week, per unit, and related to average ReHS values per unit for that week. We found that higher ReHS values (less coughing) were related to higher weight gain but also to higher SE of weights.

Identification of biomarkers for female pig fertility prediction using machine learning modelling

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The highly accurate selection of female pigs with strong reproductive potential within the breeding herd is crucial for the success of the pork industry. Currently, the low heritability of reproductive and litter-related traits is slowing the improvement of pig selection efficiency. Applying "omics" technologies and machine learning (ML) modelling may improve the current selection process. This study investigated the use of metabolomics, small non-coding RNA (sncRNA) transcriptomics and vaginal microbiome metagenomics to distinguish expression profiles in high reproductive potential (HRP; the average number of piglets born alive equal to or more than 13) and infertile (INF; not pregnant after two consecutive rounds of artificial insemination) female pigs. ML algorithms were applied to the gilt and/or sow biological datasets to identify potential biomarkers of reproductive potential and measure their potential predictive ability for selection. Across all biological datasets, INF female pigs exhibited distinct biological profiles compared to healthy HRP females. Urine, saliva and serum from HRP and INF female pigs showed significant differences in amino acids, carnitines and phospholipids composition. Additionally, 16S sequencing revealed significant ($p < 0.05$) differences in beta diversity at the genus level between the vaginal microbiomes of HRP and INF pigs. These findings confirm a divergence in vaginal microbiome composition between the two groups. Machine learning algorithms were applied to metabolomic, vaginal microbiome composition and miRNA biological datasets to predict reproductive performance in female pigs. The results demonstrated the predictive capacity of ML modelling. Overall, the study highlights the potential of combining ML algorithms with biological datasets to inform the on-farm selection of gilts and sows for reproductive success.

Session B Theatre 7

Automated chicken observation under varying light conditions using deep learning

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Lighting plays a crucial role in poultry husbandry, influencing bird welfare, behaviour, and performance. While traditional guidelines and regulations primarily focus on light intensity (Lux) and schedules (timing of light versus dark), advancements in LED technology now allow for precise control over spectrum, intensity, and dynamic variation in location and time. However, despite these innovations, lighting programs in poultry houses often rely on assumptions regarding the effects on poultry welfare, due to a lack of knowledge about birds' actual preferences. In this study, three experiments were conducted to investigate the light preferences of both broiler chickens (fast- and slower-growing) and layer pullets. In the first experiment, the broiler pen was divided into two sections: one exposed to UV light and the other without UV exposure, to assess broilers' preference. In the second experiment, the broiler and layer pens were illuminated with a gradient light, ranging from high to low intensity (200-20 lux for broilers and 100-20 lux for layer pullets), to determine effects on behaviour. To objectively assess the birds' preferences, distribution and activity, an object detection model based on YOLOv8 was developed to track and analyse their positioning within the pens under different lighting conditions. The model achieved an average precision (AP) of 96.2%, accurately identifying and localizing chickens within the pens. This approach demonstrates the potential of deep learning-based computer vision for automating behavioural analyses in poultry research. By replacing manual observation with scalable, high-precision tracking, this method enables continuous monitoring to support data-driven improvements in lighting programs and poultry welfare.

Session B Theatre 8

Harnessing AI for Personalized Dairy Cow Welfare: Insights from Multi-Year Behavioral Tracking

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Recent advances in AI and continuous tracking technologies offer unprecedented opportunities to quantify and interpret complex social and behavioral dynamics of livestock. In this study, we present an AI-driven framework to analyze the individuality and welfare of dairy cows by integrating long-term Ultra-Wideband positional data with detailed behavioral and physiological indicators. Over multiple years, our system continuously monitored a herd of 70 cows, recording each individual's location and interactions in realtime. Building on our previously introduced mathematical approach for measuring personality, we employed an Identity Domains system to reliably track individuals over time and automatically construct a multidimensional behavioral space comprising over 100 daily metrics per cow. This dataset revealed consistent inter-individual behavioral differences—evidence of distinct personality traits—and intra-individual consistency spanning months to years. Moreover, by applying machine-learning-based dominance assessments, we mapped each cow's social hierarchy and explored its influence on group structure. By integrating these behavioral metrics with physiological and production data, including cortisol, milk yield, and health outcomes, we identified significant links between social positioning, stress, and disease. Notably, cows exhibiting lower "centrality" within the herd had elevated cortisol levels and were more prone to health issues, suggesting a potentially heightened stress state and earlier onset of illness. Our findings demonstrate the applicability of AI for real-time, personalized welfare management: subtle deviations in individual behavior can be flagged early, prompting timely intervention. Overall, this work underscores the importance of multidisciplinary collaboration to advance ethical and sustainable dairy farming. By revealing the interplay between personality, dominance, and welfare, our approach paves the way for precision husbandry practices that enhance both productivity and animal wellness.

Bridging AI and Clinical Expertise: A Neuro-Symbolic System for Emergency Veterinary Triage Analysis

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Automated veterinary diagnostic and triage systems are already in use but have significant limitations. Neural networks lack transparency and reproducibility, while symbolic systems struggle with natural language comprehension and user accessibility. This dichotomy creates a critical gap between pet owners' observations and professional veterinary diagnostics. Advancements in artificial intelligence (AI) have already transformed decision support systems in human medicine, yet veterinary diagnostics face unique challenges such as data accessibility and standardization, patient owner recruitment, and funding support. This study introduces a neuro-symbolic AI system, VetApp, designed to bridge the gap between unstructured descriptions from pet owners and structured veterinary diagnostics, focusing on triage and emergency care. As part of the research, we present an extensive patient data analysis comprising information from the medical records of 4,579 dog and cat patients that were presented to the emergency service of a continuously open (24/7) private small animal emergency practice in Berlin, Germany, in 2021. The information obtained from the medical records database includes the date and time of presentation, medical history, animal species, breed, sex, date of birth, clinical problem, diagnostic procedures performed, and therapies administered. The data was characterized retrospectively concerning factors relevant to veterinary emergencies and classified based on the five-point Manchester Triage System (MTS) to determine what proportion required immediate medical attention. Based on this dataset analysis, we introduce preliminary evaluation results of the VetApp neuro-symbolic system. The system utilizes a hybrid architecture that combines the flexibility of neural networks with the precision and transparency of symbolic reasoning. Our comparative study examines the concordance between veterinarian classifications and the automatic categorizations generated by the system. Additionally, we present the Chains of Thoughts (CoT) produced by the system during evaluations.

Session B Theatre 10

Extracting video-based phenotypes on a large scale from video data

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To genetically improve health and welfare traits in pigs, accurate recording of relevant traits is needed. Traditionally, behaviour traits have been recorded manually, however, this is time consuming and may lead to erroneous data. By using video cameras and automated video analysis pipelines, such data collection could be done more cost-efficient and potentially better data quality. Tracking animal identities over time is challenging, especially in growing-finisher herds with many similar-sized animals in the image. It's crucial that the process can scale up, given the number of cameras needed to collect phenotypes for breeding programs. In this work we used a baseline video analysis pipeline and improved it with consideration on speed and accuracy to fetch phenotypes in a large scale. We use a state-of-the-art activity budget pipeline. It is based on a detection module (Yolov8) to detect 5 different pig postures (lying, sitting, standing, eating, and drinking), a tracking module (StrongSort), an ear tag detection module (Yolov8) based on differentiable ear tags, an identification module that uses metadata from RFID in feeding stations and ear tag detections. In addition, we used an orchestration module to handle the communication between the different machine learning modules. We reduced the time used to analyse a 50 minute video from 45 minutes to 2-3 minutes by utilizing parallelization for the Yolov8 models and changing the video encoding. Based on this pipeline we were able to run video analysis on a large-scale dataset and provide useful phenotypes. The pigs were fixed in pens with 11 pen-mates and had free access to feed. We processed data from 1200 animals from eight days for each test period in our dataset. The inclusion of ear tag detections helped to identify the correct pig to prevent wrong identification after an identity switch in the tracking module. Overall, the system were able to identify the animals 48 % of the time, and person correlations between the first four days and the last four days was high, ranging from 0.85 to 0.89. This study was funded through the Norwegian Research Council, by the Fund for Research Fees for Agricultural Products and Agricultural Agreement Research Fund (FFL/JA), through project number 321409.

Session B Theatre 11

Automated detection of perturbations in pigs' feed intake and feeding behavior as a resilience indicator

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Resilience is a key trait in modern pig breeding programs. Automated feeding stations facilitate collecting longitudinal feed intake and feeding behaviour data. Analysing such data may allow identifying perturbations in individual pigs possibly indicating decreased resilience. However, challenges remain in distinguishing perturbations at different levels, such as individual and group effects. This study aimed to identify perturbations feed intake and feeding behaviour of pigs using different methods, compare them, and estimate heritability and genetic correlations via blupf90 software. Feed intake and feeding behaviour data were collected via automated feeding stations by the Swiss pig breeding organization (SUISAG) during the finishing phase. The dataset included 2,032,084 daily records from 26,973 pigs, aged from 90 to 160 days, with known pedigree for all pigs and known genomic information for 5985 pigs. Perturbations were detected using (1) unsupervised outlier detection, (2) Nadaraya-Watson's smoothing curves at different hierarchical levels (batch, group, individual) via the UpDown package in R, and (3) the natural logarithm of the variance (lnvar) of expected vs. observed feed intake via regression methods like linear and quantile regression. Preliminary findings indicate that perturbations can be detected at different levels. For feed intake, perturbations appeared at the individual level in 11.2% of pigs, at the pen level in 4.1%, and at the compartment level in 10.2%, while 71.3% showed none. These perturbations were highly associated with lnvar of feed intake from linear regression, with an estimated genetic correlation of 0.62 (se=0.19). Heritability estimates for perturbations in feed intake were low (0.055–0.163) but significantly different from zero. Further analyses are ongoing, including the application of unsupervised clustering to identify patterns in feeding perturbations. These results will provide deeper insights into the effectiveness of different detection methods and contribute to understanding the genetic basis of resilience-related feeding behaviour in pigs.

Session B Theatre 12

Large Language Models for improving on-farm poultry welfare decision-making: opportunities and challenges

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The UK company, Optifarm, has developed precision livestock technology for use in poultry systems, which uses an AI model "that tracks water intake and predicts the next 15 minutes". Anomalies in the data are correlated to identify the probable cause, which could include changes in temperature, inadequate ventilation etc. In principle, the technology allows farm managers and workers to use data-driven insights to improve management. This paper will present the first empirical findings from a project centred on Optifarm's system. We aim to (1) validate Optifarm data insights' link to welfare outcomes, and (2) explore their use of Large Language Models to communicate priority management actions to users. LLMs are created by generative AI and aim to overcome the data-action gap on-farm by giving farm managers and workers clear information on where and how to intervene on the farm. Data collection has started in February 2025 and will involve (1) visits to ten poultry farms using the Optifarm system to conduct welfare assessments, exploring whether this precision livestock technology can deliver for welfare (e.g. as called for by Schillings et al., 2021) and (2) interviews with Optifarm staff and farm users (on the same ten farms) about the potential role of LLMs in farm extension, exploring opportunities and risks (as called for by e.g. Tzachor et al., 2023; De Clerq et al., 2024). Preliminary insights from Optifarm developer interviews have helped to articulate their LLM design journey, including the necessary prompts needed to generate user-friendly management instructions for users, and to help users prioritise key interventions on-farm. The presentation at EAAP will present the results from the farm visits, which will have been largely conducted by the time of the conference. References De Clerq et al. (2024): https://arxiv.org/html/2403.15475v1 Schillings et al. (2021): https://www.frontiersin.org/journals/animal-science/articles/10.3389/fanim.2021.639678/full Tzachor et al. (2023): https://www.nature.com/articles/s43016-023-00867-x

Retrieval Augmented Generation (RAG) system and AI agents for querying Feedipedia information

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While encyclopaedias have great merit in that they are both exhaustive and verified, their granular approach has limitations for users. Identifying the key ideas and connecting different entries in these works may be difficult. The Feedipedia encyclopaedia of livestock feeds is no exception to this. Additionally, its tables of quantitative data cannot be automatically retrieved, which may hinder effective dissemination and use of the knowledge Feedipedia offers. Integrating artificial intelligence into Feedipedia could potentially address the issue of quantitative data and enable the consolidation of the encyclopaedia's knowledge along thematic lines. This paper presents the development of an innovative RAG-based system to optimise the query and access to Feedipedia data. The aim is to create an application programming interface (API) that allows Feedipedia data to be extracted, structured and queried. To ensure data consistency and availability, a web scraping strategy was implemented to structure the website's information into a database. From this, an API was designed to facilitate the consultation of information at different levels of granularity. A further step in the system's evolution is the integration of an artificial intelligence (AI) agent capable of interacting dynamically with the API, enabling users to ask questions in natural language and obtain precise, contextualised answers.This large language model (LLM) approach improves the user experience by reducing manual searches and providing intuitive access to information. Moreover, the system incorporates an automated data entry and update mechanism, ensuring that new items can be added and existing information modified without compromising the integrity of the database. To enhance the security and reliability, the system's architecture has been developed on cloud-based infrastructures, guaranteeing the highest standards of security. The combination of APIs, RAG techniques and generative AI opens up considerable potential for disseminating the knowledge and expertise offered by Feedipedia.

Session Poster A Poster 1

Overcoming Data Limitations in Animal Genetics with GAN-Based Synthetic Genotypes

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Access to real genotype data is often limited due to privacy concerns, high costs of large-scale genotyping, ethical considerations, and strict access regulations, creating significant challenges for research in animal genetics. To overcome this issue, we developed a Wasserstein-GAN with gradient penalty model to simulate synthetic genotype datasets.The model was trained using Holstein cow genotype data and milk production traits, which are key indicators in livestock genetic improvement. Using a diverse set of evaluation metrics from both Deep Learning and Quantitative Genetics, we show that the generated synthetic genotypes accurately capture essential genetic structures while preserving the critical associations between genotype and phenotype. This ensures the biological validity of the synthetic data, making it a valuable resource for downstream research.Our approach provides a practical and scalable solution to the issue of data scarcity and privacy constraints, offering synthetic genotypes as a viable alternative to traditional simulation techniques. The synthetic datasets are particularly useful for data augmentation, enhancing the robustness and predictive accuracy of AI models used in genomic research.

Session Poster A Poster 2

3D Visual Reconstruction-Based Method for Comprehensive Morphological Scoring of Dairy Cows

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Comprehensive morphological assessment of dairy cows is crucial for evaluating fat reserves, nutritional status, and reproductive performance. Monitoring body condition scores (BCS) at different stages helps optimize management strategies, reducing metabolic disorders and reproductive issues, thus improving efficiency. However, most dairy farms still rely on manual scoring, which is inconsistent, inefficient, and labor-intensive, and may induce stress in cows, making it impractical for large-scale operations. This study introduces a high-precision 3D visual reconstruction approach based on multi-view images to enhance the accuracy and efficiency of dairy cow morphological assessment. The key contributions are: Multi-view Image Pose Estimation and Reconstruction: To address the challenge of animal movement, we use Structure-from-Motion (SfM) techniques to recover camera poses. Experiments reveal that larger viewing angles reduce reconstruction accuracy for complex limbs. We recommend capturing angles within 35° for complex body parts like the tail and hooves for high-quality reconstruction. Keypoint Detection for Standard Posture Identification: We develop a keypoint detection model to identify cow morphological traits and assess posture, such as head position and limb alignment. Using a cross-stage partial network (CSPNet), our model improves efficiency and accuracy, outperforming models like CPM, Hourglass, HRNet-32, and HRFormer in detecting spatial details. 3D Reconstruction with Background Suppression: During 3D modeling, volume rendering is applied to fit color and density distributions. To avoid artifacts from similar background and cow textures, we introduce a background suppression strategy that enhances reconstruction accuracy and reduces computational costs. Our model significantly improves performance, with MAE reduced from 0.0739 to 0.0645 and Sm increased from 0.8370 to 0.8628. This study provides a practical solution for intelligent dairy cow monitoring, overcoming the limitations of manual assessments by improving data accuracy and reducing labor costs, ultimately enhancing dairy farming practices.

Session Poster A Poster 3

Application of artificial intelligence in livestock genomics: combining random forest and Boruta algorithm to identify informative single nucleotide polymorphisms across pig breeds

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Autochthonous pig breeds represent a valuable source of genetic diversity, whose conservation at the genomic level is crucial in management programs across Europe. High-density single nucleotide polymorphism (SNP) genotyping is a cost-effective tool for capturing genetic variation, but processing can be computationally demanding. Feature selection methods need a compromise between computational feasibility and retaining biologically relevant markers. This work presents the application of artificial intelligence approaches combining random forest and Boruta algorithm, a random forests wrapper, to address the challenge of identifying informative single nucleotide polymorphisms (SNPs) using data from over 1,100 pigs representing 10 Italian pig breeds. These pigs were genotyped with the GGP 70k Porcine SNP array. The randomForest and boruta R packages were utilised with iterations up to 100,000 to ensure robust feature selection. The Boruta algorithm identified approx. 2,000 stable SNPs, which were then split into several subsets, ranked based on the Out-of-Bag (OOB) error. Annotation of selected SNPs using Ensembl Biomart revealed genomic regions associated with genes that could play significant roles in breed differentiation and adaptation. The smallest subset of SNPs, with an OOB error of <1%, consisted of fewer than 200 SNPs. This work demonstrates the advantages of combining high-density SNP data with machine learning techniques and highlights the potential of AI-driven approaches to identify key genetic markers explaining breed specific genetic features. Funded by the European Union – NextGenerationEU under the National Recovery and Resilience Plan (PNRR) – Mission 4 Education and research – Component 2 From research to business – Investment 1.1 Notice Prin 2022 – DD N. 104 del 2/2/2022, proposal code 202238NP9N – CUP J53D23009570001

Exploring the animal molecular phenome with machine learning algorithms: mining the plasma metabolome to describe differences between breeds

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Metabolomics is emerging as a novel tool for characterising the molecular phenome, providing insights into internal phenotypes that result from interactions between different molecular layers. The aim of this study was to identify metabolic differences between pig breeds by analysing the plasma metabolome profiles of approximately 700 metabolites in over 1,000 pigs from two breeds: Italian Large White and Italian Duroc pigs. After data quality control, we used a bioinformatics pipeline specifically designed to identify differentially abundant metabolites between the two breeds. This pipeline included the Boruta algorithm, a Random Forest wrapper, and sparse Partial Least Squares Discriminant Analysis (sPLS-DA). We compared the results obtained from these two algorithms to assess the stability of the selection of molecular features. In total, we identified 100 metabolites: 17 from sPLS-DA and 83 from the Boruta analyses. The differences in feature selection were due to the characteristics of the algorithms chosen: the former related to the minimal-optimal problem, while the latter related to the all-relevant problem. Furthermore, the selection performed by Boruta was found to be more stable through the tests we conducted. From a biological perspective, the observed differences in these molecular phenotypes can be used to describe genetic differences between Italian Large White and Italian Duroc pigs. Acknowledgements: this study has received funding from the European Union's Horizon Europe research and innovation programme under the grant agreement No. 01059609 (Re-Livestock project).

Session Poster A Poster 5

Analysing environmental factors affecting dairy sheep milk production using machine learning algorithms on a large dataset

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Introduction Sheep milk production depends on environment, management and genetics. This study assesses environmental effects and predicts yield using machine learning. Materials and Methods This study used a database of 96,195 records from Lacaune sheep in Spain, including milk yield, days in milk (DIM) and environmental factors such as temperature, moth of lambing (MoL), humidity, wind speed, temperature-humidity index, moon phase and animal space. Pandas, Numpy, XGB and Scikit-Learn in Python were used. Numerical variables were scaled using min-max normalisation, and categorical variables were one-hot coded. Random forest (RF) identified key features and assessed variable importance. RF and eXtreme Gradient Boosting (XGB) were used for prediction, with 5-fold cross-validation ensuring robustness and Bayes-Optimisation tuning the hyperparameters. A 10-fold cross-validation was performed to evaluate the models using Mean Square Error (MSE) and Symmetric Mean Absolute Percentage Error (SMAPE). Results According to the RF algorithm, the three most influential variables were animal space (56.43%), DIM (29.86%) and MoL (1.37%). The RF and XGB regressors were fitted first with the full model and then with only the two most relevant variables. The full model yielded MSE values of 0.009 (RF) and 0.007 (XGB), with SMAPE values of 25.6% and 23.6% respectively. Using only the two key variables, RF and XGB achieved MSE values of 0.0126 and 0.012, with SMAPE values of 27.86% and 28.06% respectively, demonstrating that variable reduction was effective while maintaining predictive accuracy. Conclusion Animal space significantly influences sheep milk production. Models with all variables and only two key predictors had similar errors, confirming that simplification maintains accuracy.

Session Poster A — Poster 6

Virtual Screening for Methane Emission Mitigation in Ruminants

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Drug discovery increasingly relies on in silico methods, molecular modeling, and machine learning to accelerate therapeutic development. However, this approach remains underutilized for enteric methane inhibition despite its potential. Methane (CH□) from ruminal fermentation is a major agricultural greenhouse gas, produced by methanogenic archaea via CO□ reduction. Methyl-coenzyme M reductase (MCR) catalyzes the final step, making it a key CH□ mitigation target. AI-assisted virtual screening, akin to drug discovery, can identify MCR inhibitors with minimal impact on the ruminal microbiome, which we aim to make freely accessible as a public database. Using an AI-driven workflow, we screened 180,000+ natural compounds from plant, food (FooDB), yeast (YMDB), milk (MCDB), and bovine-related (BMDB) databases. Compounds were filtered via FP-ADMET for PAINS patterns and ADMET properties (toxicity, solubility, metabolism). Structurally similar molecules were clustered to optimize screening. Molecular docking via AutoDock Vina, using the Lamarckian Genetic Algorithm (LGA) for conformational search and a semi-empirical free energy scoring function, employed a predefined grid box (20×20×20 Å) centered at the MCR active site (PDB ID: 5A0Y). Flexible-rigid docking applied to the pre-processed protein structure—water removed, hydrogens added, and active site protonation optimized. Docking targeted the methyl-CoM/CoB binding pocket, while off-target effects were assessed using MDAnalysis with seven glycolysis and short-chain fatty acid metabolism enzymes. This process identified 896 compounds (< -8kcal/mol), including Bisdemethoxycurcumin and Paeoniflorin. Selected inhibitors, based on simulated affinity with MCR, biological properties, and cost-effectiveness were chosen for in vitro validation via the Hohenheim Gas Test (HGT) with rumen fluid from fistulated dairy cows. Incubations are ongoing and will assess inhibitory effect of compounds on CH4, gas production, and organic matter degradability.

Session Poster A — Poster 7

Why we should reconsider our ethograms before attempting to automate behaviour analysis

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Automated behaviour analysis is often regarded as the holy grail in ethology and has become increasingly feasible with recent advancements in machine learning (ML). We attempted to automate the assessment of abnormal rising and lying down behaviour in cattle using accelerometers and ML, using manual observations to label training data and evaluate model performance (Brouwers et al. 2023). Despite achieving almost perfect intra-observer reliability (Cohen's Kappa $\kappa = 0.96$), model performance ranged from poor to moderate (balanced accuracies of 0.56–0.74), with learning curves plateauing. We concluded that ethograms designed for human observers may require more precise behavioural classification for successful automation. However, this issue extends beyond our study. Siegford et al. (2023) reviewed automated behaviour analysis (ABA) publications and found that behaviour descriptions were often limited or inaccurate. Even well-defined ethograms may contain vague terminology or behaviours without clear boundaries, complicating data annotation. Ambiguity in ethograms can undermine model performance by introducing noise into training data. Moreover, heterogeneous or biased training data will render model results also biased and misleading. To reduce subjectivity of human observers and improve ABA, ethograms should be refined with clearer behavioural boundaries. Alternative classification approaches, such as three-valued logic (allowing an intermediate category) or fuzzy logic (assigning probabilistic labels), could better capture behavioural variation. Ultimately, supervised ML models can only perform as well as the quality of their training data. Poor model performance may indicate limitations in the annotation process rather than deficiencies in the ML approach itself. Furthermore, high observer agreement does not guarantee high-quality labels, as behaviours may still be systematically misclassified, lack clear boundaries, or omit critical contextual information. Addressing these issues is critical for the successful application of AI in applied ethology and animal science.

Session Poster A — Poster 8

Associations between heat load, milk yield and cow behaviour on New Zealand dairy farms

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As global temperatures rise and weather pattens become increasingly variable, heat stress poses a significant challenge to dairy production systems. Heat stress occurs when the animal's body accumulates more heat load than it can dissipate. This negatively impacts the health and welfare of dairy cattle, leading to compromised immune function, increased susceptibility to diseases, and reduced reproductive performance. Cattle use behavioural and physiological responses to manage excessive heat load, including reducing metabolic activity, dry matter intake, and milk production. Studies on the impacts of heat stress on milk production are sparse from dairy cattle grazing outdoors and a greater understanding is needed. The automated collection of individual cow behavioural and physiological data by wearable devices provides an opportunity to understand cows' responses to heat load. This study utilised sensor technology to investigate the correlation between heat load, milk production, and behaviour for 1300 Friesian and Friesian-Jersey cows on two farms located in Waikato, New Zealand in summer. All cows were fitted with wearable devices capable of measuring hourly rumination and eating behaviour, and individual milk yield was captured using in shed milk meters. Cows were managed outdoors and offered a predominantly pasture-based diet for the trial duration. Localised climate data was measured every 15 minutes using on-farm weather stations and used to calculate the grazing heat load index, an index created for grazing systems that includes outdoor environmental factors (e.g. wind speed, solar radiation). The association between heat load and milk production and the variability between individuals will be investigated using machine learning models. This study will report on the impacts of climate on individual cow milk production, physiological indicators, and behaviour. The results will help farmers better understand the role of sensor data in interpreting the impact of heat stress on dairy cattle, enabling them to make strategic business decisions and explore mitigation options to offset negative impacts on cow performance and wellbeing.

Session Poster A — Poster 9

Beyond Respiration Chambers: A Field-Deployable Device for Continuous Methane Emission Measurement in Cattle

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Introduction Methane emissions from cattle contribute significantly to GHG levels, making effective monitoring essential. Traditional respiration chambers, while accurate, are costly and restrictive, potentially skewing data (Troy et al., 2016). ZELP's device provides a scalable, field-deployable alternative for continuous, real-world methane tracking. A dedicated machine learning pipeline processes trial data to refine the device's accuracy over time. Materials and Methods The device integrates Near Infrared optical and catalytic gas sensors, thermistors for temperature, and accelerometers for motion tracking. These sensors are mounted on a ventilated neoprene face sock positioned near the nostrils to capture exhaled gases before dilution. A two-week trial at Hall Farm, Reading, England (October 2024) tested three Holstein Friesian heifers, comparing device readings to respiration chamber data. Each heifer was monitored via CCTV and hourly visual inspections. Data collected included respiratory rates, breath temperatures, gas concentrations, and behavioural observations. Weight was recorded pre- and post-trial. Machine learning models analysed CH_4 and CO_2 concentrations from the trial data to improve emission estimates for future deployments. Results The device closely mirrored respiration chamber data, with a moderate positive correlation ($r = 0.612$, $p < 0.05$) between methane readings, supporting its reliability. Respiration rates remained within normal ranges (26–50 breaths per minute), and behavioural assessments showed no distress, confirming natural behaviours. Minor weight loss was observed, consistent with restricted feeding in respiration chambers (Llonch et al., 2018). Data collected from this and future trials will continue to train machine learning models, refining the device's precision. Conclusions ZELP's device presents a scalable, accurate alternative to respiration chambers, enabling continuous emissions monitoring in natural environments. While not AI-powered, ongoing machine learning analysis of trial data enhances its accuracy, supporting methane management in livestock production and climate policy efforts. Future research will further refine predictive models and expand deployment across varied conditions.

Session Poster A Poster 10

Reducing Annotation Effort with Multi-Layered Labels and a Pig Segmentation Model: A Case Study on Pig Behaviour and Identification

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Labelling images is essential for training models in animal behaviour identification, detection, and segmentation tasks. However, when target behaviours are infrequent or the animal group is large, this process becomes highly labour-intensive. This study focuses on optimizing labelling efforts for video data from four piglet pens, each containing 35 piglets, recorded over 16 days using two cameras. To enable identification, 20 pigs in each pen were manually marked with six colours and four line patterns. The workflow began with manually labelling pigs in 100 images using the Segment Anything approach in CVAT to train a YOLOv8 pig segmentation model. This model was then integrated into CVAT to pre-label an additional 107 images, followed by manual corrections. The final pig segmentation model, trained on 207 images, achieved a precision of 83%, a recall of 95%, and an F1 score of 89%. Behaviour and pig identification were subsequently labelled by placing a dot on each pig, allowing the labeller to assign behaviour, colour, and stripe pattern information using checkboxes. For infrared recordings, only behaviour and stripe patterns were labelled due to the absence of visible colour information. The labelled images facilitated the generation of four datasets in YOLO format: (1) pig segmentation, (2) behaviour classification, (3) stripe colour segmentation, and (4) stripe pattern segmentation. For images lacking manual or AI-generated segmentation, pig segments were generated in Python using the final trained pig detection model. This multi-step approach provides three advantages: (1) a general pig segmentation model reduces manual labelling efforts in new environments, (2) dot-based labelling focuses on pigs exhibiting target behaviours, minimizing redundant effort, and (3) multi-layered labelling prevents data duplication and facilitates adding additional labels later. This methodology streamlines labelling workflows while generating high-quality datasets for behaviour and identification detection in large animal groups.

Session Poster A Poster 11

Harnessing novel non-invasive biomarkers for biosensor-based health monitoring in aquaculture: the IGNITION project

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The rising global demand for high-quality animal protein has intensified pressure on aquaculture, highlighting the need for sustainable farming solutions that prioritize both productivity and animal welfare. Climate change further exacerbates challenges, subjecting aquatic species to stressors such as fluctuating temperatures, altered salinity levels, and consequently more handling procedures. In response, the IGNITION project explores innovative approaches to enhance animal welfare and disease resistance. The project focuses on key aquaculture species, including Dicentrarchus labrax, Salmo salar, Oncorhynchus mykiss, and Penaeus vannamei. A core focus of IGNITION is the identification of a signature of molecular, physiological, and behavioral responses that predict stress and health status. Advanced omics technologies, including metagenomics, transcriptomics, and proteomics, are being integrated with machine learning to uncover novel biomarkers in minimally invasive biological matrices that will enable a more precise assessment of the animal responses to challenges. Initial transcriptomic analyses have been conducted on the skin of seabass, salmon, and trout subjected to transport-stress, as well as on seabass exposed to temperature variations. Genes of interest are undergoing multiomics integration and machine learning-based selection to determine those with the highest predictive power for key surrogate endpoints (e.g., physiological indicators) and outcomes such as stress and disease resistance. To transition from research to practical applications, IGNITION is developing cutting-edge biosensors for continuous, non-invasive monitoring. These electrochemical sensors, designed as skin patches or floating devices, are being tested to detect these biomarkers in water and skin mucus samples, allowing real-time health surveillance and facilitating early interventions. The combination of AI and biosensing technologies establishes a forward-looking framework for a more efficient aquaculture industry.

Session Poster A Poster 12

Tech-Driven Transformation in Insect farming: The Future of Black Soldier Fly Larvae with Nasekomo and Fly Genetics

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Black soldier flies (Hermetia illucens) are gaining recognition for their potential in sustainable farming and circular economy. Together Nasekomo and Flygenetics, we are at the forefront of this innovation, leveraging advanced technology to enhance the farming of black soldier fly larvae. On our digital strategy, we explore the innovative integration of cutting-edge technology in our insect rearing and genetic selection operations. We utilize advanced data collection software, which consolidates all data into a centralized system, enhancing efficiency and accuracy. Daily insect rearing also uses tracking technology for rearing units' management that ensures precise monitoring and traceability. Additionally, we have integrated scales connected to the software, which directly inputs weight data, eliminating human typing errors. Furthermore, we are developing an artificial intelligence system trained with photos of larvae to determine both their number and weight. This AI-driven analysis aims to simplify the process for our team, who currently count and weigh the larvae manually. By automating these tasks, we save countless hours and ensure data accuracy, significantly improving operational efficiency and data reliability. Our integrated system not only streamlines data collection and management but also sets the stage for scalable and sustainable insect farming practices. The digital strategy envisioned will support a line of franchise factories using the power of AI and ML, which we envision to integrate to operate sustainable and intelligent insect farming.

Session Poster A Poster 13

Deep Learning for Automated Coccidiosis Detection in Poultry Gut Images

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The poultry meat industry has rapidly expanded over the last 70 years, with the European Union among the world's top producers, yielding approximately 13.4 million tons annually. However, intensive farming has increased enteric diseases, posing economic and animal welfare challenges, making gut health management crucial for sustaining production. Coccidiosis remains a major concern, with Eimeria species (E. acervulina, E. maxima, E. tenella) being the most pathogenic and prevalent. Traditional diagnostic methods, such as operator-dependent coccidiosis scoring, are labor-intensive, subjective, and expert-dependent. AI-powered image analysis offers a scalable and objective alternative. As a first step, this research applies deep learning-based computer vision to automate binary classification of poultry gut images as infected or non-infected with coccidiosis. We evaluate multiple pre-trained convolutional neural networks (CNNs), including InceptionV3, Xception, ResNet50, MobileNet, and VGG16. Data collection is ongoing, capturing high-resolution gut images from chickens experimentally challenged with coccidiosis or non-infected, using a professional camera and phone. These images are manually labeled for model training. Preliminary results indicate that InceptionV3 achieved 89% accuracy. Further data acquisition aims to enhance model robustness and scalability. This research lays the foundation for an automated and scalable diagnostic pipeline by leveraging AI-powered image analysis of poultry gut images. Future work will focus on species classification and lesion scoring, contributing to faster and more precise coccidiosis detection, improved gut health management, and enhanced poultry welfare and industry sustainability.

Milk yield prediction based on udder measurements in Pelibuey sheep using image processing and machine learning: Preliminary Results

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Introduction. Pelibuey sheep are widely bred in Latin America and other regions, mainly for meat production. However, interest in milk production has increased in recent years. This study aims to estimate milk yield using udder measurements, such as udder area, obtained from simple smartphone or camera images. Materials and methods. This study has two main stages: (1) extraction of udder measurements (width and height of udder and teats) using image processing tools such as Labelme®, PyTorch® and YOLOv8®; (2) application of machine learning (ML) algorithms for milk yield estimation based on these extracted features. We use Artificial Neural Networks (ANN), Support Vector Machines (SVM), Random Forest (RF) and Decision Trees (DT), among others. Preliminary results. Initial experiments on a dataset of 357 samples with 16 features, including udder measurements, yielded a Mean Squared Error (MSE) of 0.1176. This dataset did not yet include any image extracted features. Currently, we have analyzed 600 sheep images to classify breed using a YOLOv8 and Convolutional Neural Network (CNN) model, achieving 96% accuracy. We are also identifying and segmenting sheep udders from images. In a dataset of 90 udder images, our method effectively detects udder contours and demonstrates high accuracy. Conclusion. Our results confirm the feasibility of using image processing and machine learning to estimate the milk yield of Pelibuey sheep. Ongoing experiments integrate udder measurements extracted by image processing with validation by domain experts.

Use of machine learning algorithms to estimate the phenolic compounds and antioxidant activity of honey based on colour parameters

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Introduction: The flavonoids and phenolic acids found in honey are derived from nectar, pollen and propolis, and contribute to its nutraceutical properties. These bioactive compounds are key to the antioxidant activity of honey, which helps mitigate oxidative reactions beneficial to human health. This study aims to estimate the phenolic compound content and antioxidant activity of honey based on colour using machine learning algorithms. Materials and methods: A dataset of 210 honey samples was analyzed. Colour parameters (L*, a*, b*) were considered as predictor variables, while total phenolic content, flavonoid content and antioxidant activity (ABTS and DPPH) were considered as response variables. The following MLA were used in our study: Support Vector Regression (SVR) with a Radial Basis Function Kernel, Random Forest (RF) and eXtreme Gradient Boosting (XGBoost). A 10-fold cross-validation was performed to evaluate the models using Mean Square Error (MSE) and Symmetric Mean Absolute Percentage Error (SMAPE). Results: For all response variables, the RF algorithm showed the most accurate estimates, with the lowest MSE (0.06) and SMAPE (5.87%). It was followed by XGBoost with an MSE of 0.018 and a SMAPE of 9.62%. In contrast, SVR showed the worst predictive performance with a SMAPE of 17.42%. These results suggest that honey colour can be influenced by factors such as the content of phenolic compounds. Indeed, colour is a key quality attribute perceived by consumers, which significantly influences their preferences and choices. Conclusion: Our results showed a strong relationship between honey colour, phenolic content, and antioxidant activity, allowing accurate estimations, especially using the RF algorithm. This approach improves the accessibility of measuring these beneficial compounds at the farm level, benefiting both honey producers and consumers.

Session Poster A Poster 16

Machine Learning-Based Prediction of Milk Yield from Early-Life Data

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Accurately predicting milk yield from early-life data is critical in order to optimize dairy farm management, improve breeding programs, and enhance economic sustainability. Machine learning (ML) models, particularly those integrating genomic and phenotypic data, have shown promising results in forecasting lactation performance. This study builds upon the feed-forward neural network developed by Vergani et al. (2024), which was originally trained on 400 Holstein Friesian cows to predict daily milk yield using genomic breeding values (gEBV), parity, days in milk, age at calving, and month of calving. While the previous study focused on model development, we extend its application by validating it on a dataset of 343 lactation curves from 252 cows whose records were not used during the training phase. To evaluate predictive accuracy, the trained model's daily yield estimates were compared with the actual lactation curves of those cows using mean squared error, mean absolute error, and Pearson correlation. In addition, we introduced a novel simulation approach to assess the impact of calving timing on lifetime milk production. By systematically shifting the age and month of calving by two or four months, while keeping other factors constant, we examined how these breeding decisions influence overall lactation performance. According to our preliminary findings, there may be an opportunity to confirm the model's predictive accuracy and demonstrate the potential of integrating genomic and phenotypic data for early-life milk yield forecasting. The simulation results further highlight the influence of calving timing on lifetime production, offering valuable insights for refining breeding decisions. This study was carried out within the Agritech National Research Center and received funding from the European Union Next-GenerationEU (PIANO NAZIONALE DI RIPRESA E RESILIENZA (PNRR) – MISSIONE 4 COMPONENTE 2, INVESTIMENTO 1.4 – D.D. 1032 17/06/2022, CN00000022). This manuscript reflects only the authors' views and opinions, neither the European Union nor the European Commission can be considered responsible for them.

Plenary Session Theatre 1

AI for Healthcare: a multimodal perspective

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The world is inherently multimodal – humans interpret information through vision, sound, touch, and language. Likewise, healthcare relies on diverse data types, from medical images to clinical notes and physiological signals. Integrating these modalities effectively is vital for accurate disease assessment and treatment, yet poses a complex challenge for both humans and machines. We introduce the Multimodal Variational Mixture-of-Experts (MMVM) VAE, a novel weakly supervised model designed to learn rich representations from heterogeneous, partially labeled, and incomplete multimodal medical data. This study focuses on chest radiographs from the MIMIC-CXR dataset, using frontal and lateral X-ray views as distinct modalities. The MMVM VAE employs a soft-sharing mechanism via a modality-aware prior, allowing each modality to contribute flexibly to a shared representation while preserving its unique characteristics. Unlike standard aggregation-based multimodal VAEs, which often lose modality-specific details in a joint latent space, MMVM enhances performance across modalities. We benchmarked the model against independent VAEs and aggregation-based multimodal VAEs, evaluating diagnostic label classification (e.g., cardiomegaly, edema, pleural effusion) using random forest classifiers trained on the learned representations. MMVM consistently outperforms competitors, especially with the less informative lateral view, achieving performance on par with or surpassing fully supervised classifiers, even with limited labeled data. It maintains high performance using just 10% of labeled training data, leveraging unlabeled examples during representation learning. Additionally, the model supports conditional image generation, such as synthesizing frontal X-rays from lateral views, offering utility in scenarios with missing data. These findings underscore MMVM VAE's potential for clinical applications, addressing data integration and label scarcity. Its flexibility and strong performance make it a solid candidate for scalable medical imaging solutions. This talk explores the opportunities and challenges of multimodal learning in healthcare, and how leveraging real-world data structure can improve performance.

Plenary Session Theatre 2

AI-Driven Pathways for Intelligent Disease Diagnosis in Livestock Animals

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China's livestock and poultry industries face challenges in epidemic disease prevention, as traditional methods relying on farm workers and veterinarians often delay detection and overuse veterinary drugs. This study introduces an "inspection-diagnosis-prevention" framework, leveraging advanced techniques to enhance disease management. Drawing from human multi-modal perception, we developed intelligent technologies to detect sub-clinical and early-stage diseases through environmental, physiological, and behavioral indicators. Key innovations include a real-time pig weight estimation model free of posture constraints, a multi-modal audio framework for identifying pig coughing and sneezing in production settings, and optimized tracking and behavior identification networks with over 95% accuracy. High-precision diagnostic models (>92% accuracy) were built using multi-modal data, veterinary expertise, and extensive case data, covering 15 pig and 38 chicken diseases. For proactive prevention, autonomous robots were created for inspection, needle-free vaccination, variable spray immunization, and whole-house disinfection. The poultry inspection robot, with autonomous navigation, completes rounds in 1.5 hours. The needle-free vaccination robot delivers doses in 8.29 seconds with a 1.9 cm deviation, while the spray immunization robot adjusts volume based on bird numbers, minimizing waste. The disinfection robot, enhancing pig farm bio-security, achieves 20 mm navigation precision and cuts water use by 95%. These robots reduce labor by 80%, boosting efficiency and limiting exposure to hazardous chemicals. A smart veterinary cloud platform, embedded with diagnostic models, supports poultry and pig disease management. Collaborating with leading Chinese breeding enterprises, we conducted large-scale demonstrations across commercial farms. Over three years, the poultry platform served 52,000 users, handling 438,000 cases, while the pig platform supported 25,000 users with 648,000 cases. Together, they've aided 420 million chickens and 48 million pigs, providing critical technological support to improve disease prevention and address the shortage of front-line veterinarians in China's livestock sector.

Plenary Session Theatre 3

AI for Scientists: Perception, Reasoning, & Discovery

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Artificial intelligence (AI) holds immense potential to accelerate scientific discovery. However, significant gaps exist in translating these models to complex, real-world challenges within animal science. These challenges include integrating domain knowledge, improving data efficiency, and tailoring solutions to the unique needs of animal science research. We will present our research on collaborative AI systems designed to bridge these gaps, empowering scientists to extract insights from high-dimensional data, such as videos capturing animal behavior. First, we demonstrate how general-purpose video foundation models, by leveraging Internet-scale datasets, enable new ways to tackle domain-specific problems in behavior analysis. Next, we explore how recent advancements in AI, particularly large language models (LLMs), facilitate neurosymbolic approaches for analyzing complex scientific data, employing techniques like library learning and external knowledge integration. Looking ahead, we envision AI agents collaborating with scientists throughout the scientific process, to further our understanding of the natural world.

Intelligent Control and Robotics for Precision Livestock Farming

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Livestock farming is an important global protein producer, with the EU playing a major role in the sector, contributing nearly 125 billion euros annually. According to the Food and Agriculture Organization (FAO), global demand for livestock protein is expected to rise by 200 million tonnes between 2010 and 2050. Meeting this demand while ensuring healthy, balanced diets and environmental sustainability presents a major challenge. Additionally, livestock farming, like other agricultural systems, is highly vulnerable to climate change and faces a growing labor shortage. Implementing intelligent control and robotics to improve efficiency, sustainability, and autonomy in livestock farming is a critical priority both in the EU and worldwide. Achieving this transition requires real-time monitoring of animal status, smart indoor climate control, and energy-efficient ventilation and cooling systems are crucial. These measures help minimize pollutant gas emissions and optimize environmental conditions in livestock facilities. Moreover, planning and controlling robotic systems for operations in livestock buildings is also essential. However, livestock farming is a complex, interdisciplinary field influenced by consumer demands, input costs, animal welfare concerns, food safety regulations, and environmental impact. The dynamic and cluttered nature of these systems adds to the challenge. Additionally, livestock farming involves significant uncertainties in environmental conditions and high variability in animal behavior and production outcomes. Understanding these systems, modeling their dynamics, diagnosing issues, and interacting with them to achieve specific goals are critical yet challenging tasks. This keynote will examine intelligent control and robotic technologies that enhance efficiency, sustainability, and autonomy in livestock farming. Key examples include smart indoor climate control, emission reduction strategies, and robotic automation for manure cleaning in dairy barns. These applications highlight the transformative role of intelligent control and robotics in advancing precision livestock farming.

Session Poster B Poster 1

MCFBR-Net: A Multi-target Cow Feeding Behavior Recognition Model for Spatiotemporal Action Detection

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We propose MCFBR-Net, a novel spatiotemporal recognition model based on the enhanced YOWOv2 framework (with a baseline mean average precision mean (mAP) of 82.1% on the UCF101 – 24 datasets), which introduces a bimodal enhancement mechanism to address the above limitations and is mainly divided into 2D convolutional branching and 3D branching. The experiment is based on the Linux operating system, Pytorch framework, and carried out on 1 NVIDIA A800 with 80G of memory, while Python 3.8, torch2.1.2, and cuda11.3 are constructed as the test environment. To validate the effectiveness of the benchmark model, several mainstream spatiotemporal action detection models with different architectures, such as YOWOv2 series, ACRN, VideoMae, etc., were trained using the cow feeding behavior dataset for comparison. To ensure the stability of the model convergence, this chapter adopts a linear warm-up learning rate adjustment strategy, in which the base learning rate is set to 0.0001, the adjustment factor is set to 0.00066667, and the decay is done once every interval of 500 steps. The input image size is 224×224 the image batch size is 64, and the weight parameters are saved and the model is evaluated after confirming the convergence of the model. By synergizing spatiotemporal feature aggregation with computationally conscious design, MCFBR-Net establishes a viable pathway toward intelligent precision feeding systems that concurrently advance herd management efficiency and dairy cattle welfare. In summary, the existing research for dairy cows' arching material, foraging, and other actions is recognition accuracy still has a large room for improvement, dairy cows chewing, eating, etc. are the focus of attention, and we will continue to ingest the dairy cow feeding behavior topic of the study, in the hope of further improving the field applicability of the existing model in the complex cattle farm environment.

Session Poster B Poster 2

Prospective of Monitoring Infectious Disease Dynamics in Livestock Through an Integrated Approach of Continuous Sensor Data and Frequent Molecular Analysis

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Animal infectious diseases pose significant threats to livestock health and food security. Traditional monitoring methods, relying on snap-shot observations and low frequency biological sampling, limit the ability to detect early infection markers and understand dynamic host-pathogen interactions. However, advancements in sensor technology and obtaining minimal volumes of blood or other fluids by micro-sampling offer opportunities for near real-time, high-resolution monitoring. Our previous studies have demonstrated the feasibility of using non-invasive sensors for near real-time, automated, monitoring of individual animal activity in infectious disease trials under experimental conditions. These findings highlight the potential of continuous individual behavioral monitoring in infectious disease research. Building on this, we propose integrating continuous monitoring of animal behavior and physiological parameters, such as temperature and heart rate, with frequent blood micro-sampling for molecular analysis of e.g. metabolites and immune markers, enabling a more comprehensive assessment of disease progression. The proposed research will generate dynamic infection progression patterns, offering a comprehensive view of disease onset, progression, and recovery. We anticipate that this integrated approach of continuous sensor monitoring and frequent molecular analysis will deepen our understanding of host-pathogen interactions. By identifying key sensor markers that align with molecular disease indicators, we aim to enhance real-time health monitoring in livestock species by an earlier or improved detection of (subclinical) infectious diseases. The final prospective of this approach is to contribute to more accurate diagnostics, better interventions, while simultaneously generating more reliable data for AI applications, supporting improved AI-driven solutions for infectious diseases in farm animals.

Session Poster B Poster 3

Association between sensor-based prepartum behaviour monitoring and early postpartum health in dairy cows: A case study

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The transition period in dairy cows is a critical phase with physiological changes that increase susceptibility to periparturient disease. This study investigated whether prepartum behavioural sensor data from cows was associated with health problems postpartum. Nineteen Holstein Friesian cows were monitored from two weeks prepartum to two weeks postpartum. The cows were fitted with neck and leg accelerometers (SmartTag, Nedap N.V.) to record behaviour. Mean, variance, autocorrelation, and non-periodicity were calculated for lying, ruminating, eating, and inactivity (time per hour) and steps and neck movements (number per hour) over 8 days in the close-up group. Physical examinations, including general appearance, rectal temperature, rumen fill, rumination, udder condition, body condition score, and locomotion, were conducted three times a week before and after parturition to assess general health. A Total Deficit Score (TDS, adapted from Dixhoorn et al., 2018) was calculated based on the results of the examinations. Pearson and Spearman correlations identified relevant TDS-associated behavioural variables ($p < 0.25$) which were checked for multicollinearity before inclusion in a general linear model (GLM), adjusting for parity (primi- or multiparous). Model assumptions, including residual normality, were assessed. Significance was set at $p < 0.05$. The model was statistically significant ($F(5,8) = 10.84$, $p = 0.002$, $R^2 = 0.87$). Higher TDS was associated with increased neck movement variability and lying time but decreased mean neck movement and inactivity variability. Parity had no significant effect. Although there are few animals in this study, these findings support the potential of AI-driven sensor analysis prepartum in predicting health risks postpartum in dairy cows, enhancing precision livestock farming.

Session Poster B Poster 4

Exploring machine learning algorithms on activity and feeding behaviour for early estrus detection in dairy cows

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The recent advances in sensor technology have allowed accurate predictions of estrus events using animal behavior information. To enhance reproductive performance in dairy cows, it is essential to detect estrus onset associated with ovulation time in a timely and accurate way to ensure high pregnancy rates and profitability. The objective of this study was to evaluate the potential of machine learning techniques to identify the onset of estrus in dairy cows using hourly behaviour data collated from 1,750 dairy cows housed in a free-stall barn at 5 commercial dairy farms during the 2 years period. The behaviour was measured using the behaviour-monitoring collar (MooMonitor+, Dairymaster, Causeway, Co. Kerry, Ireland) of each animal 24 h/day. In our model, we used behavioral data about dairy cows' rumination, resting, feeding, and activity. Calculated variables such as days since last heat and mean of days since last heat were incorporated to improve accuracy of the model. Different classification machine learning techniques (Extreme Gradient Boosting (GBDT), Random Forest (RF), Decision Tree (CART), K-Nearest Neighbors (KNN), Gausian Naïve Bayes (NB), Linear Discriminant Analysis (LDA), Logistic Regrssion (LR)) were evaluated to identify the onset of estrus in dairy cows. The study showed that the accuracy, precision, sensitivity, specificity and F1 score of the Random Forest algorithm were up to 94.98%, 99.19%, 94.62%, 96.60%, 96.85%, respectively, which indicates a great potential for early estrus detection. Keywords: accelerometer; machine learning; MooMonitor+; precision farming; Random Forest

Session Poster B Poster 5

Transforming Dairy Farming in Romania: The Role of AI in Research and Precision Livestock Management

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The integration of artificial intelligence (AI) and precision livestock farming (PLF) technologies is transforming dairy farming globally by improving productivity, efficiency, and animal welfare. In Romania, small and medium-sized dairy farms face unique challenges, including financial constraints, limited digital literacy, and inadequate infrastructure, which hinder the adoption of these technologies. This study explores the role of AI in addressing research and farm management challenges, emphasizing its potential to optimize decision-making and promote sustainability. Data was collected through semi-structured interviews with dairy farmers and 8 agricultural experts, including veterinarians, policymakers, and technology providers. The interviews investigated the current use of digital technologies, barriers to adoption, and opportunities for AI integration. Results indicate that 45% of farmers use health and fertility monitoring sensors, while only 18% implement comprehensive farm management software. Barriers such as high costs (63%), limited knowledge (36%), and infrastructure challenges (27%) were identified. Despite these obstacles, stakeholders acknowledged the benefits of AI in enabling real-time monitoring, improving productivity, and reducing environmental impact. The findings highlight the need for affordable, user-friendly AI tools, enhanced digital literacy programs, and better infrastructure. Collaborative efforts between researchers, policymakers, and farmers are essential to support the digital transformation of Romania's dairy sector, fostering resilience and sustainability.

Session Poster B Poster 6

AI-driven forecasting of heat stress effects on dairy production using TSMixer neural network

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Climate change-driven heat stress poses a major threat to the dairy industry. This condition results from the interplay of environmental factors such as temperatures, humidity, and airflow, which negatively influence animal health leading to substantial economic losses for the global dairy sector. Recent developments in Artificial Intelligence introduced tools that use historical data to predict future scenarios, offering valuable support in managing heat stress-related issues. This research aims to evaluate and forecast the impact of microclimatic conditions on milk production. From 2016 to 2023, data on milk yield were gathered from an Automatic Milking System on a commercial dairy farm, while meteorological data were obtained from a weather station. Relative humidity and temperature were elaborated to compute the Temperature-Humidity Index (THI). Our analysis revealed a significant negative correlation between protein content and the THI, with the strongest correlation of -0.66 occurring at a five-day lag, highlighting a strong relationship between milk quality and environment. Understanding both present and past microclimatic conditions is essential for accurately forecasting future trends in milk production and quality. To achieve this, we used a cutting-edge Neural Network known as TSMixer to forecast protein content, fat content, milk production, and milk temperature over a two-month horizon, leveraging input data from the preceding three months. TSMixer was trained and validated using data from 2016 to 2021 and tested with data from 2022 and 2023. Test results showcased the model ability in accurately predicting linear trends, achieving R^2 values of 0.83, 0.81, and 0.80 for protein, fat, and milk production, respectively.We compared the absolute error distribution on the test set between the TSMixer model and a baseline model that describes the yearly averaged pattern of four target variables. The results show that the TSMixer model produces significant lower absolute errors compared to the baseline, because of a Wilcoxon statistical test.

Session Poster B Poster 7

Benchmarking predictive models: evaluating parametric, ensemble, and deep learning approaches for animal phenotype prediction from genotypes.

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Over the past two decades, advancements in DNA genotyping have revolutionized the acquisition of extensive genomic data, essential for enhancing genomic selection in animal breeding across multiple traits. Concurrently, the rapid progress of artificial intelligence has piqued interest in its application to genomic selection. The objective of this study was to conduct a benchmark analysis, comparing various parametric, ensemble, and neural network methods for predicting animal phenotypes using extensive genotyping data. The dataset employed for training and validating different models comprised over 100,000 Holstein cows characterized for 33 quantitative traits (milk production, fertility and morphology). Genotyping data (50K) were utilized to predict the 33 traits, employing parametric mixed model GBLUP, as well as gradient boosting (GB) and various deep learning models, including MultiLayer Perceptrons (MLP), Convolutional Neural Networks (CNN), CNN Transformer, Value Imputation and Mask Estimation (VIME), and MLP Variational AutoEncoder (VAE). According to the correlation coefficient (R), GBLUP outperformed all other models in predicting most of the traits. However, on average, MLP performed slightly less effectively than GBLUP, with no significant difference ($p>0.05$). The other models demonstrated lower efficiency. Conversely, based on RMSE, 2/9 traits were more accurately predicted by GB or MLP models. Further refinement of deep learning models specifically tailored to genomic data is essential for improved prediction of traits.

Session Poster B Poster 8

Computer Vision and Deep Learning for Remote Cattle Behavior Tracking on Pasture

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Incorporating pasture access into dairy production systems provides substantial benefits, such as lowering feed costs, promoting natural behaviors like grazing and resting, and enhancing animal health and welfare. These benefits also create challenges related to efficient animal monitoring and feed management for example. Precision Livestock Farming (PLF) systems help in supporting the adoption of pasture-based farming by enabling real-time and long-term monitoring of livestock. This study presents a novel computer vision system leveraging the YOLOv8 deep learning model to monitor cattle grazing, lying, and standing behaviors on pastures. Video data was collected from 24 cows across two pastures. A high-resolution camera setup captured over 200 hours of video footage, and 12578 annotated images were used to train the model. The model achieved an overall accuracy of 97%, with the highest precision and recall scores (98%) obtained for lying behavior, followed by grazing and standing behaviors (91-97%). By processing data locally on an edge computing board (Nvidia Jetson Orin Nano), the system processes the recordings locally in remote locations, only transmitting processed results via 4G/5G networks to an InfluxDB database for analysis. The results highlight the potential of edge computing and computer vision to deliver scalable, cost-effective solutions for real-time livestock monitoring. Future developments include expanded datasets, autonomous solar-powered setups, individual animal tracking, and integration with remote sensing for enhanced pasture quality assessments. This research marks a significant step toward sustainable and precision livestock farming practices, and was performed within the framework of the Horizon Europe project XGain (Grant agreement ID: 101060294).

Session Poster B Poster 9

A Decision-Making Tool Leveraging Open-Access Dataset: Unsupervised Learning for Individualized Benchmarking of Grigio Alpina Cattle

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Grigio Alpina is an indigenous Italian cattle breed, typically managed in small-scale herds (average herd size = 9.6). Limited access to advanced commercial management tools hinders Grigio Alpina farmers' ability to assess individual animal performance. This study explores the potential of open-source datasets to support these farmers in evaluating their cattle and making informed management decisions. We developed a digital reporting system to provide insights into individual animal performance, leveraging data from the Livestock Environment Opendata. Key performance scores were calculated for milk quality (based on fat, lactose, casein, protein, and a cheese-making performance index), fertility (represented by average calving interval), and disease (derived from somatic cell count, acetone, and beta-hydroxybutyrate). Using unsupervised learning techniques, Principal Component Analysis (PCA) reduced dimensionality, revealing fertility (-0.87) as the main driver of Component 1 (41.0% variance) and disease indicators (-0.76) as the primary contributor to Component 2 (37.1%). K-means clustering grouped animals into three clusters: (1) overall best-performing, (2) fertility-deficient, and (3) disease-susceptible. Farmers can visualize individual animals within the clustering results, identifying their relative standing compared to the broader Grigio Alpina cattle population. This enables informed decision-making regarding culling, breeding, and overall herd management. This study highlights the feasibility of using open-source datasets to generate actionable insights, even in the absence of extensive labelled data.

Session Poster B Poster 10

The effects of climate change on thermal stress in cattle: global projections with high temporal resolution

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Cattle farming is highly sensitive to environmental conditions, with heat stress causing significant economic losses in this agricultural sector. Temperature and humidity are the two main determinants of thermal balance in cattle. The Temperature-Humidity Index (THI) is a non-invasive measure, commonly used to estimate the effects of thermal stress on livestock. This study utilizes a dataset, generated through a novel machine-learning approach, containing hourly THI projections with global coverage, extending to the end of the century, under different greenhouse gas emission scenarios. Using widely validated definitions of mild and severe thermal stress, we project the duration and intensity of thermal stress periods, as well as the frequency and duration of thermal stress waves. By cross-referencing these projections with global cattle distribution data, we identify regions with the highest risk of worsening thermal conditions for cattle. Our findings indicate that conditions associated with severe thermal stress will pose increasing challenges to the global cattle farming industry. Additionally, we identify the Americas, Africa, and South-east Asia as regions with the highest future risk for worsening thermal conditions. These results highlight the urgent need for adaptation strategies to mitigate the effects of rising temperatures on livestock production.

Session Poster B Poster 11

AI-Driven Approaches for Animal Welfare Monitoring in Agroforestry Systems

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Climate change and shifting agricultural practices require innovative methods to monitor and improve animal welfare for pasture-based and other outdoor livestock. Agroforestry systems, integrating livestock with trees, shrubs and other woody vegetation, might provide shade, shelter, diversified feed and improved microclimates but require advanced monitoring to assess their impact on animal well-being. As part of the Agroforestry Living Laboratory at Rhine-Waal University, we are developing AI-driven, sensor-based solutions to monitor livestock welfare, focusing on small ruminants as well as poultry. To achieve this, we are evaluating AI-based monitoring methods to improve our understanding of animal welfare, while evaluating the role of different data sources. Sensors on animals collect data on movement patterns, and shade use, potentially providing insights into behavioral adaptations and stress responses. Stationary non-invasive camera systems are tested using computer vision and AI to assess posture, interactions, and activity on individual and group levels. Additionally, microclimate sensors might measure environmental conditions such as temperature, humidity, and radiation to evaluate their effects on animal behavior. As agroforestry systems are often in remote areas without external power, we also analyze the potential of self-sustaining sensor networks powered by solar energy and edge computing. These systems minimize energy consumption through deep-sleep modes and decentralized data processing, ensuring continuous monitoring without constant human intervention. By integrating AI-driven pattern recognition with agroforestry systems, we aim to establish an autonomous, energy-efficient monitoring network for further insights into animal welfare, behavioral changes, and environmental adaptation. Though still in development, early findings suggest these methods might enhance data-driven decision-making for sustainable pasture management, benefiting both animal welfare and agroforestry system resilience.

Session Poster B Poster 12

Decisions-making model for microclimate control on the pig farms

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The presented microclimate control model to provide animal welfare and immunity uses a combination of natural and forced ventilation and a sorbent to remove ammonia from the air in the pig farm buildings. The model is based on the next controlled processes: the three-level system of windows and vents for ventilation of air: at the floor level, at the level of the pig growth and at a height of 1-1.5 m above their growth;air purification from ammonia to ensure its safe content of 0.0025% vol.;air cooling or heating to maintain an optimal temperature 15-20^{0}C;spraying water (irrigation) to regulate the optimal air humidity 50-70%.Microclimate control parameters are measured using sensors at three levels inside the building: indoor temperature and humidity, humidity above the floor and floor bedding, ammonia and carbon dioxide concentration, air velocity (air inflow velocity), outdoor temperature and humidity. Pig condition control parameters for thermoregulation are the temperature of individual body parts and skin moisture; for welfare – pig immunity and hormone biomarkers. The control parameters are automatically regulated according to the algorithm and adapted software at deviations of 15-20%. A sorbent based on natural humic substances with a humic acid content of min 62% was developed to clean the air from ammonia. This sorbent can be used in adsorbers and as component of a floor bedding. Thermal activation was carried out at a temperature of 60 to 105^{0}C. This method is a simple, inexpensive and industrially scalable. The processes of sorption – desorption of ammonia and water at 18^{0}C were studied. The amount of adsorbed ammonia and water was 5-10 times greater for thermoactivated samples than for undried ones. Ammonia sorption under static conditions above 2% aqueous ammonia solutions was 0.8% for activated samples after 1 h, after 4 h – 2.2%, after 24 h – 7.5%, after 10 days – 24.3%. Sorption of water vapor was 4.7% after 24 h, 13.8% after 10 days. The intensive evaporation of ammonia was 22.1% from activated samples for the first hour of desorption. This activated sorbent can be added to the floor bedding for air purification in farms. The study was supported by the Ministry of Agriculture of the Czech Republic– project RO0723 and QK23020085.

Session Poster B Poster 13

Deep Learning in the bioinformatic modelling of functionally annotated microbial communities in aquaculture

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Recently, there is a significant increase in interest in machine learning techniques. These technologies are increasingly being used in image generation and text recognition, demonstrating high accuracy. They are also gaining popularity in scientific and biological fields, aiding in predictive and classification problem-solving. The aim of this study is to assess the usefulness of these tools in common carp classification based on applied probiotics. Microbiome data were collected from the intestines of Common Carp. Samples were obtained from individuals living in different environments and then sequenced. Based on this data, tables of abundance of different biounits were created (bacterial family, KEGG orthology, KEGG pathways). The study aimed to determine whether the type of given probiotic could be identified based on differences in the occurrence of specific biounits. To achieve this, two neural network classification models were developed and refined: dense (DNN) and convolutional (CNN). Preliminary results indicate that dense models performed better with accuracy of 0.65, when CNN models achieved 0.5, meaning the models correctly classified 65% and 50% of cases. While these are not perfect results, further model refinement through changes in structure or training on larger datasets could significantly improve effectiveness.

Session Poster B Poster 14

AI Meets Tradition: Enhancing Italian Small Ruminant Biodiversity through Breed Identification

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The conservation and sustainable management of Italian small ruminant breeds are crucial for preserving livestock biodiversity. Italy counts over 100 sheep and goat breeds, often raised in extensive farming systems and mountainous and marginal areas, many of which hold high cultural and environmental value. Their presence supports rural economies and contributes to the identity and landscape of regions with strong tourist appeal. However, many local breeds are at risk due to limited distribution and declining populations. One key challenge in their management is the correct registration of an animal to a breed, traditionally based on expert morphological evaluation and assessment of standard adherence. Artificial intelligence (AI), particularly deep learning techniques, offers innovative solutions to support this sector. A promising application, explored in few studies with encouraging results, is the development of AI-powered image-based classification tools for breed identification. Extending this approach to a broader scale could have significant practical implications. With photographic data collected under diverse conditions and image augmentation techniques, it becomes possible to build a robust and efficient system adaptable to the morphological variability of local breeds. Also, georeferencing images might be especially valuable, as many populations are strongly localized in specific regions; spatial data could thus enhance breed recognition, even in cases of high phenotypic variability or morphological similarity between breeds. A possible outcome of this approach could be a user-friendly mobile application to assist breeders, technicians, and associations in breed identification and registration, streamlining procedures and minimizing animal handling. Additionally, such a tool could serve an educational purpose, providing users—including tourists and local communities—with information about each breed's history, risk status, and typical products. By raising public awareness and fostering a connection between people and livestock biodiversity, this AI-based solution may contribute to the conservation and valorization of Italy's small ruminant heritage, while supporting the resilience of rural areas.

Session C Theatre 1

Leveraging AI and Multi-Sensor Data Integration for Sustainable Livestock Monitoring

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Ensuring sustainable livestock production is critical for addressing global challenges in food security, animal welfare, and environmental impact. Recent advancements in multi-sensor systems, data harmonization, and Artificial Intelligence (AI) have transformed livestock monitoring, enabling precise and automated assessment of health, behavior, and productivity at scale. The integration of AI-driven predictive models with diverse livestock data sources, including optical, thermal, acoustic, and phenotypic sensors, has unlocked new opportunities for real-time decision support and automated welfare monitoring. By analyzing large-scale multi-modal datasets, AI algorithms can extract meaningful patterns, detect anomalies, and enhance breeding schemes through improved trait selection. In this context, the EU-funded Digi4Live project (https://digi4live.eu/) focuses on collaboration and co-creation. It aims to elevate the capacity of the entire livestock supply chain, from farm to fork, by harnessing the power of digital technologies and data-driven solutions. Towards this end, one of the overarching goals of Digi4Live was to create an inventory of existing datasets and data collection technologies and assess their information content. Systematic online research was performed, and a total of 378 industry products, applications, datasets, and projects were identified. A digital platform (https://aua-site.vercel.app/) was created providing easy access and navigation to the identified solutions. The majority were used for dairy cows (69.6%) and the most frequent application area was animal health and welfare (87.8%); environment, resilience transparency and traceability, production, and policy-administration were mostly reported in livestock tracking projects. The idea of the next steps is to use the transformative potential of AI-enhanced multi-sensor data integration in livestock monitoring, highlighting key advances, challenges, and future directions for sustainable and ethical animal production.

Session C Theatre 2

Accelerometry and Machine Learning for Early Health Detection in Livestock and Companion Animals

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Early detection of health issues in livestock improves welfare, productivity, and reduces medical reliance. Mobility changes can indicate problems but are hard to detect without continuous monitoring. Wearable accelerometers with machine learning offer a scalable, non-invasive solution. In small ruminants, accelerometry-based models predicted health status with high accuracy. In sheep and goats, classification models achieved up to 83% AUC in detecting parasitic burden and treatment response. Similar methods have been applied to companion animals, successfully detecting early degenerative joint disease in cats. Ongoing research explores mobility changes linked to heart disease in dogs. Commercial sensors had issues with data quality, raw data access, battery life, and cost, leading to the development of a custom open-source sensor. Built around an nRF5340 microcontroller, it features a three-axis accelerometer with programmable sampling and sensitivity. A 50 mAh, 3.7V lithium-polymer battery provides 7 days of power, with microSD storage. The enclosure is 3D-printed, with a silicone sleeve attachment ensuring flexibility and comfort, the current version was particularly designed for maintaining cat welfare. The compact design (3 cm × 2 cm × 1 cm, 11 g) allows deployment on small animals while maintaining robust data collection. The platform supports interchangeable batteries and enclosures, making it scalable for livestock monitoring.

Session C Theatre 3

Digital Transformation of Veterinary Medicine: Opportunities and Challenges for Livestock Farming

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The digital transformation of veterinary medicine presents significant opportunities and challenges for livestock farming. Advancements in artificial intelligence (AI), the Internet of Things (IoT), and telemedicine are revolutionizing animal health management and accessibility, particularly in precision livestock farming (PLF). AI-powered diagnostics, real-time health monitoring through wearable sensors, and remote consultations via telemedicine platforms enable early disease detection, personalized treatment plans, and improved animal welfare. These technologies also optimize resource utilization, reduce environmental impact, and enhance farm efficiency. However, challenges persist, including the costs of implementing these systems, and the need for robust digital infrastructure and reliable energy-sources, particularly in remote areas. Our research highlights the emergence of a more sustainable implementation of Precision Livestock Farming (PLF) practices through the lens of Green Computer Vision and Green AI. It showcases our current work in developing energy-efficient hardware prototypes combined with low-resource computational methods for real-time analysis of visual data from sensors and cameras, reducing the carbon footprint of AI-driven livestock management and veterinary care.

Session C Theatre 4

LIB: Livestock Images Behavior

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Convolutional neural networks (CNNs) are a powerful tool for monitoring livestock using image analysis. Today, many studies have demonstrated their potential for long-term and continuous monitoring of behavior, with numerous applications in animal health and welfare, behavior understanding, and, more generally, in precision livestock farming (PLF). Most studies do not rely on custom-built CNNs but rather on pre-trained CNNs that can be downloaded online. These models have a robust design and are trained on very large datasets. However, to be used for a specific application—such as livestock monitoring—they need to be re-trained on a set of annotated images, which limits their applicability in real-world conditions. Indeed, when applied to images captured from a new angle, with background variations, or featuring animals of different colors, the CNN's performance can be drastically reduced. Although CNN architectures could be improved for greater generalization, at our level, building a diverse dataset of annotated images appears to be a promising approach. Dataset diversity is key to making CNNs more adaptable and capable of performing well even in situations not represented in the training set. Considering the numerous computer vision projects across Europe and beyond, many of which involve small annotated image datasets, we may already have a large and diverse dataset available to train a CNN specifically for livestock behavior analysis. Data sharing has proven to be highly effective, particularly in the field of animal genetics, although progress has been slower in other areas. The LIB project (Livestock Images Behavior) was conceived to initiate a collaborative research effort, where livestock images can be shared, annotated, and aggregated into a single database that will be published and made fully public. Currently, the annotated dataset includes over 10,500 images for small ruminants, 3,800 for pigs, and 2,200 for cows. These numbers continue to grow daily as more images are collected and annotated. The annotations include the location (bounding box) of the animal's body and head, as well as posture classification (standing, lying, or transitioning). We hope that this project will foster a culture of data sharing within the research community, driving progress in the study of animal behavior and precision livestock farming.

Session C Theatre 5

In-house Developed Mobile Monitoring System for Sow and Piglet Behaviour in Commercial Farming Environments

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Pre-weaning piglet mortality is a serious issue in commercial pig production with losses of about 12%. Suckling behaviour, creep feed intake, piglet vitality but also sow activity, lying behaviour and details of the farrowing process can give insights into risk factors and facilitate the development of management strategies to prevent piglet mortality. This research aims to develop a mobile monitoring system consisting of cameras, a processing unit and AI algorithms to detect and classify sow and piglet behaviour on commercial pig farms. Two pig farms at ILVO, each with a different farrowing pen layout, were equipped with 16 cameras. So far, images of eight and four farrowing batches were collected in farms 1, and 2 respectively. Recordings included daytime colour and nighttime infrared streams. An ethogram was developed to score eight classes of sow behaviour and six classes of piglet behaviour. Images were labelled by trained observers using LabelBox, resulting in 15,387 labelled instances on 845 images. A Yolov8 segmentation model was trained on 676 training images and 169 validation images, achieving a precision of 80.3%, accuracy of 88.2%, and F1 score of 77.0%. For commercial farm applications, a mobile monitoring system was developed with eight cameras, 4G, Wi-Fi, Ethernet connectivity, and local storage. This setup can autonomously collect data from 16 farrowing pens and can be easily installed on commercial farms to identify risk factors for piglet mortality during minimum one farrowing batch, and allows to advice the farmers. For privacy reasons a button to pause the recording was also added. The system and AI algorithms will be integrated into the 'PigLife toolbox' for targeted identification and resolution of farm-specific causes of piglet mortality and will be applied across 20 commercial pig farms in Flanders, Belgium.

Session C Theatre 6

AI-driven Optimization of Veterinary Care Services

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Ensuring food safety and healthy and high-quality food of animal origin requires comprehensive veterinary care. However, veterinary services are often unavailable during nights and weekends. On the one hand, the out-of-office hours services are not organized centrally (for a larger region), and the necessary information is not provided sufficiently to the animal owners. In this way, many animal owners are unaware of which veterinarians are available in the case of emergencies. In addition, the available resources are manually scheduled, not considering temporal unavailability or geographic constraints. To alleviate these problems, we propose a twofold approach providing the basis for dynamic supply regions and an interactive veterinarian finder. To this end, the locations of the practices and the animal owners are considered in a graph-based model, which is adapted over time if parameters such as available veterinarians, the position of the animal owner, or the traffic situation change. To this end, we build on publicly available map data, i.e., GADM maps, which are freely available (https://gadm.org/index.html). The bipartite graph consists of two sets of nodes: one representing veterinarians and the other representing animal owners. The edges are modeled flexibly, allowing us to include multiple parameters such as potential routes, topographic and traffic information, vacation, sick leaves, or any other occupancy of veterinarians. Based on the graph-based model, we perform within-graph cluster analysis to obtain the optimal care regions and find the optimal veterinarian for the given case together with the shortest path between patient and veterinarian. To demonstrate both services, we run experiments on three different regions in Austria and Switzerland using the actual locations of veterinary practices. By changing (manually or randomly) the number of available practices in the database, both the dynamic support regions and the veterinarian finder can be simulated. In the latter case, either an address is provided to the system or the actual GPS position can be used to find the optimal route. The services are implemented as an R-Shiny app running on a publicly available web server, allowing users to use them via any device with an installed internet browser.

Session C Theatre 7

A pilot model testing machine learning models to predict back muscle strength activity from exercising horses based on surface electromyography sensor data

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In equine biomechanics, optimising skeletal muscle function reduces injury risk, enhances recovery, and improves training adaptability. The longissimus dorsi muscle plays an important role in back stabilisation. Acquiring and processing muscle activity patterns are often time-consuming and require complex analyses. In the human surface electromyography (sEMG), muscle strength is primarily defined through Maximal Voluntary Contraction (MVC). However, MVC is impossible to collect from animals, due to lack of voluntary muscle control on command; therefore, other methods are required to assess muscle strength. This study investigates applying supervised machine learning models to predict muscle activity strength. We used PyCaret to train and compare regression models on a muscle activation dataset. We evaluated the performance of 19 regression models. Muscle data was acquired from back muscles of nine adult Warmblood horses that freely trotted in an automated horse walker. Standard signal processing was carried out. Based on the limb accelerations, a total of 820 trot strides incorporating longissimus dorsi muscle activity parameters were analysed. Among the models tested, Decision Tree and Gradient Boosting classifiers showed the best performance. They both had the highest accuracy (98.95%). Their Recall, Precision, and F1-score were also very high (0.9895-0.9920). Kappa and MCC (0.9856-0.9859) indicate excellent agreement between predictions and actual labels. The top four models underwent cross-validation, with performance re-evaluated across multiple subsets. Gradient Boosting emerged as the most accurate predictive model (MSE: 0.06609), highlighting the advantage of boosting techniques over traditional methods. The findings highlight the potential of advanced machine learning in refining muscle strength assessments, enabling more precise and dynamic biomechanical evaluations.

A Top-View 3D Point Cloud Extraction Method for Pig Bodies

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This study addresses the challenge of extracting 3D point clouds of pig bodies in complex environments by proposing a segmentation method based on a single Time-of-Flight (TOF) depth camera with a variable-height bird's-eye view.The method utilizes a self-designed push-cart data acquisition device to collect 328 point cloud datasets under complex conditions, covering three different heights, various pig body sizes, and postures.A dynamic algorithm named Dynamic Point-cloud Feature Focusing and Segmentation(DPFFS) is designed, which includes two core modules: dynamic point peak statistical filtering and dynamic multi-dimensional perceptual spatial filtering. These modules effectively remove ground point clouds and other interfering noise. Experimental results show that the method achieves a pig body extraction accuracy of 97.3%, with a maximum algorithm runtime of 1.9 seconds and an average runtime of 1.5 seconds. The method does not require dataset training and does not restrict pigs to specific channels,providing an efficient and feasible solution for pig body point cloud extraction.

Ammonia emission mitigation in pig farming: sensor monitoring and cloud analytics for sustainable agriculture

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Livestock farming is a major contributor to ammonia emissions, impacting animal welfare and the environment. Many countries regulate its concentrations and emissions, traditionally requiring expensive research equipment. Recent advancements in sensing, communication, and computing enable commercial-scale farm monitoring, optimizing data usage. This study develops an application for automatic emission calculation using gas sensors and farm parameters. Previous data from a commercial fattening pig farm were selected. Two identical, naturally ventilated buildings (980 pigs each) housed six measurement points per building, with ammonia and CO2 sensors. External concentrations, temperature, and humidity were also recorded. Data was stored in the cloud, and processed via a mass balance approach, using the CO2 balance method by CIGR to estimate ventilation in naturally ventilated buildings. The user interface, built with Flet 0.23.2 (Flutter-based) and Python 3.11.9, allows users to estimate emissions over selectable timeframes. Data preprocessing includes outlier removal, interpolation, and visualization at minute or hourly intervals. The CO2 balance method requires animal weight estimation, with two alternatives: (1) using Gompertz growth parameters and initial weight, or (2) incorporating repeated weight measurements for advanced farms. Ammonia emissions are calculated via mass balance, with results plotted and saved in CSV format. Ongoing work will also improve high-volume data processing, accelerate calculations, and integrate machine learning for enhanced emission predictions and early warning systems according to the current data obtained. Algorithms such as RNN, LSTM, and tensors will be implemented to evaluate the prediction capacity of emissions values with the available data. This research is part of the Project PLEC2023-010275 funded by MCIN/AEI /10.13039/501100011033

AI-Driven Cloud-Edge Framework for Automated Feral Pigeon Monitoring in Urban Environments

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Abstract The rapid increase in feral pigeon populations in Hong Kong has raised significant concerns related to urban hygiene, infrastructural damage, public health, and animal welfare. Despite government efforts to regulate pigeon feeding and control the population through education, penalties, and fertility control measures such as Nicarbazin, challenges persist due to the adaptability and high reproductive rate of pigeons. Traditional monitoring methods rely heavily on manual population surveys, which are time-consuming, labor-intensive, and inefficient. These limitations underscore the lag in AI adoption for ecological management and the challenges of implementing automated monitoring solutions. To address these issues, we propose a cloud-edge computing framework that integrates deep learning and computer vision for real-time and accurate pigeon population estimation. The framework consists of a mobile application for image collection, a modified YOLO model deployed on the Huawei Cloud platform for automated analysis, and a database-driven system for data storage and visualization. Designed for scalability and efficiency, this architecture holds significant potential for broader applications in ecological and agricultural monitoring. This study introduces an automated and intelligent solution framework, demonstrating how AI-driven approaches can enhance urban wildlife management and ecological monitoring. Preliminary results from an ongoing pigeon population survey in Hong Kong indicate promising outcomes, with final data and findings expected by March. Keywords: urban wildlife management, feral pigeon monitoring, deep learning, cloud-edge computing, computer vision, environmental conservation

VetInspector – an automated tool for post-mortem inspection of broiler chicken

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The European meat control consists of ante-mortem inspection (AMI) and post-mortem inspection (PMI) of carcasses, viscera and meat hygiene. Currently, official veterinarians (OV) in Denmark conduct PMI on broiler carcasses at high slaughter speeds, inspecting up to four birds per second. Introducing computer-based vision systems (CVS) like VetInspector can enhance and sustain PMI. The main objective of the VetInspector project is to develop an automatic PMI of broilers at a high Technology Readiness Level. This project involves the development, implementation, and validation of four PMI stations to support official inspections. At present, the footpad station and external station have been installed in the abattoir and will undergo training and validation in the initial phase of the study. Subsequently, the performance of these stations will be compared to that of the OV. Additional stations, including a camera station for viscera inspection and a meat hygiene inspection station, will be installed. To facilitate large-scale implementation, a risk-based condemnation code set has been developed. The ten codes covered 80% of all the reasons for condemnation in nine European countries. The remaining three codes are broiler welfare indicators. The neural network models are initially developed. Thereafter the algorithms are trained on constantly growing data sets to achieve the best possible performance. The model will allow detection of findings at the same level as an OV. Since neither OV nor the camera stations can be defined as a gold standard test, Bayesian latent class analysis is used to estimate and compare the prevalence of the lesions, sensitivity and specificity in the tested flocks. The performance results will be presented to regulatory bodies of interest in Denmark and EU for approval of the concepts and diagnostic as well as practical performance. The system will remove the line speed constraints without sacrificing food safety. It will provide data for improved animal welfare and better quality of birds. Moreover, the VetInspector will add more data about the individual chicken and perform consistent inspection for each bird in all abattoirs.

Session C Theatre 12

Machine learning-based detection of individual cow global health using MIR-predicted traits and big data

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Global health in dairy cows reflects health status and production traits, indicating overall farm performance. Traditional monitoring methods are labor-intensive, underscoring the need for data-driven approaches. Milk mid-infrared (MIR) spectra effectively predict production traits and health-related biomarkers in dairy cows. This study aimed to: (1) identify individual-level global health cluster using unsupervised hierarchical clustering with 35 MIR-predicted traits; (2) develop a predictive model for global health classification with four supervised machine learning algorithms and 35 MIR-predicted traits; and (3) assess the feasibility of directly predicting global health classification from MIR using two supervised algorithms. A total of 27,765,481 records from 11 cattle breeds, each with 35 MIR-predicted traits, were processed. For unsupervised clustering, a balanced subset of 5,845,345 records was used. The global health cluster was defined by calculating the mean values of the 35 MIR-predicted traits within each cluster from the full dataset. For the predictive model, the dataset was split (7:3) for calibration and validation. Four supervised learning algorithms—partial least squares discriminant analysis (PLS-DA), support vector machine, neural network, and random forest (RF)—were used to develop prediction models. Five clusters were identified, with the fourth and fifth clusters considered the global health cluster. In validation, the prediction accuracy of the five clusters using 35 MIR-predicted traits ranged from 0.70 (PLS-DA) to 0.83 (RF). Directly predicting the five clusters from MIR achieved 0.75 accuracy with PLS-DA and 0.87 accuracy with RF in validation. Our findings suggest that MIR-predicted traits can be used to assess individual-level global health in dairy cows and demonstrate the potential for directly predicting the five clusters from MIR. This newly defined global health cluster may provide opportunities for genomic evaluation of global health in cattle; however, further validation in practical applications is necessary.

Session C Theatre 13

New insights into pig social interactions from AI-assisted digital phenotypes

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Social interactions affect performance, health, and welfare in humans and animals. Social network analysis (SNA) is a well-established method to study social structures and interactions, but its application in farmed animals remains limited due to insufficient data. Recently, AI-enabled automated monitoring systems have shown promise for real-time animal tracking. This study explores, for the first time, the hypothesis that applying SNA to AI-assisted data from automated systems can yield new insights into farm animal social interactions. Objectives were to (1) assess the feasibility of using AI-assisted monitoring data to build social networks and detect aggressive behaviour, and (2) understand dynamic social structures within commercial farm pens. Automated systems recorded 2D images and videos of pigs in six pens, each with 16–19 animals. AI routines provided real-time data on activity (e.g., feeding/drinking), posture (e.g., standing), and position (XY coordinates of shoulder/rump) for each pig. Undirected weighted social contact networks were created for early and late growing periods. Group-level degree and betweenness centrality increased significantly over time. Individually, central pigs with bridging roles retained their positions, though influence fluctuated. Video analysis identified 37 fights, 81% of which were correctly detected using proximity matrices from AI-assisted shoulder coordinates. These results demonstrate that combining SNA with AI-driven monitoring data offers novel insights into pig social behaviour. Potential applications for enhancing farmed animal breeding and management will be discussed.

Session D Theatre 1

Deep Learning for Advancing Animal Breeding - A Study on Austrian Fleckvieh Cattle

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This study explores the application of deep learning models for predicting genomic breeding values using genotypic and pedigree data from Austrian Fleckvieh cattle. We investigate transformer-encoder and graph neural network (GNN)-based architectures to enhance predictive accuracy and assess their performance against traditional approaches like Single-Step Genomic Best Linear Unbiased Prediction (ssGBLUP) and machine learning methods such as XGBoost. Model performance was evaluated using mean squared error (MSE), □^{2} score, and Pearson correlation, with regression and residual plots providing further insights. Results indicate that transformer-based models, particularly one utilizing a Hyena operator as a substitute for standard attention within a transformer, achieved the highest predictive accuracy, outperforming all other models across multiple metrics. Specifically, transformer-based models achieved the lowest MSE and highest R^2 score and Pearson correlation, while GNN and XGBoost models exhibited comparatively lower performance. The ssGBLUP benchmark model demonstrated competitive results but was outperformed by both transformer-based approaches in most metrics. Furthermore, an interpretability analysis using integrated gradients revealed associations between single nucleotide polymorphism (SNP) attributions and quantitative trait loci, highlighting the models' ability to map loci. This work contributes to advancing deep learning applications in genomic selection and underscores the potential of transformer-based models for handling high-dimensional genomic data effectively.

Session D Theatre 2

Three-dimensional reconstruction of multi-view pig images based on Gaussian Splatting

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The research incorporates 2DGS's 2D-oriented planar Gaussian discs and employs ray-splat intersection and volume integration to achieve perspective-correct splatting, resulting in a more accurate geometric representation. Additionally, during the training process, two regularization terms—depth distortion and normal consistency—are integrated into the loss function. To reinforce geometric constraints in the model, a TSDF-based rendering method is implemented, which plays a critical role in generating the final mesh model. Based on the data collection methods, the reconstruction results of three methods were evaluated: Instant-NGP (NeRF-based model reconstruction), 3DGS (model using 3DGS to represent the scene), and 2DGS (GS model with the best surface reconstruction quality). The results visually demonstrate the high-fidelity capabilities of the methods applied to pig 3D reconstruction, highlighting the accuracy in reproducing morphological structures and fine texture details from 2D images to 3D models. The geometric accuracy of the 3D models generated from 2D images of pigs was evaluated. The reconstruction quality and evaluation metrics for different reconstruction methods were presented, illustrating the rationale behind the chosen approach. Additionally, a quantitative comparison of the 3D model results was conducted by measuring phenotypic information such as body length, width, and height of the pigs, further validating the reasonableness of the experimental methods employed. This study innovatively applies the GS method for the 3D reconstruction of pigs, marking a breakthrough in traditional 3D reconstruction using point clouds. Previously, 3D point clouds were obtained through depth cameras for reconstruction, but now, 3D reconstruction of pigs can be performed using only 2D images. Based on this 3D reconstruction method, a data collection plan was designed, offering new ideas for animal 3D reconstruction data acquisition.

Application of Machine Learning Algorithms for Estimating Body Weight in Horses Using Morphometric Measurements

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Introduction Estimation of body weight (BW) in horses is essential for effective health monitoring, dosing and nutritional planning. Machine learning (ML) algorithms have shown the potential to predict BW. This study aims to compare the performance of ML algorithms to predict BW based on morphometric measurements. Methodology A dataset of BW records and morphometric measurements was compiled from 142 horses in Mexico. BW (kg) was recorded using a digital scale, along with height at withers, chest girth, neck circumference, body length, age and body condition. The ML models included multiple linear regression (MLR), MLR with interaction (MLRi), stepwise MLR (MLRs), artificial neural networks (ANN), generalised additive model with penalised splines (GAMLSS) and support vector machines (SVM). The dataset was randomly divided into training (70%) and testing (30%) subsets. Model performance was assessed using the coefficient of determination (r^2), root of mean square error (MSE) and mean absolute percentage error (MAPE). All analyses were performed in R software. Results Based on r^2 values (>0.81) and RMSE (0.05), MLR and GAMLSS showed the best performance in both training and testing. In terms of MAPE, SVM (4.41%) and ANN (4.42%) showed the highest prediction accuracy. However, these algorithms showed signs of overfitting, as evidenced by lower r^2 values in the test set (0.78). While MLRi and MLRs performed well on the training data ($r^2 = 0.94$), their performance on the test set was poor ($r^2 = -0.53$), indicating severe overfitting and poor generalisation. Conclusion MLR and GAMLSS showed the best overall performance for BW estimation, high accuracy and generalisation. While SVM and ANN showed good predictive ability, their susceptibility to overfitting limits their reliability.

Session D Theatre 4

Automated pig gut segmentation in CT images using Deep Learning

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Animal welfare is a key concern in livestock studies, requiring precise body composition measurements. While analyzing carcasses with CT scans is straightforward, live pigs present a challenge due to the presence of internal organs. The SegPig project aims to solve this issue using artificial intelligence (AI). SegPig is an AI-powered software designed to automatically segment viscera in CT images of live pigs using deep learning techniques. A comparative study of segmentation models led to the selection of a 2D model for its efficiency on large datasets and compatibility with GPU. The UNET model achieved the best accuracy, reaching 98.82% on mask predictions. The dataset used for training consists of 219 pigs, each represented by 400 to 800 CT scan slices, depending on their body length and scanning resolution. The pigs are scanned in different positions (on their back or side) and at various growth stages, ranging from 30 kg to 115 kg. To ensure robust model performance, dataset balancing techniques were applied, including data augmentation (rotations, contrast adjustments) and scanner table preprocessing. Each CT image was manually annotated to create ground truth masks, ensuring precise delineation of viscera. As a result, SegPig includes three software tools for segmentation and manual result correction. This innovation significantly reduces analysis time, improving efficiency in pig body composition studies while ensuring animal welfare.

Session D Theatre 5

Application of AutoEncoder architectures to the analysis of fish gut microbiome.

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The study aimed to identify the abundance of gut bacterial families that were altered by probiotic supplementation of water and feed. The analysed data originated from the field experiment involving the common carp (Cyprinus carpio). Specifically, gut microbiome samples were collected from 125 individuals distributed across 25 ponds, representing a control setup and four experimental conditions that differed regarding the probiotic supplementation scheme. The abundance of bacterial families was assessed based on sequencing of the v2 and v3 hypervariable regions of the 16S rRNA gene. The AutoEncoder approach was applied to assess whether the probiotic supplementation affected the abundance of some bacterial families. In particular, two AutoEncoder architectures (referred to as AE1 and AE2) were trained on 25 individuals from the control group. Then, the abundance alterations due to supplementation were represented by bacterial families identified as anomalous observations by the AutoEncoder. Anomalies were marked by high residuals. The AE1 architecture was based on a set of Dense Neural Networks preceded by the embedding layer. The architecture AE2 implemented a transformer architecture with an attention head mechanism. The code was implemented in Python using the Keras API with the TensorFlow library. The results were compared with pairwise testing of differential bacterial family abundance using a traditional approach based on the estimation of the LogFoldChange, implemented in DESeq2 software.

Session D Theatre 6

Breaking down big data: A two-step method for visualizing complex data structures

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Principal Component Analysis (PCA) is a widely used method for uncovering patterns in complex data structures. It effectively simplifies complex data by reducing their dimensionality. However, anticipating big datasets including thousands of observations, the interpretation of PCA results becomes more challenging, as visualization beyond three dimensions becomes ineffective and limits the insights that can be derived. To address these limitations, we combined PCA with network visualization to enhance the exploration of complex data structures. By applying the mathematical principle of Eigenvalue Decomposition (EVD) to a data matrix, we derived a score that highlights observations capturing the most significant variation. Like PCA, EVD is a multivariate technique that identifies and optimal subspace by maximizing variation on the highest components. The method has been particularly useful in identifying key contributors within complex population structures, hence the derived score is termed "genetic contribution". In population genetics, we have demonstrated that combining the identification of key contributors with network visualization helps uncover fine-scale population structures and improves phasing and imputation accuracy in reference and target populations, respectively. Therefore, we believe our two-step method offers substantial potential for visualizing complex data structures across various research disciplines, extending far beyond population genetics.

A review on implementational gaps and barriers regarding data quality and robustness for AI applications in livestock digital solutions

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The integration of artificial intelligence (AI) into animal science has the potential to revolutionize livestock management by enabling precision farming and data-driven decision-making. However, significant implementation gaps persist. The European Project Digi4Live (https://digi4live.eu/) is currently summarizing these principal gaps into a deliverable and an upcoming opinion paper. This communication focuses on one critical gap: data quality and robustness. Data quality, encompassing accuracy and reliability, forms the backbone of precision livestock farming, while robustness extends beyond collection to include interpretation and utilization under variable or imperfect conditions. Key challenges at the data collection level include data incompleteness due to sensor failures or connectivity issues, inconsistencies caused by environmental factors, and precision limitations stemming from sensor drift and calibration deficiencies. The main barrier to these challenges remains the cost of solutions such as more reliable sensors, extended battery life, and robust telecommunication systems. To mitigate these limitations, we advocate for advancements in sensor technology and strategies to enhance data robustness at the usage level. Data preprocessing pipelines incorporating filtering techniques, anomaly detection algorithms, and expert-driven data cleaning are essential solutions. Additionally, on-farm validation methods that assess solution robustness under real-world conditions will be discussed, underscoring the necessity of standardized evaluation frameworks beyond mere accuracy. Enhancing AI model robustness requires training datasets that represent diverse breeds, environmental conditions, and geographical regions. Although constructing such datasets presents logistical and financial challenges, prioritizing quality and variance over sheer data volume is essential. By fostering collaborations, we can drive the development of high-fidelity datasets and improve AI applications in livestock management, ultimately ensuring greater sustainability, productivity, and resilience in the sector.

Does SNP imputation require attention?

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The goal of our study was to explore the efficacy of Single Nucleotide Polymorphism (SNP) genotype imputation from Illumina BovineSNP50v2 BeadChip (54,609 SNPs) to high-density WGS (whole genome sequence) resolution. For this purpose, we introduce a novel implementation of AutoEncoder-based architectures for SNP imputation, implemented utilising Python and the Keras API with Tensor Flow as the backend library. The material used for the method presentation represents a subset of bulls from the 1000 Bull Genome Project. In particular, the imputation was based on BTA28, which contains 297,605 SNPs identified in the WGS of Hostein-Friesian bulls. This data was divided into a training data set of 742 individuals with the WGS level information and the test data set of 186 individuals with known genotypes of 54,609 SNPs and genotypes of the remainder of SNPs blended by setting them to missing. Three different approaches based on the AutoEncoder paradigm of increasing complexity were applied for the imputation. First, an AutoEncoder was implemented based on a single embedding layer and a sequence of fully connected dense layers. Second, the transformer layer with attention heads block was added. Third, the additional positional encoding layer incorporated the information on SNP distances. The architectures were optimised for the following hyperparameters: encoder and decoder depth, size of the networks expressed by the number of nodes and the number of heads within the attention block, dimension of the embedding vector, as well as the loss function optimisation procedure expressed by the optimisation algorithm and the learning rate. Whereas hyperparameters fixed and common to all three architectures comprised the activation function set to linear, encoding SNP genotypes as quantitative values on the scale 0-2 and the loss function expressed by the Mean Squared Error. The choice of quantitative SNP encoding over a typical categorical class was to circumvent the problem of a minority class represented by homozygous alternative genotypes.

Session D Theatre 9

Deep Neural Networks for Transferable Cluster Models in Dairy Milk Transformation Ability Assessment

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Assessing the transformation ability (TA) of dairy cows milk is critical for optimizing processing efficiency and product consistency. During HoliCow NWE Interreg research project, unsupervised learning approaches have been used to categorize milk samples based on transformation properties, but their applicability across datasets remains limited. This limitation arises from three key challenges: (1) the inability to directly use the output of unsupervised clustering algorithms for inference on new datasets; (2) the computational burden of traditional supervised learning methods; (3) the extreme memory and computational requirements associated with large-scale analysis. Specifically, our study involves learning from 41 million records containing milk recording information and milk Fourier-transform mid-infrared (FT-MIR) spectral data, necessitating the use of incremental learning techniques. To address these challenges, we developed deep neural networks (DNNs) that transfer previously developed clustering models, enabling robust and scalable classification of TA groups across diverse milk datasets. Six TA groups were identified: prone for cheese and yoghurt transformation, prone for butter, overall good, normal, low TA, and sick cows. Our DNN models learn TA probability of belonging from spectral, and milking data, ensuring adaptability across various dairy farm conditions and processing environments. Depending on the trait, coefficients of correlation between original cluster belonging and DNN prediction ranged from 0.62±0.24 for the sick group to 0.92±0.17 for the normal group, with varying performances depending on the milk recording organisation data originates. This research presents thus an implementation of transfer learning taking advantage of DNN flexibility to develop lightweight, scalable and highly versatile model. They overcome computational constraints for widespread adoption and are particularly suitable for integration into decision support tools.

Session D Theatre 10

Incremental hierarchical clustering for pattern discovery to optimize on-farm milk processing

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Incremental hierarchical clustering is an unsupervised machine learning algorithm that creates clusters and updates them continuously as new data arrives. This approach is particularly advantageous for big data applications as it minimizes computational costs. It has been successfully implemented in the HoliCow Interreg NWE project database, which comprises over 41 million records collected through milk recording organizations in Belgium, Germany, France, Austria, Ireland and Switzerland. The dataset included 26 predictions derived from mid-infrared spectra of cow milk and specifically related to milk technological traits. The procedure began by randomly dividing the database into subsets. Ward's agglomerative hierarchical clustering, using Euclidean distance, was applied to the first subset, and the resulting clusters were summarized into centroids, representing the mean of the observations within each cluster. These centroids were then introduced into the next subset, and the process was repeated iteratively for all subsets. Once this iterative process was completed, a final hierarchical clustering was applied to the centroids to reduce the number of clusters, making them more interpretable. The optimal number of subsets and centroids was determined by considering both the percentage of variance explained by the clustering structure, which had to exceed 95%, and the script execution time. To assess the robustness of the method, given that the subsets were randomly determined, the entire clustering procedure was repeated 10 times. A k-means clustering algorithm was then applied to group similar clusters across different repetitions. The resulting clusters were visualized using the first two dimensions of a principal component analysis. The results demonstrated that the 6 identified clusters remained stable across repetitions. Furthermore, the method led to the formation of clusters that, upon interpretation, revealed enhanced suitability for milk processing into yogurt, cheese, and butter.

Session D Theatre 11

Time series data analysis to predict the status of mastitis in dairy cows by applying machine learning models to automated milking systems data

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Introduction: Mastitis in dairy cows is one of the most important issues that not only pose risk to animal health and welfare but also cause huge direct and indirect economic losses to the dairy sector. In recent times, automated milking systems (AMS) have gained sharp rise in popularity and adaptation. Mastitis detection under AMS operations becomes more difficult due to lack of direct human inspection of milk and udder during milking. The AMS technology consistently produces large amounts of milking records, which create the opportunity of developing algorithms to identify mastitis. The aim of this study was to predict mastitis in individual dairy cows through application of machine learning (ML) models on AMS generated high resolution data. Materials and Methods: The multivariable time series data with seven daily observed predictor variables and mastitis records of 1790 individual cows, was collected from two dairy farms situated in Saxony and Brandenburg states of Germany for a period of four years. We applied six ML models to correctly predict the status of mastitis (i) one day prior and (ii) on the day of clinical observation. Results: Each ML model varied in its efficiency for mastitis predictions. The overall accuracy, sensitivity and specificity scores of ML models ranged between (i) 0.80-0.90, 0.64-0.78 and 0.80-0.90 and, (ii) 0.84-0.93, 0.76-0.91 and 0.84-0.93 respectively. Conclusion: Our findings indicated moderate to high accuracy of ML models and demonstrated the robustness of time series AMS data by correctly predicting the future events of mastitis. However, as each model had its own strengths and weaknesses, therefore these findings have certain limitations. We propose inclusion of additional variables from AMS records and integration of other sensorial data for future studies.

Session D Theatre 12

Can AI accurately predict forage energy and protein values using chemical and textual data?

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Rationing is crucial in animal nutrition to meet protein and energy requirements, maximizing performance and minimizing feed costs. In France, the INRAE system calculates the energy and protein values of forages for ruminants, based on equations dependent on chemical composition, plant species, maturity, and other information. However, these calculations can be challenging when input data are lacking. We explored AI methods for calculating forage values according to the INRAE system, using six routine chemical parameters (dry matter, ash, protein, crude fibre, neutral detergent fibre, acid detergent fibre, lipids) and a text description of the forage. Output data are the energy values UFL (0.4 to 1.3 per kg) and UFV (0.3 to 1.4 per kg) and the protein values PDI (45 to 120 g/kg), PDIA (5 to 61 g/kg) and BPR (-60 to +150 g/kg). We used Python with machine learning and deep learning techniques, with a fine-tuned LLM on agricultural vocabulary. The training data (913 forages) came from the INRA 2018 tables for ruminants. Root mean square error (RMSE) is the evaluation metric. Using classical machine learning with decision tree boosting gave good results. The best were obtained using gradient boosting trees algorithms combining chemical data with the first two levels of text labels. RMSE of PDI, PDIA, and BPR were 2.65, 1.89, and 3.86 respectively. RMSE of UFL and UFV were 0.054 and 0.047 when chemical data were combined with a multiple correspondence analysis of labels. The deep learning approach used the BERT and camemBERTav2 LLMs to retrieve fodder description embeddings, combined with chemical data in a multi-layer perceptron. Fine-tuned BERT gave the lowest RMSE for PDI, PDIA, BPR, UFL and UFV: 4.21, 3.61, 5.04, 0.046, and 0.062 respectively. They were all higher than for the machine learning model except for UFL. Both classical machine learning and deep learning thus gave satisfactory results for the prediction of nutritional values of forages, with the former being more efficient than the latter. Further exploration is needed for practical deployment.

Session D Theatre 13

Looking inside: Poultry evaluation, Box Inspections and foreign body plastic detections: challenging tasks solved by new approaches in deep learning and different image acquisition systems.

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We show in this talk that image acquisition with RGB, hyperspectral and 3D cameras combined with AI cannot only used to evaluate the surface but also to get information from inside of the objects. To check if boxes (E1, E2 of each color) are clean and without damage we use surface and transmitted light cameras. So we can detect not only uncleanliness and flaking at the edge of the box but also small cracks. With this results one can optimize the parameters of the washing machines and the ejection of the not repairable boxes. For hygienic reasons the crop detection of chickens in the slaughter line is essential. We use 2D and 3D cameras for classification and can detect with a patented process the fullness of the crop for each bird. To detect plastic in food we developed a space-saving device which can be implemented in a multi head weigher. Four cameras with a lot of light are under the weighers and watch the falling objects like grated cheese, meat balls, salad, pieces of fish, etc. with a video evaluated by AI. With a new intensive transmitted light system of certain wavelength we can also look through chicken nuggets, sliced sausage and other thin meat objects to detect thin plastic foils and small pieces of bones inside the meat. To better understand the resulting neural nets we use a new approach we call CLKSOM. The idea is to introduce self organization in a single layer of the neural network. The additional condition to a normal DeepLearning layer optimized with ADAM is that the neighboring neurons in a layer do similar work. The inspiration to that comes from biological findings in the cortex and from Kohonen in simplified nets. The result is that you get an ordered system of feature neurons which are much more interpretable than before. You can see which attributes are done by multiple neurons and which are missing, you can sort the features and it gives an impression of order in your deep learning network. First results are promising, but there is a lot of work to be done.

Session E Theatre 1

Occlusion-Resilient Cattle Tracking in Barn Environments Using Monocular Depth Estimation and 3D Relational Bounding Boxes

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Occlusion, or loss of line-of-sight, remains a major challenge in computer vision-based animal monitoring, particularly in enclosed environments where traditional tracking methods fail. This disrupts identity continuity, complicating long-term behavioural and health analyses. Building on prior work in 3D scene reconstruction via deep learning-based monocular depth estimation, we implement a relational quasi-3D bounding box re-identification method for cattle in a straw-bedded calving barn environment. By incorporating estimated depth, the method computes relative 3D positions and angles between detected animals, enabling spatial re-identification during misdetections and after occlusion. To improve temporal continuity, relational bounding boxes are used to interpolate missing detections and resolve ID inconsistencies. Initial tracking predictions were generated using a fine-tuned YOLOv8 model with ByteTrack for identity preservation. The re-identification (ReID) framework was evaluated on a 15-minute video (10,800 frames) and applied solely to identity reassignment and false detection recovery. Compared to the baseline tracker, the ReID-enhanced method improved identity consistency while maintaining high accuracy, achieving a Multi-Object Tracking Accuracy (MOTA) of 99.57% and IDF1 score of 99.79%, outperforming the baseline's 99.48% MOTA and 99.78% IDF1. MOTA reflects overall tracking performance by accounting for missed detections, false positives, and identity switches, while IDF1 assesses identity consistency through the F1 score of correctly matched detections over time. Importantly, the identity switches dropped from 62 to 5, and false positives from 306 to 13, demonstrating stronger robustness under occlusion. This non-invasive, occlusion-resilient approach offers enhanced identification continuity over 2D-based tracking methods while relying on standard RGB camera systems.

Session E Theatre 2

High-density 3D pose estimation for pigs: enhancing anatomical precision for social behavior analysis

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Recent findings in animal social behavior research suggest that anatomical specificity plays a crucial role in shaping social interactions and their affective valence. However, existing pose estimation models for pigs lack the necessary granularity, often identifying only broad anatomical regions during interactions. This limitation leaves room for subjective interpretations of behavior, reducing the reliability of automated social behavior analysis. To address this gap, we propose a high-density 3D pose estimation model for pigs that precisely tracks fine-grained anatomical key points during social interactions. Our approach follows a three-stage training pipeline using DeepLabCut. First, we train a deep learning model based on a ResNet-50 backbone using UV (texture coordinates) mapped 3D pig models, capturing detailed anatomical and key point information. More than 300 keypoints based on these UV maps are applied to various textured 3D models with diverse shapes, sizes, and postures to improve generalizability. In the second stage, we fine-tune the model by applying it to open access images, own recording or video datasets of pigs in real-world settings (e.g. PigBehavior, PigAgonistcBehavior), then refining the model's predictions based on this data. Finally, we validate the model by applying it to video recordings (2-6 hours per video) of eight sows and their piglets around nursing bouts, captured in free farrowing pens within our experimental farm setting. This will allow us to quantify sow-piglet and piglet-piglet interactions with high anatomical precision to gain new insights into the anatomical specificity of early-life social dynamics. We anticipate that our model will significantly enhance the accuracy and objectivity of social behavior assessment in pigs (data currently under analysis). This approach offers a robust, non-invasive tool for high-resolution monitoring of pig social dynamics, with implications for both animal welfare and behavioral research.

Session E Theatre 3

Pose estimation for behavioral anomaly detection in pigs: comparative analysis of key point configuration and neural networks

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Effective monitoring of tail-biting behavior in pigs is crucial for ensuring animal welfare and reducing economic losses in livestock farming. This study evaluates the accuracy and computational performance of pose estimation techniques in detecting behavioral anomalies, specifically interactions involving pig's snouts and tails. A custom video dataset of 100 annotated frames, tracking 10 key points per animal, was used. Five neural networks (AnimalTokenPose, HRNet-W32, ResNet-50, and ResNet-101) were tested for tracking accuracy, computational efficiency, and robustness under challenging conditions (e.g., occlusions and lighting variability). The analysis revealed distinct movement patterns, with the tail and body (snout, head, ears, and five points along the dorsal axis) exhibiting the most concentrated trajectories on the 2D plane, suggesting frequent movement in monitored videos. Confidence scores for tracking accuracy were evaluated, and a confidence score cutoff (p_cutoff) was set to exclude unreliable key points. Key points with confidence scores below this threshold were excluded from further analysis. Models for which at least 90% of the key points had a confidence score higher than the p_cutoff threshold demonstrated higher reliability for pose estimation (confidence score>0.6). Additionally, precision and recall metrics were defined based on the detection of key points (tail and snout positions) across all frames. Precision was calculated as the proportion of correctly detected key points relative to the total number of detected key points. Recall was calculated as the proportion of correctly detected key points relative to the total number of actual key points. The best-performing model in terms of precision (mAP) and recall (mAR) was ResNet-101 pretrained on ImageNet weights, achieving a precision of 93.68% and a recall of 94.17%. Conversely, the worst-performing model was HRNet-W32 pre-trained on the Super Animal Quadruped weights, with a precision and a recall of 66.85% and 77.0% respectively.

Complex Behaviours Prediction in Pigs using YOLOv8

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Abnormal behaviours like belly nosing, tail biting, and ear biting cause serious welfare issues for pigs and economic challenges for pig farmers worldwide. Such behaviours are difficult to record, as they are not continuous and appear and disappear suddenly. Traditionally, recording of such behaviours has been done manually, which makes the recordings subjective, labour-intensive, and prone to human error. The aim of this study was to develop a prediction model for the following traits: tail biting, ear biting, belly nosing, and tail position. We created a behaviours prediction model based on the YOLOv8 object detection framework, which can significantly enhance the identification and quantification of complex behaviours in pigs under challenging conditions. The model was deployed on visual data collected from a growing-finisher herd in Norway. The model was trained on an annotated dataset including the four traits to evaluate the performance of YOLOv8 in predicting belly nosing, tail biting, ear biting, and tail position. We used mean average precision (mAP), F1-score, precision, recall, and confusion matrix to illustrate the effectiveness of our proposed method. The results demonstrate an overall accuracy of 80.2%, while the highest mAP for belly nosing is 93.2% since it is the most occurring behaviour in our dataset. However, the accuracy is lower for traits with a more prominent temporal component, while the ratio of false positives is higher. Therefore, we plan to integrate temporal information to capture dynamic behaviour patterns and refine the action detection and recognition performance by developing a more comprehensive and sophisticated spatiotemporal action prediction models such as SlowFast which captures both the spatial and temporal information for abnormal behaviours prediction in the pig barns. This study was funded through the Norwegian Research Council, by the Fund for Research Fees for Agricultural Products and Agricultural Agreement Research Fund (FFL/JA), through project number 321409.

Characterisation of the impact of feed restriction on individual activity patterns in dairy goats.

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Monitoring individual animal behaviour can provide early signs of changes in animal welfare. This study investigates how a controlled feed restriction affects the activity profiles of dairy goats at the individual level. By activity profiles, we refer to the temporal organisation of activities, such as ruminating, lying, and putting the head in the feeder. To do so, the activity of fourteen goats equipped with an accelerometer fixed to the collar was collected for seventeen days, including two days of feed restriction by providing only straw. The Act4Behav pipeline was used to infer goat activity from accelerometer data. To characterise activity profiles, several features describing behavioural durations and transitions were extracted. T-SNE dimensionality reduction and K-means clustering were used to identify natural groupings within individual activity patterns. Moreover, the effect of feed restriction was analysed at both group and individual levels. Results showed that activity profiles followed a structured daily pattern under normal conditions, and that feed restriction disrupted this pattern. A high inter-individual variability in the goats' response was observed for lying, ruminating and head-in-the-feeder behaviours. To account for this inter-individual variability, the cumulative duration of each behaviour was plotted and individual regression lines were fitted, thereby quantifying the perturbation impact on each animal activity profile. These observations not only highlight the importance of individual-level analyses in detecting early signs of welfare degradation but also demonstrate the feasibility of employing advanced sensor and computational techniques in routine farm management. Future research should explore how such individual responses relate to physiological and production traits, paving the way for precision livestock farming approaches to adapted farming management.

Session E Theatre 6

Real-Time Detection of Parturition Onset in Small Ruminants Using Wearable Accelerometers and Machine Learning

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The automatic detection of parturition onset has great potential to improve the welfare of ewes/goats and their newborns by triggering nursing assistance and addressing birth issues without constant human supervision. Wearable accelerometers have been investigated as a technology for detecting births, with some solutions already available for large ruminants. In the case of small ruminants, several approaches have been tested, demonstrating feasibility but failing to provide real-time detection. To overcome this gap, a detection mechanism was developed using accelerometer data collected from collars worn by the animals. This data was employed to train models based on machine learning (ML) and deep learning (DL) methodologies, aiming to create a reliable and efficient system. The study involved monitoring 61 Norwegian White Sheep and 11 Charnequeira goats. The data annotation process involved establishing temporal classes for hourly periods preceding the birth event, in addition to a class for the post-birth period. This systematic approach allows precise training and evaluation of the models. A comparison was conducted on various ML and DL models regarding their detection performance and computational cost. The model that provided the optimal equilibrium between accuracy and efficiency was chosen for additional refinement. A filter was implemented to eliminate infeasible state transitions in the model's predictions, thereby reducing errors and improving reliability. The results of the system tests were promising. Machine learning models, specifically the Random Forest model, exhibited superior performance with an accuracy of 0.71 and an F1-score of 0.78 in predicting birth up to 11 hours in advance. Additionally, the system was tested for three days before delivery, revealing that the incidence of false positives was minimal. This result highlights the system's practicality and effectiveness for near real-time forecasting of parturition onset, rendering it an invaluable tool for farmers.

Session E Theatre 7

Development of algorithms for live weight prediction in rabbits by computer vision

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Rabbit meat, recognized for its high protein content, low fat, and unsaturated fatty acids, is emerging as a sustainable alternative to traditional meats. However, large-scale production requires efficient weight-monitoring systems to ensure quality and productivity. Current practices rely on manual weighing, which is labor-intensive and stressful for animals. This study proposes a non-contact computer vision approach using stereo depth and segmented images from overhead rabbit to predict live weight, minimizing animal handling. Images were collected from adult rabbits at Universitat Politècnica de València using an OAK-D Pro camera (12 MP, 50 cm height), yielding 632 images with corresponding weights. Data were segmented via YOLOv11 and split into training (70%), validation (15%), and test (15%) sets. Two bracnhes with EfficientNetV2 for images and custom CNN for stereo depth images were trained for 100 epochs and feature concatenated to a fully connected layers. For training process, Adam optimizer was implemented (Python 3.11.9). As result the combined model outperform the models separately, with EfficientNetV2 achieving (MSE: 314,093), custom CNN (MSE: 450837) and combined model (MSE: 271183). Training loss trends indicated overfitting after 20 epochs, highlighting the need for enhanced generalization. Future efforts will refine the segmentation process to reduce noise, and expand the dataset for improved accuracy with different rabbit stages. Additional model architectures will also be evaluated. This computer vision strategy shows promise for automating weight prediction in intensive rabbit farming, supporting animal welfare and operational efficiency. Further optimization of depth-based features and model robustness is critical to advance toward scalable, precision livestock management.

Automated Body Measurement of Sows in Feeding Stations Using Multiple Cameras

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Monitoring the health and welfare of sows is an important aspect of pig farming. In particular, during gestation, the optimal nutrition of sows is of high relevance. Parameters such as weight, length, width, and thickness of the back fat and muscles are key indicators to determine the condition of the sows and whether or not the daily diet needs to be adjusted. This, however, is a time-consuming and tedious task, raising the need for more efficient, optimally automatized approaches. We developed a computer-vision-based system which monitors these parameters daily. We installed three cameras inside an automated feeding station, one above and two behind the feeding sow. The images obtained from the cameras were fed into a prediction network consisting of three modules: First, three separate convolutional neural networks – one for each camera – are used to extract visual features. Second, the resulting information is concatenated and traversed through a sequence of fully connected layers. Third, a separate dense prediction head is used for each body measurement. We also include information such as age, parity, and day of gestation as additional input to the prediction heads. This architecture allows us to use the same visual information for all predictions. To train the network, we used the recordings of 4,659 individual feedings of 159 sows over a period of four months on three different pig farms. The ground truth data was obtained by manual measurements by experts every three weeks. We evaluated the model on independent test data consisting of 18 sows not seen by the model during training. We obtained a coefficient of determination (R^2) of 0.81, 0.86, and 0.64 for the estimation of the length, weight, and width of the sows. The mean absolute percentage error was 1.7% for length, 3.9% for weight, and 2.1% for width. Estimating the thickness of the back fat and muscles on independent test data has proven to be not robust enough, mainly due to inconsistent manual measurements. In addition to information from nutrition experts, we will use these parameters to estimate an optimal diet for each sow. Ongoing and future work includes further data collection to improve the model's generalization properties.

Deep learning for pain recognition in cows

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Deep learning technology for pain recognition in animals was successfully used for various species. In our study, based on a custom bovine dataset from a clinic including approximately 1000 manually scored images, we demonstrate that deep learning algorithms can be successfully employed for pain detection in dairy cows. We proposed a combined approach involving an EfficientNet-based model (efficient_v2) and a feature embedding model to tackle this problem. Nine models were trained, including resnet, efficient_v2, and Vision Transformer (vit), both as standalone models and in combination with feature embedding components such as autoencoders (ae) and Variational Autoencoders (vae). Among these, the EfficientNet-based model with vae (efficient_v2_vae) demonstrated superior performance across most metrics, including Loss, F1-score-weighted, F1-score-macro, Matthews Correlation Coefficient (MCC), and Area Under the Curve (AUC), offering stability and reliability for the pain detection task. On the test dataset, efficient_v2_vae achieved an F1-score (weighted) of 0.8411 ± 0.0152 and an AUC of 0.8693 ± 0.0272. Models incorporating the vae component, such as efficient_v2_vae and resnet_vae, outperformed their standalone counterparts, highlighting the vae's effectiveness in capturing pain-related visual features. Convolutional-based models proved more suitable for this classification task compared to transformer-based models like vit, which showed limitations when applied to this dataset. The study's practical implications include assisting veterinary hospitals in pain prediction, significantly reducing veterinarian time for diagnosis, and enabling early intervention to improve recovery outcomes. We developed a web-based application that allows stakeholders to upload cow images or videos and receive pain predictions with explanatory insights. This tool enhances veterinary diagnostics, supports veterinarians by automating assessments, promotes animal welfare, and broadens AI accessibility for dairy farmers.

Evaluation and comparison of pre-trained convolutional neural networks for detecting Equine Pain Face

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Background: Ensuring horse welfare requires accurate pain detection, as behavioural signs are often misinterpreted by the owner or suppressed by the horse. The Equine Pain Face (EPF) is a visual pain evaluation tool, but its subjective nature limits consistency. Artificial intelligence (AI) provides a promising avenue for reliable pain detection. Aim: This study evaluated the performance of seven pre-trained convolutional neural network (CNN) base-models—VGG16, Xception, DenseNet201, ResNet101V2, MobileNetV2, EfficientNetB7, and InceptionResNetV2—to classify horses as expressing or not expressing EPF. Methods: The dataset consisted of 22 videos of 11 horses filmed before and after dental surgery. Video frames were extracted at one frame per second, resulting in 613 images. Pre-trained CNNs served as base models to encode video frames into feature vectors. These encoded features were subsequently used to train secondary fully connected artificial neural networks (FC-ANNs). Systematic hyperparameter optimization was applied to enhance model performance. Cross-validation ensured reliable evaluation, and performance was assessed using the area under the ROC curve (AUC). Results: All base-models achieved best AUCs between 0.95 and 0.99, with DenseNet201 and Xception achieving the highest scores (0.99). DenseNet201 demonstrated superior computational efficiency, requiring only 128 principle components of the encoded images, while Xception required 2499. VGG16 and MobileNetV2, though less computationally intensive, were more sensitive to hyperparameter optimization to avoid random-guess performance. Conclusions: Model selection depends on resource availability. DenseNet201 is optimal for environments with ample computational capacity, whereas VGG16 is suitable for limited-resource scenarios. This study underscores AI's potential to enhance horse welfare by enabling consistent pain assessment.

Automated detection of asymmetrical udders in dairy goats using deep learning-based imaging

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Dairy goats with an inflammation of the mammary gland (mastitis) are frequently found with disproportionate size of the udder halves. The affected udder half shrinks, which consequently leads to visible udder asymmetry. Ideally, all the goats should be routinely checked for asymmetry, and decision regarding treatment should be made with no hesitation. However, considering the size and density of modern dairy goat farms it is challenging to inspect every single goat on a daily basis. Therefore new inspection techniques involving artificial intelligence (AI) are highly desired. Therefore the aim of the study was to train and evaluate a deep learning-based imaging model to detect udder asymmetry in dairy goats during milking using a regular digital camera. The computer vision object detection model was trained using YOLOv9 architecture. The inputed data were there frames obtained from videos recorded during two morning milking rounds on a typical Dutch dairy goat farm with around 500-600 goats in lactation. In total, 3200 manually expert annotated image frames (from 1200 dairy goats) were divided into three categories: 1. symmetrical udder, 2. left-asymmetrical udder, 3. right-asymmetrical udder. The dataset was split into training, validation, and test datasets. The standard object detection evaluation metrics were used to assess the model: mean average precision at 0.5 threshold (mAP50), which is the metric for easy detection, and mean average precision at the threshold of 0.50-0.95 (mAP50-95), which is the metric for difficult detection. Preliminary results show satisfactory model performance on the test dataset: mAP50 = 0.84, and mAP50-95 = 0.74. In conclusion, the detection of udder asymmetry can be automated and applied in real-time using a low-cost digital camera linked to an AI model. This solution can improve early detection of udder asymmetry, while assisting in udder health management on dairy goat farms leading ultimately to improved animal health and productivity.

Epigenetic Disease-Driven Aging in Dairy Cattle: A Machine Learning Approach Integrating Longitudinal and Cross-Sectional DNA Methylation Data

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DNA methylation is one of the most promising biomarkers for age prediction, enabling the development of epigenetic clocks that correlate methylation profiles with chronological age. In this study, we applied machine learning methods to develop an epigenetic clock for Holstein dairy cows (n = 114) using a mixed longitudinal-transversal design to assess the interplay between aging and disease susceptibility. Using enzymatic methyl-seq (EM-seq), which sequences 50 million positions, we analyzed 18 cows sampled at multiple time points and 96 cows sampled cross-sectionally, covering a lifespan from birth to nine years. We employed advanced machine learning models to identify the most predictive CpG sites for age estimation, optimizing the model to achieve high accuracy in age prediction. Beyond chronological age prediction, we investigated the impact of disease status on epigenetic aging. Our findings indicate that the models can detect accelerated epigenetic aging in cows affected by mastitis, lameness, infertility, or metabolic disorders, suggesting a potential link between health stress and DNA methylation dynamics. Additionally, we identified a set of genes whose promoter methylation patterns change with age, including MAB21L1, which may play a role in molecular aging mechanisms. This study highlights the potential of epigenetic models for precise age prediction. More broadly, it underscores the power of machine learning in computational epigenetics, paving the way for precision agriculture applications to enhance livestock health and longevity.

Monitoring Play Behavior in Dairy Calves Using Computer Vision and Accelerometers

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Keywords: behavior analysis, dairy calves, accelerometer, computer vision, transformers, VideoMAE, SAM 2, Clip Monitoring play behavior in dairy calves provides crucial insight into their welfare and development. Traditional methods rely on labor-intensive video annotation, so we developed two scalable, automated pipelines that use accelerometer and video data collected from six European farms. In the accelerometer pipeline, data recorded at 100 Hz on three axes were segmented into overlapping 300-millisecond sequences. A bidirectional LSTM autoencoder was trained exclusively on non-playing sequences to learn normal behavior. Sequences with reconstruction errors above the 95th percentile were flagged as play events. This method processed 47 hours of data in 4 minutes and achieved a ROC-AUC of 0.87. For the vision pipeline, video segments were preprocessed to meet VideoMAE requirements, and spatiotemporal embeddings were extracted. A neural network classifier trained on these embeddings achieved over 97% accuracy on cross-validation and test sets; however, performance dropped when applied to data from a new farm, highlighting the need for a larger, more diverse training dataset. Future work will enhance feature engineering and refine segmentation methods and tracking methods for individual calf detection with models like Segment Anything Model 2. Single-frame feature extraction models like clip and DINOv2 will also be deployed to enable single-shot detection. This pipeline promises to reduce manual annotation labor, detect precise play behavior in real time, and advance our understanding of calf welfare.

Session E Theatre 14

Damaging Behavior Prediction in Precision Livestock Farming Using Multi-Sensor Data

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Damaging behaviors such as ear and tail biting in pigs pose serious welfare concerns, leading to economic losses and management challenges. Predicting these issues early enables timely intervention, reducing severe injuries and reliance on reactive treatments. This approach can improve animal welfare, productivity, and farm sustainability. Tail and ear biting result from multiple risk factors, making early detection complex. While previous research identified tail posture in undocked pigs and water usage as potential early indicators, they lack specificity due to their association with other welfare or health issues. To enhance accuracy and reduce false alarms, we integrate behavioral and environmental data for a more robust prediction model. This study focuses on docked piglets after weaning, a critical period in which animals undergo dietary and environmental changes. The dataset comprises nine data collection cycles from 108 pens, where weaned piglets housed for six weeks. Environmental sensor data, including NH□, CO□, humidity, temperature, light, and water flow at the group level, provide insights into external factors that may influence biting behavior. RFID readers also collect data from drinking units to analyze drinking frequency and water consumption volume in greater detail on an individual level. Additionally, video-based monitoring allows us to detect behavioral deviations that may indicate early signs of damages. To analyze the data, we extract behavioral features from video recordings using computer vision methods. These behaviors include movement patterns, interaction frequency, and feeding and drinking patterns over time. Environmental parameters are processed and synchronized with behavioral data to identify and predict damaging lesions using integrated data from multiple sensors. Machine learning techniques, including anomaly detection methods in time series, will be applied to detect early signs of biting behavior. The data analysis is currently in progress, focusing on feature selection, model optimization, and evaluating the predictive performance of different approaches.

Session F Theatre 1

Counting Sheep with Drones: A Feasible AI Solution for Outdoor-Based Farming

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In outdoor-based sheep farming, shepherds must ensure that all animals return safely to a barn or protective pen to prevent predation. This raises a critical daily question: "Have I gathered my entire flock, or have some been left behind, vulnerable to predators?" Accurate counting is essential for informed decision-making, yet traditional methods—such as visual counting and electronic identification (eID)—present logistical and accuracy challenges. To address these limitations, we explore the integration of computer vision and drones to automate sheep counting, bridging key gaps in existing solutions. Our research, conducted within the European project ICAERUS (https://icaerus.eu/), leverages recent advancements in AI and aerial imaging. Rather than pursuing full automation—which is often impractical due to aerial regulations, environmental variability, and occlusion issues—we propose a more feasible approach. By using drones as stationary cameras at strategic "count-friendly" locations, such as pasture gates, we enhance counting accuracy while ensuring practical on-farm deployment. We fine-tuned YOLO-based detection models using drone-acquired datasets, sourced from Roboflow or collected by ourselves and shared on Zenodo. The integration of the ByteTrack algorithm enables animal tracking and counting. Preliminary results demonstrate promising detection rates (precision: 0.87, recall: 0.80, mAP50-95: 0.57), though challenges remain in tracking high-density flocks, detecting low-frequency coat colors (e.g., dark-colored sheep), and minimizing misclassification of surrounding objects. Sheep counting is most effective when animals are dispersed, with fewer than 8% remaining uncounted (mainly due to detection issues). Ongoing efforts focus on dataset expansion, the definition of the best on-field conditions, and farmer-centered co-design to facilitate practical adoption. This work underscores the importance of realistic AI implementation in precision livestock farming. By balancing technological capabilities with operational constraints, we aim to provide a scalable, regulatory-compliant solution for improved sheep management.

Session F Theatre 2

Automated dairy cow tracking and identification pipeline across 50 cameras to underpin the John Oldacre Centre for Dairy Welfare & Sustainability Research

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The John Oldacre Centre for Diary Welfare and Sustainability at Bristol Veterinary School is a living lab built on top of our 200-cow dairy farm representing housed commercial dairies in the UK. Our group aims to use computer vision and deep learning to continuously analyse cow videos linked to veterinary/production records and environmental monitoring. This will underpin the aim of the platform to contribute to early-stage disease prevention strategies, optimised farm management and improved animal welfare. The key areas to be presented include: Dairy Research Platform We deployed 55 top-down cameras in the barn for 24/7 monitoring of feeding, drinking, and resting areas, as well as pre- and post-milking zones, enabling long-term AI activity recognition and social behaviour analysis. This is augmented with two eye-level cameras for expert body condition and mobility scoring, and one that reads to RFID ear tag reader data to link machine vision monitoring to individual metadata. Cow Identification Each Holstein Friesian cow has a unique coat pattern, enabling automated detection, tracking, and re-identification for long-term monitoring, thus avoiding the classical tracking issues of objects losing their identifiers over long periods, particularly when moving between cameras. Our work on the single camera dataset Cows2021, achieved a mean Average Precision of 97.3% using a cow head orientation-aware detector for detection. We also obtained an identification accuracy of 92.4% (Adjusted Rand Index = 0.93) across 155 cows. In the MultiCamCows2024 dataset, which utilises three cameras, an identification accuracy of 96.4% is achieved for 90 cows. Data Collection We are currently implementing our first 20-week data collection period across the camera network and including fortnightly mobility scoring, body condition scoring, and saliva and milk sampling including spectroscopy. We aim to develop early disease prediction models by linking changing social behaviour to the development of subclinical mastitis and lameness.

Session F Theatre 3

Chicken Individual Recognition Method Based on CFNET model

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Abstract: With the rapid development of smart agriculture, higher requirements are put forward for intelligent and precise management in large – scale chicken farms.Precise individual identification is of great significance for the elimination management and health traceability of individual chickens. In traditional breeding management, individual marking usually uses foot rings, color marking, or RFID identification, but problems such as label loss and waste of labor force may occur. Therefore, we developed a non – invasive chicken face recognition model named ChickenFaceNet (CFNet) based on the Siamese neural network and YOLO.First, the YOLOv8 chicken head detection model and StrongSort tracking algorithm were used to intercept the facial images of individual chickens from the video data obtained in commercial chicken farms.Similar images were removed using the Structural Similarity Index Method (SSIM), and a chicken face dataset containing 9010 images of 115 chickens was established.Second, this paper introduced the (Inception Depthwise Convolution) IDC module to extract chicken face features from multiple dimensions, improving computational efficiency while maintaining a large receptive field.Then, the FS (Frequency Selection) module was used to divide the chicken face features into low – frequency components containing information such as the overall structure and general shape of the image, and high – frequency components containing details and texture information, optimizing the feature representation. Finally, this paper proposed the Frequency Interaction (FI) method to adaptively fuse high – frequency and low – frequency features, making full use of the extracted chicken face features at different levels.The experimental results show that the accuracy of the CFNet proposed in this paper is 96.96%, which is better than that of ResNet50(90.46%),EfficientNet-B0 (87.52%), AlexNet (84.95%),VGG16 (90.28%), and ConvNeXt-Tiny (91.16%). Ablation experiments show that the IDC, FS, and FI modules increased the accuracy by 0.65%, 6.4%, and 2.15%, respectively.The proposed CFNet can provide support for precise livestock and poultry breeding.

Session F Theatre 4

Location-Partitioned Residual Feed Detection Using RFP-LP Model in Cage Poultry Houses for Precise Feeding

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China is a leader in egg-laying hen production, predominantly using multi-tier cage systems. However, traditional feeding methods fail to meet modern demands for precision and efficiency. Current precision feeding technologies are geared toward large livestock(cows, pigs, etc.), lacking the accuracy needed for individual cage-level feeding, And residual feed detection methods are overly complex, making them unsuitable for large-scale data collection and monitoring. To address these challenges, a novel method for measuring residual feed proportion at the cage level was developed using machine vision technology. This method involves three key modules: RFP, which employs the YOLOv11s model used as the baseline model for detecting cage columns and segmenting residual feed□and a series of optimization strategies were applied to improve its accuracy and efficiency; LP, for cage partitioning and calculating residual feed area proportions for each cage; and PP, for preprocessing residual feed proportion calculations and post-processing to convert area data into volume measurements. Extensive testing on 500 cages in a commercial farm demonstrated 100% cage localization accuracy, 95.91% accuracy in residual feed proportion calculation, and a frame rate of 166.7 FPS, surpassing advanced YOLO models. This method replaces traditional weight sensor-based residual feed measurement, enabling rapid data collection for all cages in the poultry house with significantly improved computation time, offering a valuable tool for precise feeding. It further boosts egg production efficiency by identifying low-performing cages, facilitating adjusted feeding regimes, and supporting companies in more efficient culling practices.

Session F Theatre 5

Sparse Multi View and Dense Stereo 3D Reconstruction in Feed Intake Measurement for Precision Livestock Farming

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ABSTRACT: Estimating feed intake is crucial for effective livestock and farm management, as it directly influences animal health, nutrition strategies, and overall farm productivity. Monitoring individual feed consumption allows farmers to optimize feeding regimes, detect health issues early, and improve precision livestock farming (PLF). Recent advancements in computer vision (CV) and deep learning have introduced non-invasive, automated methods for feed intake estimation using depth imaging, RGB-D cameras, and volumetric analysis, enhancing farm efficiency and precision livestock farming. Unlike existing single-view depth camera approaches, our method leverages multi-view 3D reconstruction, combining sparse multi-view and dense stereo algorithms to generate accurate, dynamic feed volume tracking, ensuring scalability and resilience to environmental variations. This work estimates individual feed intake of cow by leveraging 3D reconstruction techniques to measure the amount of feed consumed per animal at the feed bunk. Using sparse multi-view reconstruction in combination with dense stereo algorithms, we generate detailed and precise 3D models that track feed volume at the feed bunk over time. This approach offers a non-invasive method to quantify changes in feed volume, enabling real-time monitoring of feeding behaviour. The system supports farmers in gaining a better understanding of animal feed intake, contributing to enhanced animal management, health, and overall farm efficiency.

Session F Theatre 6

Automating Body Condition Scoring of Dairy Cows Using Machine Learning on Time-of-Flight Data

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Body Condition Score (BCS) measures an animal's fat reserves and nutritional status, guiding on-farm feeding decisions. Manual BCS is time-consuming and subjective. Artificial Intelligence can automate BCS for more frequent and consistent results, enabling faster management decisions—provided the training data is high-quality. This study explored automating BCS using our vision-based system. The dataset consisted of 25,000 Time-of-Flight images of cows taken from the top of a rotary milking parlour (17,700 images used for training, 7,300 for testing) on a large commercial dairy farm. This corresponded to 3,800 and 820 Holstein-Friesian cows in training and test sets, respectively. An experienced veterinarian with substantial intra-scorer agreement (weighted Cohen's Kappa = 0.79), scored the cows using an industry–approved method (1-5 scale with 0.25 increments). An EfficientNetB0 neural network regressor was trained to predict a continuous value (Body Condition Index, BCI) ranging from 1 to 5. Evaluation metrics included the Root Mean Squared Error (RMSE), the R2 score, the Pearson correlation coefficient, the weighted Cohen's kappa (obtained by rounding the BCI to the closest 0.25 step), and the accuracy on 0.25 and 0.50 deviation tolerance from the human-labelled BCS. EfficientNetB0 achieved an RMSE of 0.31, an R2 score of 0.71, a Pearson correlation coefficient of 0.84 ($P<0.001$), a weighted Cohen's Kappa of 0.82, and an accuracy of 0.61 ($BCS \leq 0.25$) and 0.89 ($BCS \leq 0.50$). This suggests a strong agreement between the predicted and actual values. The model demonstrated higher predictive accuracy for cows within the critical BCS range ($2 < BCS < 4$; RMSE = 0.30) compared to under-conditioned ($BCS \leq 2$; RMSE = 0.40) and over-conditioned cows ($BCS \geq 4$; RMSE = 0.47). Our results demonstrate the feasibility of predicting BCS with simple data processing and small neural networks, making it suitable for commercial use in large dairy farms while aligning with industry requirements. Notably, this study used the largest test set to our knowledge, which should enhance reliability, generalisability, and statistical robustness.

Session F Theatre 7

Recognition and quantification of melanin-based skin pigmentation fading as a stress response in Atlantic salmon using computer vision

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The aquaculture industry is in immediate need of novel, non-invasive techniques to assess stress and welfare in farmed fish. Conventional indicators frequently only expose welfare effects once they have already happened. This study presents the fading of melanin skin spots categorized by changes in the size and pixel intensities as a potential visual indicator of stress and well-being in Atlantic salmon. We examined 130 Atlantic salmon, with an average age of 1.5 years. Initially, every fish was photographed and subjected to a standardized stress test. This test involved confinement in lowered water levels for 17 hours, until their dorsal fins were submerged. After that, the fish were photographed once more. A subset of captured images is annotated in Roboflow, and a pretrained computer vision instance segmentation model (Yolov11) is trained on these annotations. The model was validated using a distinct validation set, achieving 60% mAP50-95 for spot detection and 52% mAP for spot segmentation masks. During the inference phase, an unseen set of 80 images, consisting of pairs of pre- and post-stress images for the left and right operculum regions across 20 samples, is initially preprocessed. Subsequently, spots free of visual anomalies are chosen to ensure precise and unbiased assessment of changes in spot size and pixel intensities. Afterwards, segmentation masks of spots are obtained from the model and utilized in a post-processing phase to compute changes in pixel intensities and sizes of the pre- and post-stress spots. The quantitative analysis of changes observed in the pre- and post-stress spots highlights the potential of leveraging melanin-based skin spots fading as a reliable and non-invasive indicator of fish stress and welfare in Atlantic salmon, potentially enhancing welfare assessment techniques in aquaculture.

Monitoring foaling mares' behavior using computer vision

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Early detection of time-sensitive equine behaviors, such as foaling or signs of distress, is essential for timely intervention and improved animal welfare. Video-based analysis is increasingly being used in activity studies due to its ability to provide continuous, non-invasive monitoring, making it a valuable tool for tracking animal behavior. Traditional object detection models can identify general categories, such as ”horse” or ”person,” but lack the precision to distinguish between specific actions or postures. This study presents an iterative approach to improve object detection models for equine monitoring, focusing on refining activity classification through advanced bounding box techniques and dataset enhancement. The aim of the study was to determine whether the videodata could be part of a foaling alert system in horses. In this study, we analyze video data of 55 mares and trained a YOLO-based deep learning model to detect and classify key behaviors associated with foaling. After retraining with an improved dataset and bounding box adjustments, our YOLO-based model, which initially failed to detect lying horses, successfully identified them with high precision at a confidence threshold of 77%.

A Multi-Object Tracking Approach to Identify Low-Yield Laying Hens

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With the rapid advancement of smart agriculture, large-scale egg-laying chicken farming imposes higher demands on individual health monitoring and production efficiency evaluation. Traditional low-yield hens identification relying on manual observation and RFID tracking faces limitations including inefficiency, high stress risks, and inability to quantify behavioral characteristics. To address these challenges, this paper proposes a low-yield hens detection method based on multi-object behavior tracking. Firstly, an enhanced YOLOv11n behavior recognition model is developed by restructuring the SPPF module in the backbone network to compress computational redundancy and embedding Convolutional Block Attention Module (CBAM) mechanisms in the detection head to reinforce critical behavior feature extraction (e.g., feeding/drinking). Evaluated on a self-constructed dataset containing 2,530 annotated images of layer behaviors, the model achieves 98.3% feeding recognition accuracy and 97.8% drinking accuracy, outperforming the original YOLOv11n by 3.2-3.7 percentage points. Secondly, the Bytetrack multi-object tracking algorithm is improved by reconstructing the Kalman filter state vector , achieving 91.5% MOTA and 80.2% HOTA in occlusion scenarios. Finally, a behavior data-driven identification model for low-yield hens is established by integrating 12-dimensional behavioral features during the critical 3 minute post-feeding period. Through feature standardization and LBFGS-optimized logistic regression training, the classifier attains 96.8% accuracy on a test set of 347 hens, significantly surpassing SVM (85.3%) and LightGBM (91.2%) benchmarks. This methodology provides reliable decision support for precise culling of low-productivity hens, thereby enhancing the precision and efficiency of poultry farming management.

Session F Theatre 10

Predicting future cow lifetime milk revenue using test day data and neural network regression

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Increasing the longevity of dairy cows can contribute to a more sustainable dairy industry and improve farm profitability. Farmers frequently face critical herd management decisions, such as determining which animals to retain. Integrating data with advanced analytics can streamline this decision-making process. The aim was to develop a model to predict the future cow lifetime revenue based on yields using Dairy Herd Improvement (DHI) data. Data were sourced from the Lactanet (Canadian Network for Dairy Excellence) database encompassing 2,296 herds over eight years (2017-2024), totaling 539,072 cows and 12.5 million test records. For model training, 80% of the data was used (N =1,836 herds), while 20% (N = 460 herds) was reserved for testing. A multilayer perceptron regressor from the scikit-learn package in Python was employed to predict lifetime cumulative milk, fat and protein yields at any given age in future. These predicted yields were then used to calculate projected income. The model utilized 14 input features: age on test day, parity, days in milk, fat and protein yields on the test day, somatic cell count linear score, current lactation and lifetime yields, and age at test. Up to eight consecutive test day records were randomly selected for each cow for prediction, with a minimum of one test. The inclusion of various breeds ensured the model's breed-agnostic nature. The model's projections for milk, fat, and protein yields demonstrated high accuracy with an $R^2 = 0.97$ for milk fat and protein, respectively (MAPE= 5.68%; 5.92% and 5.51% for milk, fat and protein yields, respectively). In addition, the projected income, showed a high correlation with the observed income (R^2=0.97; MAPE=5.53%). Consistent results were observed across breeds (e.g., Holstein R^2= 0.97; Jersey R^2= 0.94; Ayrshire R^2= 0.97). The model effectively predicted cumulative yields at any age in the future, on average 5.4 years ahead. Future cow lifetime yields can be thus projected and ranked within a herd for any future age class. These findings indicate that the neural network's performance in predicting yields at any future age can aid in informed decision-making.

Session F Theatre 11

Assessing the impact of extensive husbandry conditions on broiler meat quality using machine learning

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The effects of extensive farming on the quality of broiler meat are not straightforward because measuring the quality of meat and the extensiveness husbandry conditions is complex. We aimed to assess the impact of extensive husbandry conditions on broiler meat quality using machine learning. The data was collected from seven farms across three European countries. Husbandry conditions included space allowance, diet, genetics, and quality of space. These conditions were binarized to extensiveness versus conventional husbandry. The broilers (N = 885) were analyzed in terms of their sensory properties (N =175) and their chemical properties (N = 710) forming two datasets. We predicted the extensiveness of each husbandry condition using the meat quality attributes with multiple machine learning models (XGBoost, AdaBoost, Support Vector Machine, RandomForrest, Logistic Regression, Decision Tree). We trained separate models for chemical attributes and sensory attributes. The performance of each model was evaluated using the area under the receiving operator characteristics curve (AUC-ROC) on the test set. Important meat quality attributes were identified using SHapley Additive exPlanations (SHAP). Our preliminary analysis of the sensory attribute data showed that the best predicted condition was diet extensiveness (XGBoost AUC-ROC = 0.71). The flavor and crispiness of the skin and the juiciness of the breast were the most important meat quality attributes. The most important variables for predicting the space allowance (logistic regression AUC-ROC = 0.68) were juiciness breast, fried chicken flavor, and sweetness of the breast. Genetics was the best predicted condition for the chemical attribute data (XGBoost AUC-ROC = 0.82). Lightness of color and sheer energy were the most important characteristic for predicting genetics.

AI-Powered Welfare Monitoring in Poultry Production: Enhancing Research and Farm Management

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Commercial poultry production, with its large flock sizes and limited ability to observe individuals, presents unique challenges for animal welfare monitoring that AI enhanced methods would directly address. Piling is a behaviour in laying hen flocks characterised by the excessive clustering of birds. These piles often escalate into smothering which is the cause of a significant proportion of on-farm mortalities. However, these behaviours are unpredictable with unknown triggers and as such their prevention is difficult. This talk demonstrates the potential of an AI-based tool to automate the detection of these piling events from video. The dataset used consisted of 3 weeks of video of 10 flocks of brown, free-range, laying hens on UK farms. Videos were annotated as either Piling or Non-Piling. A total of 49,908 frames (33,669 Piling and 16,239 Non-Piling) were extracted from the videos. The frames of 2 of the flocks were withheld from inclusion in the training data set for use in final validation of the resulting model. A ResNet Convolutional Neural Network was trained on the remaining data using a transfer learning approach. During training, the model achieved a peak validation accuracy of 0.93. The weightings of the most performant epoch were then used to infer the classifications of the withheld validation frames achieving an accuracy of 0.87. Within this validation data 5.56% of Non-Piling frames, and 19.76% of Piling frames were misclassified. We demonstrate the potential of a low-complexity, widely available AI model to supplement the longitudinal monitoring capabilities of both researchers and stock people. The model performed well across flocks and through the inspection of misclassified images some insight was gained into potential issues and areas of future development. This study illustrates how such technologies can benefit the welfare of livestock both by enabling more targeted responses to these behaviours by stock people and expediting research into the potential causes of this and similar behavioural phenomena.

Facilitating decision-making using PLF technologies and ML algorithms to predict shade-seeking behaviour in dairy heifers

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Heat stress can significantly impact the health, welfare, and future productivity of dairy cattle. Hence, it is key to implement tailored management strategies to mitigate these adverse effects. To this end, this study aims to create added value to data collected through precision livestock farming (PLF) technologies by predicting shade-seeking behaviour in heifers. By understanding this behaviour, farmers can better manage their herds and reduce the negative consequences of heat stress on animals. During the summer of 2023, temperature and humidity data together with video recordings were collected at a contract-rearing farm in Valencia (Spain). The temperature-humidity index (THI) was calculated to quantify heat stress levels. At the same time, the number of animals seeking shade was used as a proxy to assess behavioural responses towards heat stress. A machine learning (ML) model, in this case, Random Forest, was the selected method to predict shade-seeking behaviour. The results reveal that shade-seeking behaviour is influenced not only by immediate THI values, but also by the accumulation and distribution of heat stress over time, with effects on behaviour up to four days in advance. These results highlight the importance of assessing both short-term and long-term exposure to heat stress when developing management strategies for dairy heifers. Furthermore, by identifying context-specific behavioural triggers, we help farmers make informed farm management decisions. Our results underline the potential of combining ML with PLF when developing highly accurate predictive models. Furthermore, the proposed framework facilitates the design of sustainable and context-specific mitigation strategies tailored to local conditions to improve animal welfare and farm productivity.

Innovation in Tradition: The Use of Artificial Intelligence in Sheep Farming

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Sheep farming is a longstanding tradition deeply embedded in the cultures of countries such as Italy, Greece, Spain, and France. Extensive pasture-based systems characterise these regions, helping to keep production costs low and reducing dependency on market fluctuations. In recent years, innovations like artificial intelligence (AI), machine learning, and deep learning have been introduced to boost productivity, enhance animal welfare, and improve working conditions for farmers. However, challenges persist due to an ageing farming population and limited digital literacy. Precision Livestock Farming (PLF) tools—including GPS sensors, pedometers, and rumination trackers—have begun to transform sheep farming by enabling early detection of health issues and more efficient pasture management. A particularly promising development is virtual fencing, which employs collars that emit acoustic and electric signals to define grazing areas, thereby reducing the costs of physical fences. Despite its advantages, this technology requires stable network coverage and technical expertise. Rather than replacing human labour, AI is designed to support farmers by delivering valuable data for informed decision-making. Furthermore, deep learning holds the potential to revolutionise the selection of replacement stock. Currently, this process is based solely on the morphological characteristics of lambs at weaning, without considering the productivity and health history of their mothers. By integrating comprehensive data analysis, farmers could make more targeted and sustainable decisions, leading to improved flock productivity, extended animal longevity, and enhanced welfare. The future of sheep farming lies in balancing tradition with innovation, ensuring a sustainable and profitable industry for generations to come as some examples, or potential applications, of AI in sheep farming are presented.

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