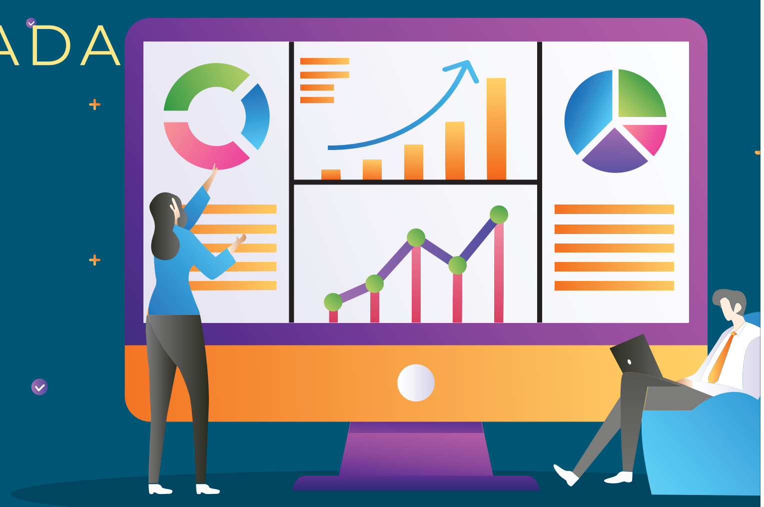
ACPV SPONSORED WORKSHOP

SENSOR DATA AND ANALYTICS FOR POULTRY HEALTH, WELFARE, AND FOOD SAFETY

APRIL 3, 2022
VANCOUVER CANADA



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Dear Colleagues,

Welcome to Vancouver! On behalf of the American College of Poultry Veterinarians (ACPV) and the ACPV Continuing Education Committee, I welcome you to the workshop "Sensor Data and Analytics for Poultry Health, Welfare, and Food Safety." This workshop will allow poultry veterinarians to learn more about electronic sensor technologies and data analytics techniques to monitor poultry welfare, health, and food safety.

This year we have a hybrid program that started a month ago with eight modules of the course Introduction to Data Analytics for the Poultry Industry. The course is self-paced, interactive, and virtual. The modules will provide a short overview of data analytic techniques and will be available until June 15, 2022.

For the live session in Vancouver, we invited a select group of speakers with recognized expertise in electronic sensors, hardware, and software for poultry data capturing, warehousing, and analysis. I want to express my sincere gratitude to these distinguished professionals for accepting our invitation and sharing their knowledge, experiences, and perspectives with our diplomates. I am sure that they will provide us with valuable and updated information that will be very useful to our attendees.

I also want to express my appreciation to the companies that generously contributed financially to make our workshop possible. With your collaboration, you are helping the ACPV to accomplish its mission. Thank you so much for supporting our college!

This year, I had the opportunity to collaborate with a wonderful group of diplomates as part of our Continuing Education Committee. All your ideas, suggestions, and collaboration were so helpful, and at the end of this process, we put together a very diverse and interesting agenda.

I also want to express special recognition to Janece Bevans-Kerr and Diana Kerr for their logistic support.

Finally, we would deeply appreciate all our attendees providing us with their candid feedback to improve future workshops. We hope that you enjoy this workshop and that the knowledge shared by our outstanding speakers is useful and valuable to be applied in your professional activities.

Sincerely,

Edgar O. Oviedo-Rondon, DVM, M.Sc., Ph.D., Dipl. ACPV, MBA
Professor/Extension Specialist, North Carolina State University
Program Chair, ACPV Workshop (2022) American College of Poultry Veterinarians

7:00 AM	**Continental Breakfast**	*Sponsored by:*
8:00 AM	Introduction: Sensors, Data Analytics for Poultry Health, and Welfare	Edgar O. Oviedo
8:40 AM	Sensors for Monitoring Health. Making Sense of Sensors Based on Big Data in Poultry Production	Suresh Neethirajan
9:20 AM	Experiences with Sensors in Poultry Biosecurity	Jean Pierre Vaillancourt
10:00 AM	**Coffee Break**	*Sponsored by:*
10:15 AM	Panel Discussion: Companies Offering Services in Data Analytics	Alan Beynon Kevin Watkins Simon Cohen
11:50 AM	**Lunch on Your Own.**	
1:00 PM	Data Challenges and Practical Aspects of Machine Learning-based Statistical Methods for the Analysis of Poultry Data	Maurice Pitesky
1:40 PM	Modeling for Infectious Bronchitis and Salmonella	Gustavo Machado
2:20 PM	**Coffee Break**	*Sponsored by:*
2:30 PM	Methodology to Analyze Real World Data to Promote Better Decision Making	Jose Linares
3:10 PM	Data Management and Data Minded for Poultry Food Safety	Joe Heinzelmann
3:45 PM	Adjourn	

Introduction: Sensors, Data Analytics for Poultry Health, and Welfare
8:00 AM

Dr. Edgar O. Oviedo
North Carolina State University

Biography

Dr. Edgar O. Oviedo-Rondón is a Professor and Extension Specialist in the Prestage Department of Poultry Science at North Carolina State University. He received his veterinary degree from the University of Tolima in Colombia. Edgar obtained his M.S. in Animal Nutrition and Production in Brazil at the State University of Maringa, Ph.D. in Poultry Science at the University of Arkansas, and in 2018 an MBA in Decision Making and Analytics from NC State University. Dr. Oviedo has experience in the poultry industry as a veterinarian, nutritionist, extension specialist, and consultant in 32 countries. Dr. Oviedo's responsibilities include extension and research in broiler, broiler breeder nutrition and management, incubation, and data analytics. The extension programs and events are related to broiler production, incubation, and data analytics. His research activities are related to feedstuff quality and processing, evaluation of feed additives, especially enzymes, mineral metabolism, intestinal health, avian bone, and muscle development and its impacts on locomotion and meat quality, incubation effects, and applications of data analytics and computer models. Dr. Oviedo is author or co-author of 101 peer-review publications in scientific journals, 315 proceedings of international meetings, 282 abstracts of presentations in scientific meetings of national and international level, 97 popular press articles, and 10 book chapters.

Abstract

This presentation will introduce the topics to discuss during the live session of this workshop and summarize some of the available online material. Participants will have the opportunity to have a brief overview of data analytics techniques used in the poultry industry during the online workshop. In the live session, the electronic sensors available for monitoring the poultry environment, behavior, health, and welfare and the ones available to track and improve biosecurity and facilitate management will be discussed. Analytics is a whole discipline that includes data analysis and proper data collection, organization, storage, control, and many tools and techniques to apply data. Analytics seek to make complete logical use of data to describe, predict, and improve a company's overall performance. This course is a brief overview of the principal data analytics methodologies that you can apply later to achieve your data analytics goals controlling health, food safety, and welfare. The poultry industry is a supply chain usually vertically integrated. In general terms, integration controls reproduction, grow out, feed production, processing of products, and marketing. Each sector generates lots of diverse data, and the volume and speed of data creation are growing exponentially. Electronic sensors will increase data generation exponentially in the next years. As leaders of this sector, poultry veterinarians need to learn how to manage it, convert it to information, and apply it in making informed decisions.

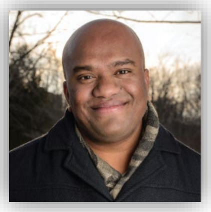
Data in animal agriculture has been used mainly to generate reports describing the final results of a process within each production sector. The results of these descriptive statistics are generally average values of what has happened. Very few companies express, record, or use the variability observed to make decisions, quality control, or risk analysis. These average values are employed in comparisons either with standard parameters or with other producers under benchmarking systems. Generally, these comparisons are based on average values and seldom include statistical or mathematical methodologies that differentiate between random variation and

the one caused by specific factors. Data analysis has assisted the administrative process by gaining knowledge of the operations, identifying main factors for control, determining key performance indicators, evaluating results, and planning. Data governance is usually centralized, and results take time to come back to data producers and information users. Having more people trained in data analytics may help speed up information discovery in at least part of the data. But there is much more value in the data than just the descriptive analysis. The data analysis looks backward over time, providing a historical view of what has happened in a process.

In contrast, data analytics tends to look forward to modeling the future and predicting a result. We can learn more from company processes using the data to acquire meaningful insights, diagnose problems, explore issues and potential solutions, rule out human bias, and help make better-informed decisions while gaining a competitive advantage. We can create predictive and prescriptive tools that can help control automatic processes while they are happening and help detect anomalies to ensure the operation reaches the desired goals. We can try to achieve optimization. This evolution comes with applying more advanced techniques that have been available for more than two decades but have low application in our sector. We expect this workshop will be a good contribution to the learning experiences for poultry veterinarians.

Sensors for Monitoring Health. Making Sense of Sensors Based on Big Data in Poultry Production

8:40 AM



Dr. Suresh Neethirajan

Wageningen University & Research, The Netherlands

Biography

Suresh Neethirajan is an Associate Professor in the Animal Sciences department, Wageningen University & Research, The Netherlands. His technical background is in bioengineering with sensor technologies expertise, and he is focused on bringing solutions to improving animal health and welfare through enabling digital technologies and Artificial Intelligence. He has published over 115 peer-reviewed high impact journal articles, 8 book chapters, 6 US patents in the Digital Livestock Farming research domain and has been a speaker in numerous conferences. He is a recipient of several global awards including Young Engineer of the Year award by Engineers Canada, Japan Society for the Promotion of Science Fellowship, New Holland Researcher award from the American Society for Agricultural and Biological Engineers, and Grand Challenges Canada award to name a few. He currently serves as an Associate Editor for the Frontiers in Animal Science journal and the Sensors journals. Before moving to Netherlands, Suresh worked as the Director of Bionano laboratory and as an Associate Professor at the University of Guelph of Canada for a period of 7 years. He obtained his PhD and MSc from the University of Manitoba, Winnipeg. Suresh is also a registered Professional Certified Coach with the International Coaching Federation (ICF) and occasionally provides life coaching services.

Abstract

The smaller size of chickens, complex behavior and large flocks in commercial production systems make the monitoring of poultry health and welfare a challenge. However, sensor technologies offer new possibilities in accurate monitoring and precise management of the poultry birds. Poultry sector is drastically undergoing change from conventional precision livestock farming (PLF) to digital livestock farming (DLF) methods enabled by the high-performance computing and big data analytical tools. The challenges of big data in poultry production includes the capturing of the data, analysis, retrieval of information, real-time data transfer, visualization and data privacy and security. Ability to make real-time decision on-farm and in the production

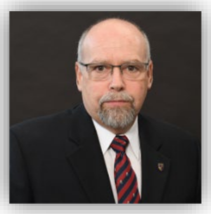
systems are driven by upscaling methods via computational and edge computing techniques, natural language processing, and high throughput data analysis.

In this invited keynote talk, I provide behind the scenes information on the academic frontiers in sensor technologies and computational ways in capturing and analyzing health and welfare data of poultry systems.

To use the data in the value chain and address the governmental needs, first the data needs to be put to use for the farmer. The more we can create a framework to support the farmer in monitoring the animals and ensuring health and welfare, the more usable the farm data will be in the value chain. Multimodal continuous real-time heterogeneous sensor data acquired by video cameras, thermal cameras, microphones, variety of sensor platforms on the vocalization calls, visual activity index, egg production, variations in humidity and temperature, feed and water intake can be used via sensor fusion approach for data analysis and prediction model development. Various Artificial Intelligence algorithms comes in play in determining the patterns and trends on the indicators and predictors of health and welfare of poultry birds. In moving the technological readiness levels from 3 to 7, validation of the developed methodologies and platforms in commercial industrial settings are warranted.

By being able to harness the massive datasets of health and welfare indicators in poultry systems, the poultry sector with the help of researchers and data scientists envision the ability to predict disease before it strikes and take management interventions to avoid them. Digital biomarkers data captured by novel sensor tools from poultry helps to shift from reactive to proactive by empowering poultry industries for healthy poultry system. The sensor technologies and the methodology of big data analysis are the keys to leveraging poultry health data in enabling the farmers to transform the health and welfare management.

Experiences with Sensors in Poultry Biosecurity
9:20 AM



Dr. Jean Pierre Vaillancourt
University of Montreal

Biography

Dr. Vaillancourt received his DVM (1983) and his MSc in Clinical Sciences (1986) from the University of Montreal and his PhD in Veterinary Medicine from the University of Minnesota (1990). Prior to returning to the University of Montreal, he held faculty positions at the University of Guelph (1990-1996), at North Carolina State University (1996-2004), and was a visiting professor at the National University of Mexico in Mexico City (2002-2003) and the School of Veterinary Medicine in Toulouse, France (2017-2018). In 1997, he received the Bayer-Snoeyenbos New Investigator Award from the AAAP. In 1998, he received the Outstanding Extension Service Award in North Carolina, and in 2000, he was inducted in the Academy of Outstanding Faculty Engaged in Extension at North Carolina State University. In 2004, Dr Vaillancourt received The Lamplighter Award from the US Poultry & Egg Association for his contributions to infectious disease research and biosecurity. In 2012, he was elected foreign member of the French Academy of Veterinary Medicine; and in 2016 he was also elected foreign member in the National Academy of Medicine (France). In 2019, the French government made him Knight of the Order of Agricultural Merit. In addition to his position at the University of Montreal, Dr Vaillancourt has served as coordinator of the Quebec team for the design and implementation of emergency measures for the poultry industry. He has served as director of the Epidemiology of Zoonoses and Public Health Research Unit (2009-2017) and as associate director of the Public Health Research Institute of the University of Montreal (2013-2017). He has also served as a member of Canadian advisory committees for the control of infectious diseases in poultry, pigs and beef cattle. He initiated the avian medicine section of the World Veterinary Education in Production Animal Health, based at the University of Luxemburg.

Abstract

Jean-Pierre Vaillancourt, DVM, MSc, PhD, Department of Clinical Sciences, Faculty of Veterinary Medicine, Université de Montréal

Manon Racicot, DVM, PhD, adjunct professor, Department of Microbiology & Pathology, Faculty of Veterinary Medicine, Université de Montréal

The COVID-19 pandemic has shed the spotlight on emerging diseases. In fact, since 1942, the medical community has identified about 340 emerging infectious diseases affecting humans, with three quarters of them being zoonotic. Poultry is no different with at least one or two emerging or re-emerging (new strain of a known disease) infectious agents recorded yearly for the past several decades. One key element of solution is stringent on-farm and regional biosecurity allowing to minimize production loses, reduce antibiotic use, as well as the impact of important zoonotic diseases. However, although effective biosecurity measures are widely known to poultry personnel and stakeholders, their application in the field is often inadequate, with compliance rates often not exceeding 50%.

One way to improve compliance and obtain real time critical information about on-farm activities is the application of sensor technologies automatically recording events. Multi-sensor systems already exist and are further being developed to monitor and control indoor conditions in poultry farms. Such smart poultry management systems offer technologies that favor productivity and cost reductions, including less on-site human involvement, which reduces traffic. Although this contributes indirectly to on-farm biosecurity, this talk will focus on sensor technologies with direct biosecurity applications.

A key feature of smart sensors is the ability to collect and process data in real time. Although it is not essential for a system to be connected to the internet in order to provide immediate feedback to employees when a breach in biosecurity is detected (the data can be recorded locally), it is essential for systems designed to provide data for real-time decision-making. The analytical tools needed to process the data will depend on the amount being generated.

On-farm biosecurity

Some hospitals use a radio-frequency-identification-based (RFID) real-time continuous automated monitoring system to assess hand sanitizing compliance. Sensors with an antenna at the door and floor are used to record who is getting into specific rooms. Employees have chips in their work shoes, allowing tracking who is getting in and when. A hand sanitizer is connected to the system to monitor hand washing compliance. We adapted this technology to monitor boot and hand sanitizing compliance when entering and exiting an egg layer and a broiler farm. On the egg-layer farm, we tested the system for 17 days with four employees. During that time, there were 254 entries and exits recorded. A 93% changing boot compliance was recorded, by contrast to 53% compliance when the same activity was monitored on other farms without any intervention. The proportion of personnel and visitors sanitizing hands was also superior (68%) using the RFID technology compared to compliance on control farms (36%). The RFID system included a sound alarm when non-compliance was recorded. This real time feedback triggered corrective actions 22% of the time for changing boots and 32% of the time for hand washing. For the broiler farm, 56 entries and exists by three different employees were recorded over a 13-day period. Boot compliance was 100% for the entire period and hand sanitizing compliance was 73.2%. Out of the 15 non-compliant hand sanitizing occurrences, one was corrected after the alarm rang. In this pilot project, only one of the employees on each farm was responsible for the majority of non-compliance

events. A similar observation was made in another pilot study conducted on a swine farm and using a different sensor technology.

A RFID system designed specifically for poultry and swine farms is currently being tested and results will be presented at the conference. One objective will be to address issues such as the difficulty to monitor if the employee enters or leaves the anteroom when there are multiple movements on the antenna in a short period of time. This will be addressed by adding pressure mats to the RFID system.

Several other applications of sensor technology can be considered for on-farm activities. For example, unmanned aircraft systems (drones) with heat detection sensors can be used to assess wildlife activities in order to assist with pest management.

Regional biosecurity

Real time track and trace processes using sensor technologies are being developed to improve disease outbreak response time and consequently minimize regional disease spread. This is important as traditional paper-based systems are inadequate given that less than half farm visitors register their visits and these systems do not have the ability to collate all the data in a useful central manner necessary for quick decision making.

Currently, different technologies are being tested (Bluetooth Low Energy (BLE), GPS, mid-range and short-range RFID and LoRa, a low-power wide-area network modulation technology). Each must have cloud storage in order to facilitate the secured access and analysis of very large datasets.

For example, in a recent test, sensors on a feed truck over a 24-hour continuous monitoring period determined that this vehicle traveled to 10 different poultry sites as part of 15 separate farm visits, including six on one of these farms. The truck was on the road visiting farms for 10.2 hours, in maintenance for 6.5 hours and park the rest of the time. Since wash bays were monitored, it was possible to determine that at no time was it washed between farms, since none of them were equipped for on-site vehicle decontamination.

Using artificial intelligence, it will be possible to use existing disease spread models for a given disease with the real-time data being recorded in order to inform decision makers and accelerate reaction time to contain the disease.

Conclusion

On-farm sensor technology offers several opportunities, such as monitoring compliance, evaluating the optimal feedback approach to improve compliance, evaluating the effect of peer performance comparison, and evaluating the effectiveness of biosecurity training programs, interventions, or incentives.

At the regional level, the potential is enormous regarding the ability to monitor and plan vehicle movements in such a way as to reduce the probability of disease spread. Real-time traceback will also be possible and will have a very significant impact on disease control once an important condition is detected.

Panel Discussion
Companies Providing Perspective in Data Analytics

Alan Beynon
MSD

Biography

Alan qualified as a veterinarian from Edinburgh University in 1988 and has worked the majority of his career in his independently owned private poultry practice. In 2016 he founded Poultry Sense, a startup business to bring together technology, machine learning and veterinarians to create actionable insights leading to improved performance, health and welfare on broiler farms.

This business was acquired by MSD in early 2021 as part of the development of their animal health and intelligence unit.

Abstract

While the role of veterinarians in the poultry industry is to safeguard animal health, welfare and public health, their ability to do so has been thwarted by their lack of accessible data.

As a result, much of the current work is retrospective, reactive and involves historic reporting which has limited value in an industry that demonstrates rapid progress in genetic advancement, nutrition, and production efficiencies.

Any veterinary investigation on farm inevitably requires a certain amount of data collection and while flock records are held on hand- written paper records or via a controller system that is often difficult to access, a visit to a farm can prove frustrating. Even if the data can be gathered, the analysis of that data then requires considerable work.

The next aspect to consider is whether the data collected is accurate to the needs. While a sensor from a controller may be accurate, its position in the house will not indicate what that value represents at bird level.

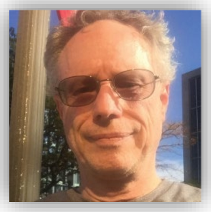
Finally, the collection of data from one sensor in a shed has limited value and as shed size becomes larger, one requires more granular data to understand where deficiencies exist.

The recent advances in sensor technology and the IoT (Internet of Things) explosion globally have facilitated rapid progress in the automotive, aviation and oil industries with the ability to monitor facilities in real time to understand better the efficiencies of these industries. It is interesting also to note that as the price of crude oil fell the adoption of technology increased as efficiency was ever more important in a climate of low margin.

Poultry Sense is a business developed by veterinarians and engineers to create a means of monitoring the bird's environment in real time through the use of IoT and to attribute this data collection to other parameters e.g., feed intake, weight, flock code, veterinary diagnostics etc. The business created an analytics platform to allow interrogation of the data to create outcomes that are actionable and relevant to creating positive change in efficiency and welfare objectives.

The analytics platform allows for the creation of an automated "end of flock report" which details what parameters are outside of set parameters. These parameters may track the genetic companies' profiles, however, an integrated business is also able to set their own profiles based on geographical location, feed produced, and breed standards used.

By using real time data and accessing the analytics tool a veterinarian is in a better place to make current informed decisions on broiler farms leading to a more proactive approach to problem solving and predicting outcomes.



Dr. Kevin Watkins
FoodFirst, LLC

Biography

Kevin has a MS in Animal Nutrition from the University of Missouri and a PhD in Animal Science with a minor in Human Nutrition from Louisiana State University. After serving as Laboratory Manager and Instructor at LSU, he joined the parasitic protozoology team at Lilly Research Laboratories. Kevin then held several R&D, regulatory, technical consulting, and analytics positions at Elanco Animal Health. After 29 years at Elanco, Kevin retired as Nutritional Health Advisor and started FoodFirst LLC to provide consulting and analytic services for those who recognize that food and feed are paramount to One Health. More recently, Kevin earned a Data Analytic Certificate from Cornell University and has been awarded an Honorary Senior Research Fellow appointment in the Department of Epidemiology and Population Health at University of Liverpool where he advises on the Global Burden of Animal Diseases program. Kevin has authored or co-authored more than 100 articles on animal health, nutrition, and food security. He lives in Indianapolis, IN USA spends time riding his bicycle, restoring a historic house, gardening, and volunteering for various hunger relief organizations

Abstract

Kevin Watkins[1], Sebastian Villegas Palacino[2], and Juan Pedro Fernandez Sanin[2]
[1]FoodFirst LLC, Indianapolis, IN, USA; [2]Asimetrix Inc., Durham, NC, USA

Poultry producers generally have access to enough data to accurately describe production results. However, these data rarely provide much predictive or prescriptive value. Access to more leading indicators of production can help producers not only understand what happened but provide insights into what is going to happen and how to achieve the best that could happen. But does more data always lead to better decisions and improved animal health, welfare, and productivity?

Asimetrix has provided analytics solutions to the food-animal industry since 2011. To achieve our vision of a better nourished world, we use remote sensing, cloud computing, and machine learning to help food producers make inefficiencies optional. We use the latest sensor technology and statistical methods to monitor the production environment remotely and provide dynamic web-based insights so you can more quickly respond and continually improve. Our remote sensing technology includes hanging and platform scales, environmental monitoring, and vision systems. Asimetrix provides real-time web reports, custom alerts, and chat bots along with descriptive, predictive, and prescriptive analysis. But experience has taught us that we often don't spend enough time learning about the more complex process of how the poultry industry uses data to make decisions.

After one of our smart farm installations, with sensors sensing, data flowing, and reports reporting, a broiler integrator told us that we "did an excellent job showing them we can collect data." Everyone agreed we had learned more about when, where, and why productivity gaps occur, but no action had turned that knowledge into more meat, dollars, time, or marketable value. Although the use of analytics is increasing across all industries, many companies still struggle to get positive returns on their analytic investment1,2.

A 2021 survey of 85 Fortune 1000 corporations showed 92.2% reported that culture, people, and organizational processes were the largest impediment to becoming a data-driven organization3. Yet most of our discussions with food animal producers are about hardware, software, and reports. We often focus on the quantity of inputs instead of the value of outputs and are usually ready to collect data and generate reports even before fully understanding the primary business objectives. This can result in outputs that are too late or fragmented to act on or too disconnected from critical production needs to be of significant value.
Asimetrix has identified several factors that are critical for achieving a good analytic ROI. For example, an inability to put data into actionable outputs or to align decision-makers on how to use analytic services can result in inaction even when data are clearly telling you something. Some decision-makers discount data and rely more on experience. Asimetrix believes that the best decisions are made when analytics and experience work together—but that takes planning. While starting small can be a great way to initiate an analytic program, it is hard to ask a producer to act when the sample size is not sufficient to confidently represent their enterp. e. Value can also fall short when companies can't integrate data across their operation or when critical data are not available or not available in a timely ma. r. Poultry production moves fast, analytic services need to,. o. But the speed of poultry production often becomes an excuse for not learning from deviations or a pretext for quickly responding without cause. Not learning is a missed opportunity for improvement. But acting without justification might mean you are overreacting to normal variation, only making matters worse. We don't just need to know when and where to act but when not to act.

The journey to becoming an analytic competitor is not easy, but with a disciplined approach every step along the way can provide better decision-making power. Asimetrix recommends that the journey begins with enterprise-level business needs, not technology—what questions do you need to answer, not what data do you want to collect. Investments in technology have significantly increased the probability that analytic products and services will achieve technical success—you can accurately collect, process, and report data. Asimetrix is trying to change processes and paradigms to increase the probability that analytic investments also achieve commercial success—improve the health, welfare, and productivity of your birds, the performance of your company, and your ability to meet consumer demands for your products. It has been estimated that the gap between actual global broiler production margins and breed potential is over USD 9 billion annually4 and that the global cost of coccidiosis alone in broilers, breeders, and layers is about USD 14 billion a year5. With such large opportunities, even small improvements in data-driven decision-making can not only help your bottom line, but can reduce the economic, environmental, and social impact of poultry production and advance One Health.

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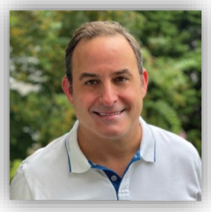


Simon Cohen
M-Tech Systems USA, LLC

Biography

A native of Caracas, Venezuela, Mr. Cohen received his bachelor's degree in industrial engineering from Georgia Southern University. Previously, he worked with Systemate, Netherlands, responsible for the design of poultry processing plants. Mr. Cohen is now Chief Marketing and Sales Officer and shareholder with M-Tech Systems, responsible for transforming its profile from a regional company in the Southeastern United States to a global industry leader in agribusiness software.

Abstract

MTech Systems Leverages IoT and Machine Learning to correlate data with final flock performance. We will combine data captured through different sensing technology to then process Big Data and analyze it in the MTech ML platform.

Data Challenges and Practical Aspects of Machine Learning-based Statistical Methods for the Analysis of Poultry Data
1:00 PM

Dr. Maurice Pitesky
UC Cooperative Extension

Biography

Maurice Pitesky is an associate professor of cooperative extension at the UC Davis School of Veterinary Medicine with an appointment in poultry health and food safety epidemiology. Dr. Pitesky earned his BS in biology from UCLA, and his DVM and MPVM from UC Davis. Pitesky is also boarded in Preventative Veterinary Medicine (DACVPM).

Pitesky's research interests are focused in four major areas:
1) Using "traditional" epidemiological techniques and cartography to understand how avian diseases move in time and space.
2) Disease modeling of avian diseases
3) Understand the role of social media in promotion of best practices associated with backyard poultry and
4) Gaining a better understanding of small-scale poultry production with respect to environmental sustainability, poultry heath, and food safety.

Abstract

Maurice Pitesky*^, Tristan Bond^, Roberto Carrasco-Medanic*^, Megan Bond^ and Joseph Gendreau*^

*UC Davis School of Veterinary Medicine, 530-752-3215, mepitesky@ucdavis.edu
^AgriNerds www.agrinerds.com Davis, CA.

Commercial breeding, layer, broiler, and turkey flocks collect an overwhelming amount of data, some of which is not complete, inaccurate, insufficiently integrated and/or not leveraged for decision making. Optimizing production, economics, food safety and flock health requires a deep understanding of the data currently collected including the ability to easily identify errors. Once linked and visualized, specific on-farm and processing data offer valuable insights to factors that affect production, flock's health, economics, and food safety. Supervised machine learning based techniques are capable of "searching" and "learning" by detecting non-obvious associations and patterns in the data for non-linear and interactive relationships to create more reliable, accurate, explanatory, and predictive models. This presentation will describe the utilization of data integration and data visualization for "whole company analyses," including integrated methods of economic analysis that link multiple factors. Additionally, various machine learning based models will be discussed that have been shown to perform efficiently for predicting several productive parameters in commercial layers and broilers. As an example, a modification of the machine learning ensemble technique Random Forest identified multiple variables including "age," "farm" and "mortality" as predictive of hen housed eggs using a dataset from a large commercial layer operation in California. The task of developing a robust model that accounts for intricate interdependence between several production parameters and outputs while predicting multiple sequential outputs is complex. Random Forest and other machine learning techniques offer a novel and efficient approach towards overcoming this difficulty. The use of these models could offer a more comprehensive approach toward evaluating and predicting productivity and profitability in poultry production using the data currently collected.

Modeling for Infectious Bronchitis and Salmonella

1:40 PM

Dr. Gustavo Machado
NC State College of Veterinary Medicine

Biography

My main research develops and applies epidemiological tools and models to investigate dynamics of animal infectious diseases spread. I have dedicated my efforts on developing machine-learning, mathematical modelling methods, and tools with direct application to emerging and transboundary animal diseases. Ultimately, we are interested in providing an understanding of infectious disease transmission processes among livestock populations, providing science-based support for decision making with regard to prevention and control. In the past few years, my research focused on the mathematical modeling and traditional statistics for practical mapping the spread of infectious diseases among pig population. I authored or co-authored more than 137 peer-reviewed publications in the field of animal and human health. My research provides training opportunities in interdisciplinary research at the interface of disease spread and control strategies, both nationally and internationally. As faculty, I have been a research mentor for 15 undergraduate students, 9 veterinary students, 3 graduate students and 3 postdoctoral fellows. My laboratory in the College of Veterinary Medicine at the North Carolina State University is current funded by USDA-NIFA FACT and USDA-NIFA

CARE, USDA-APHIS, Swine Health Information Center, internationally by FUNDESA-Fundo de Desenvolvimento e Defesa Sanitaria Animal (Brazil).

Abstract

Historically many infectious diseases have been introduced and re-introduced in the U.S. poultry populations causing outbreaks with different dissemination patterns. As result, many epidemiological models have been developed and used to reproduce trajectories of pandemics/endemics. Since 1960, three main revolutions in the field of "modelling of infectious disease epidemiology": 1) Methodological developments disease dynamics and heterogeneity; 2) Advanced computing and inference, and complexity, and 3) The use of transmission models with application in real-world problems.

Regardless of these revolutionary improvements in modelling diseases propagation, still many challenges limit our ability to reconstruct transmission dynamics, especially in food animal systems in with plenty of mixed factors including, rising immunization levels, diverse viral variants, unpredictable behavior of animal populations, not to mention how complex between-farm animal movements can vary and impact directly how diseases can propagate.

The good news is that many industries have started to share important information with researchers which can finally develop transmission models capable of answering questions about the dissemination of diseases but also simulated the deployment of control strategies, including:

- When should I vaccinate my flock/herd? which vaccine is expected to work best?
- Should we implement herd closure? for how long?
- By mixing animals of many sources (e.g., commingling) will increase my chances of spreading the disease throughout my entire company?

In this workshop, we will discuss two approaches on how such models can be used to inform stakeholders. Briefly, the following sections describe the two example that will be presented:

1. Infectious bronchitis virus (IBV) and phylodynamic: Infecting large portions of the global poultry populations, the avian infectious bronchitis virus (IBV) remains a major economic burden in North America. With more than 30 serotypes globally distributed, Arkansas, Connecticut, Delaware, Georgia, and Massachusetts are among the most predominant serotypes in the United States. Even though vaccination is widely used, the high mutation rate exhibited by IBV is continuously triggering the emergence of new viral strains and hindering control and prevention measures. For that reason, targeted strategies based on constantly updated information on the IBV circulation are necessary. Here, we sampled IBV-infected farms from one US state and collected and analyzed 65 genetic sequences coming from three different lineages along with the immunization information of each sampled farm. Phylodynamic analyses showed that IBV dispersal velocity was 12.3 km/year. The majority of IBV infections appeared to have derived from the introduction of the Arkansas DPI serotype, and the Arkansas DPI and Georgia 13 were the predominant serotypes. When analyzed against IBV sequences collected across the United States and deposited in the GenBank database, the most likely viral origin of our sequences was from the states of Alabama, Georgia, and Delaware. Information about vaccination showed that the MILDVAC-MASS+ARK vaccine was applied on 26% of the farms. Using a publicly accessible open-source tool for real-time interactive tracking of pathogen spread and evolution, we analyzed the spatiotemporal spread of IBV and developed an online reporting dashboard. Overall, our work demonstrates how the combination of genetic and spatial information could be used to track the spread and evolution of poultry diseases, providing timely information to the industry. Our results could allow producers and veterinarians to monitor in near-real time the current IBV strain circulating, making it more informative, for example, in vaccination-related decisions.

2. Salmonellosis and animal movement: Salmonellosis originating from poultry poses a significant threat to human health. Surveillance within production is thus needed to minimize risk. The objectives of this work were to investigate the distribution of Salmonella spp. from a commercial turkey operation and describe the

animal movement patterns to investigate the association between contact network structure and Salmonella infection status. Four years of routine growout farm samples along with data on facility location, time since barns were built, production style, and bird movement data were utilized. From all of the surveillance samples collected, Salmonella serotyping was performed on positive samples and results showed that the most represented groups were C1 (28.67%), B (24.37%) and C2 (17.13%). The serovar Infantis (26.44%) was the most highly represented, followed by Senftenberg (12.76%) and Albany (10.93%). Results illustrated the seasonality of Salmonella presence with a higher number of positive samples being collected in the second half of each calendar year. We also demonstrated that Salmonella was more likely to occur in samples from older farms compared to farms built more recently. The contact network connectivity was low, although a few highly connected farms were identified. Results of the contact network showed that the farms which tested positive for Salmonella were not clustered within the network, suggesting that even though Salmonella dissemination occurs via transferring infected birds, for this study case it is unlikely the most important route of transmission. In conclusion, this study identified seasonality of Salmonella with significantly more cases in the second half of each year and also uncovered the role of between-farm movement of birds as not a major mode of Salmonella transmission.

Methodology to Analyze Real World Data to Promote Better Decision Making

2:30 PM

Dr. Jose Linares
Ceva Animal Health

Biography

Dr. Jose Linares is Manager of Veterinarian Services for CEVA Animal Health in the United States. Dr. Linares brings to CEVA 25 plus years of experience in the global poultry industry having worked in various technical roles involving primary breeders, pathology, diagnostics, consulting, international development activities and the animal health industry. He provides technical support focusing on respiratory diseases and troubleshooting challenging cases.

His Doctor of Veterinary Medicine (DVM) degree is from Purdue University, and he is board certified by the American College of Poultry Veterinarians (ACPV) and the American College of Animal Welfare (ACAW). His areas of expertise include poultry medicine, pathology, diagnostics, high consequence disease prevention and control, and animal welfare

Abstract

Jose A. Linares, Mathilde Lecoupeur, Higor Cotta

In medicine, real-world data (RWD) consists of data relating to patient health status, collected from multiple sources outside the context of a non-randomized controlled trial setting and generated during the routine execution of medical evaluations. Real-world evidence (RWE) is clinical evidence regarding how a product is used and its potential benefits/risks, derived from analyzing RWD. In poultry medicine, this concept applies to the evaluation of vaccination programs via analysis of real-world poultry health data.

Since 2017, our veterinary services and data analysis teams initiated an RWE initiative by applying professional statistical analysis to poultry health, performance, and diagnostic data. In poultry production, RWD originates

from multiple sources such as breeders, hatcheries, live production, and processing plants. In our experience, data is collected using a variety of platforms and the data itself could be in a variety of formats. In this inherent complexity, data should be an asset, but we run into various scenarios such as:

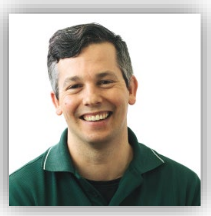
- Large amounts of existing data not leveraged across an organization
- Data visibility is not optimal for decision makers
- Data is siloed between departments
- It takes too long to gather data for simple troubleshooting
- Large amounts of data but statistics are not applied
- Only a few data analyst that understand/work on poultry data

Our goal is to help promote fact-based decisions through professional statistical analysis. We work with existing data shared by our customers, or design field trials to generate the needed data. Comprehensive field trials to evaluate the value of a vaccine/vaccination program require the generation and analysis data on health parameters (livability, condemnations, medication costs), disease surveillance (isolation, detection, serology) and performance (body weight, average daily gain, feed conversion). Subsequent economic analysis helps to determining the benefit of changes/interventions to the customer. Sometimes data analysis could help quantify the cost of subclinical disease. Ultimately, we aim to extract the unrealized added value of data in decision making.

The data analysis process begins with data cleaning/homogenization, followed by merging/consolidation. Python software is used to analyze the data, generate visualization of the data (boxplots, correlation matrix, contingency table, scatterplots, etc.) and conduct statistical analysis. Several kinds of data analysis have been conducted over the past 5 years: 2 or 3 group comparisons, repeated measures ANOVA, correlations, confusion matrix (sensitivity, specificity), kappa agreement and so on.

In this presentation we will share real-world examples of data analysis for improved decision making.

Data Management and Data Minded for Poultry Food Safety
3:10 PM



Joe Heinzelmann
Neogen

Biography

Joe Heinzelmann began his career in nanotechnology. He has held various sales and marketing positions in the nanotechnology space until he joined Neogen in 2011. He's been in food safety for over a decade, and at Neogen he's held a variety of commercial roles. Currently Joe leads our innovation and digitalization efforts for food safety as the Director of Food Safety Digital Solutions, including Neogen Analytics and blockchain. His undergraduate degree is from Albion College and has an MBA from Northwood University.

Abstract

As the smarter era of food safety continues to evolve, more and more companies are digitalizing food safety systems. As food safety systems become easier to use, easier to deploy, and easier to scale our ability to manage risk and deploy resources will change. Various industries have undergone digital transformation in order to

improve operational, safety, or effectiveness metrics. As investments and technologies improve, domain expertise needed to define and lead the way for technologists and innovation. The presentation will largely cover applications of track and tracing endeavors in food safety, specifically some of the technologies being evaluated, used, and leveraged according to rule 204. Examples of data aggregation engines, and data deployment solutions to improve workflows, processes, and decision making.

Unique data sources, data types, and data velocity are key elements in data management for food safety, specifically the complexities of overall food quality systems and deployment to manage both food safety and food quality requirements of businesses.

Practical use cases that will be reviewed include identifying potential root causes in ready to eat food manufacturing environments for sources of pathogen contamination. This will include data visualization, graphics, and different key performance indicators of facility environmental monitoring management. The workflow systems needed to define and deliver new insights, improved data quality, and unique metrics will help define the risk profile and overall effectiveness of deployed programs.

Lastly, within any organizational improvement, change management can be a critical success factor in the deployment of new technologies specifically around digitalization. There are multiple different models for change management and digital deployments, and this topic will review the framework in a traditional customer success deployment model with multiple phases, and key success factors as organization mature.

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