

# **10th International Livestock Environment Symposium 2018 (ILES X)**

Omaha, Nebraska, USA  
25 - 27 September 2018

ISBN: 978-1-5108-9689-5

**Printed from e-media with permission by:**

Curran Associates, Inc.  
57 Morehouse Lane  
Red Hook, NY 12571



**Some format issues inherent in the e-media version may also appear in this print version.**

Copyright© (2018) by American Society of Agricultural & Biological Engineers  
All rights reserved.

Printed with permission by Curran Associates, Inc. (2020)

For permission requests, please contact American Society of Agricultural & Biological Engineers  
at the address below.

American Society of Agricultural & Biological Engineers  
2950 Niles Road  
St. Joseph, MI 49085  
USA

Phone: (269) 429-0300

Fax: (269) 429-3852

[hq@asabe.org](mailto:hq@asabe.org)

**Additional copies of this publication are available from:**

Curran Associates, Inc.  
57 Morehouse Lane  
Red Hook, NY 12571 USA  
Phone: 845-758-0400  
Fax: 845-758-2633  
Email: [curran@proceedings.com](mailto:curran@proceedings.com)  
Web: [www.proceedings.com](http://www.proceedings.com)

# TABLE OF CONTENTS

<b>MODERN SHEEP BARNS IN COLD CLIMATE - PREFERENCE BY SHORN SHEEP FOR DIFFERENT TYPES OF SLATTED FLOORING</b> .....	1
<i>Grete H.M. Jorgensen, Juni Rosann Egelien Johanssen, Knut Egil Boe</i>	
<b>SAND BEDDING FOR DAIRY COWS: BENEFITS, CUBICLES, AND MANURE HANDLING</b> .....	8
<i>Andrew W Wedel</i>	
<b>EVALUATING A LIDAR SENSOR AND ARTIFICIAL NEURAL NETWORK BASED-MODEL TO ESTIMATE CATTLE LIVE WEIGHT</b> .....	21
<i>Rafael V. Sousa, Rubens A. Tabile, Ricardo Y. Inamasu, Luciane S. Martello</i>	
<b>COMPUTATIONAL FLUID DYNAMICS MODEL FOR AIR VELOCITY THROUGH A POULTRY TRANSPORT TRAILER IN A HOLDING SHED</b> .....	27
<i>Christian L Heymsfield, Yi Liang, Thomas A. Costello</i>	
<b>CONSTRUCTION AND PERFORMANCE OF A SELF-CONTAINED, TEMPERATURE-CONTROLLED HEAT SOURCE TO QUANTIFY THERMAL LOAD DURING LIVE HAUL OF BROILERS</b> .....	35
<i>Kaushik Luthra, Yi Liang, James R Andress, Thomas A Costello, Susan E Watkins</i>	
<b>CONTROL ALGORITHM DEVELOPMENT AND SIMULATION FOR COMPARING EVAPORATIVE PADS AND SPRINKLERS FOR GROW-FINISH PIGS</b> .....	43
<i>Brett C. Ramirez, Steven J. Hoff, Jay D. Harmon</i>	
<b>BEHAVIORAL AND PRODUCTION RESPONSES OF W-36 CHICKS TO SUPPLEMENTARY UVA LIGHT</b> .....	48
<i>Kai Liu, Kailao Wang, Tao Fei, Lilong Chai, Hongwei Xin</i>	
<b>PARTICULATE MATTER SUPPRESSION AND HEAT STRESS RELIEF IN A CAGE-FREE HEN HOUSE</b> .....	59
<i>Lilong Chai, Hongwei Xin, Jofran Oliveira, Yu Wang, Kailao Wang, Yang Zhao</i>	
<b>RESPONSES OF LAYING HENS TO FULL VS. PARTIAL LITTER ACCESS IN AVIARY HOUSING</b> .....	67
<i>Jofran L Oliveira, Hongwei Xin</i>	
<b>THE EMISSION OF AIR POLLUTANTS IN FATTENING PIG HOUSES</b> .....	75
<i>Shihua Pu, Dingbiao Long, Zuohua Liu, Yaqiong Zeng</i>	
<b>AN IMAGE ACQUISITION SYSTEM FOR STUDYING BEHAVIORS OF SOWS AND PIGLETS IN FARROWING BARNS</b> .....	84
<i>Suzanne M. Leonard, Hongwei Xin, Tami Brown-Brandl, Brett C. Ramirez</i>	
<b>PRODUCTION OF RECYCLED MANURE SOLIDS USED AS BEDDING FOR DAIRY COWS IN CANADA: ANALYSIS OF SOLID-LIQUID SEPARATION AND COMPOSTING METHODS</b> .....	89
<i>S. Fournel, S. Godbout, P. Ruel, A. Fortin, K. Duquette-Lozeau, V. Letourneau, M. Genereux, J. Lemieux, D. Potvin, C. Cote, C. Duchaine, D. Pellerin</i>	
<b>ANALYSIS OF AERODYNAMIC PROBLEMS OF DOMESTIC SWINE HOUSES AND DEVELOPMENT OF EDUCATIONAL VR SIMULATOR</b> .....	100
<i>Jun-Gyu Kim, Rack-woo Kim, In-Bok Lee, Tae-Hwan Ha</i>	
<b>A REAL-TIME SOW BEHAVIOR ANALYSIS SYSTEM TO PREDICT AN OPTIMAL TIMING FOR INSEMINATION</b> .....	106
<i>Jacquelin Labrecque, Joel Rivest</i>	
<b>A RFID-BASED MONITORING SYSTEM FOR CHARACTERIZATION OF PERCHING BEHAVIORS OF INDIVIDUAL POULTRY</b> .....	112
<i>Kailao Wang, Kai Liu, Hongwei Xin, Lilong Chai, Yu Wang, Tao Fei, Jofran Oliveira, Jinming Pan, Yibin Ying</i>	
<b>DETERMINING ENVIRONMENTAL BENEFITS AND ECONOMIC COSTS OF DIFFERENT MANURE HANDLING STRATEGIES IN QUEBEC'S DAIRY PRODUCTION USING FARM SIMULATION</b> .....	120
<i>S. Fournel, E. Charbonneau, S. Binggeli, J.M. Dion, D. Pellerin, M.H. Chantigny S. Godbout</i>	
<b>FUNCTION OF AUTOMATIC MANURE SCRAPERS</b> .....	130
<i>Lars Erik Ruud, Oyvind Froknestad</i>	
<b>FAN PLACEMENT IN HORSE STALLS</b> .....	134
<i>Staci E McGill, Morgan Hayes, Robert Coleman</i>	
<b>SIMULATION TO IMPROVE TEMPERATURE AND AIRFLOW PATTERNS IN TUNNEL VENTILATION SYSTEMS</b> .....	141
<i>Daniella Jorge Moura, Vilmar Rodrigues Sousa Jr.</i>	

<b>THERMAL ENVIRONMENT EVALUATION OF A NOVEL POSITIVE PRESSURE FILTERED VENTILATION SYSTEM IN A SWINE BREEDING-GESTATION BARN</b> .....	149
<i>Benjamin C. Smith, Blake J. Fonken, John P. Stinn, Steven J. Hoff, Jay D. Harmon</i>	
<b>AUTOMATIC IDENTIFICATION OF BROILER MORTALITY USING IMAGE PROCESSING TECHNOLOGY</b> .....	157
<i>Veera V. R. M. K. R. Muuva, Yang Zhao, Pratik Parajuli, Song Zhang, Tom Tabler, Joseph Purswell</i>	
<b>EFFECTS OF SUSTAINED COLD AND HEAT STRESS ON ENERGY INTAKE, GROWTH AND MITOCHONDRIAL FUNCTION OF BROILER CHICKENS</b> .....	164
<i>Shuai Shao Zhang, Guang Hong Su, Ying Zhou, Mei Xiu Li, Hong Min Zhang, Hai Jing Feng</i>	
<b>HERD-LEVEL PRODUCTION IMPACTS OF EVAPORATIVE COOLING OF DAIRY COWS ON MILK PRODUCTION IN SLOVAKIAN LOWLANDS</b> .....	175
<i>Jan Broucek, Stefan Ryba, Marta Dianova, Michael Uhrincat, Miloslav Soch, Anton Hanus, Lubos Zabransky</i>	
<b>EFFECT OF WATER DELIVERY MANNER ON DAIRY CALF PERFORMANCE</b> .....	181
<i>Jan Broucek, Michael Uhrincat, Anton Hanus, Miloslav Soch, Peter Tongel, Lubos Zabransky</i>	
<b>DEVELOPMENT AND VALIDATION OF A LOW-FREQUENCY RFID SYSTEM FOR MONITORING GROW-FINISH PIG FEEDING AND DRINKING BEHAVIOR</b> .....	186
<i>T. M. Brown-Brandl, F. Adrion, E. Gallmann, R. Eigenberg</i>	
<b>IDENTIFYING ANOMALOUS DECREASES IN FEEDING TIME OF GROW-FINISH PIGS</b> .....	195
<i>F. Adrion, T. M. Brown-Brandl, D. Jones, E. Gallmann</i>	
<b>USING AN ARTIFICIAL NEURAL NETWORK TO PREDICT PIG MASS FROM DEPTH IMAGES</b> .....	203
<i>Isabella C. F. S. Condotta, Tami M. Brown-Brandl, Rafael V. Sousa, K. O. Silva-Miranda</i>	
<b>TEMPORAL VARIABILITY OF ILLUMINANCE IN COMMERCIAL BROILER HOUSES</b> .....	210
<i>Joseph L. Purswell, John E. Linhoss</i>	
<b>IMPROVING AIR QUALITY IN SWINE BUILDINGS BY USING A COMBINATION OF TECHNOLOGIES - PILOT-SCALE TESTS</b> .....	218
<i>A. Levesque, M. Girard, V. Letourneau, C. Duchaine, S. Godbout, S.P. Lemay</i>	
<b>RADIO-FREQUENCY IDENTIFICATION (RFID) SYSTEM FOR MONITORING SPECIFIC BEHAVIORS OF GROUP HOUSED BROILERS</b> .....	225
<i>Guoming Li, Yang Zhao, Rhet Hailey, Nan Zhang, Yuanji Liang, Joseph L. Purswell</i>	
<b>AMMONIA AND SIZE FRACTIONED PARTICULATE MATTER EMISSION FACTORS FOR A CAGE-FREE LAYER FACILITY IN CANADA</b> .....	233
<i>Jaime E Anderson, Patrick K McGrath, Hanna A Ivankovic, Bill J Van Heyst</i>	
<b>SURVEY AND FUTURE PROSPECTS IN PRECISION DAIRY FARMING</b> .....	241
<i>Hugo FM Milan, Kristen M Perano, Kifle G Gebremedhin</i>	
<b>DEVELOPMENT OF A RAINWATER HARVESTING MODEL FOR BROILER FARMS TO ESTIMATE ON-FARM STORAGE NEEDS</b> .....	249
<i>Carson M. Edge, Jeremiah D. Davis, Joseph L. Purswell, William D. Batchelor, Eugene H. Simpson</i>	
<b>IDENTIFICATION OF DIFFERENTIALLY EXPRESSED GENES ASSOCIATED WITH BREAST MEAT YIELD OF BROILERS IN RESPONSE TO ATMOSPHERIC AMMONIA USING RNA SEQUENCING</b> .....	257
<i>Bao Yi, Liang Chen, Ruqing Zhong, Hongfu Zhang</i>	
<b>THERMAL ENVIRONMENTAL PERFORMANCE OF A DAIRY BARN CROSS-VENTILATED IN WARM WEATHER AND NATURALLY VENTILATED IN COOL WEATHER</b> .....	266
<i>K A Janni, J A Salfer, E L Cortus, J Knorr</i>	
<b>OPTIMAL PLACEMENT AND SIZE OF THE BAFFLES TO DIRECT AIRFLOW IN MECHANICALLY VENTILATED DAIRY HOUSING</b> .....	275
<i>Bo Zhou, Xiaoshuai Wang, Mario R Mondaca, Christopher Y Choi</i>	
<b>CONTINUOUS AND WIRELESS SKIN CONTACT AND EAR IMPLANT TEMPERATURE MEASUREMENTS AND RELATIONS TO THE CORE BODY TEMPERATURE OF HEAT STRESSED DAIRY COWS</b> .....	285
<i>Hanwook Chung, Jingjie Li, Younghyun Kim, Christopher Y Choi</i>	
<b>MEASUREMENT OF 3-D SURFACE AREA OF PIGLETS</b> .....	294
<i>Hugo FM Milan, Gustavo AM Moura, Patric A Castro, Alex SC Maia, Kifle G Gebremedhin</i>	
<b>IMPACT OF SLATTED FLOOR ON AMMONIA EMISSIONS IN FATTENING SWINE HOUSING</b> .....	300
<i>Joahnn H. Palacios, Stephane Godbout, Sebastien Turcotte, Marie-Aude Richard</i>	
<b>EFFECTS OF EXPOSING EGGS TO VARIOUS GREEN LIGHT INTENSITIES DURING INCUBATION ON HATCH PERFORMANCE, POST-HATCH GROW PERFORMANCE, FEAR AND STRESS RESPONSES IN LAYER CHICKS</b> .....	308
<i>Yue Yu, Zhanming Li, Jinming Pan</i>	

<b>IMPROVING AIR QUALITY AND EFFECTIVE COWSIDE VELOCITY (ECV) INSIDE MODERN DAIRY FACILITIES .....</b>	<b>322</b>
<i>Michael J Wolf, John McBride</i>	
<b>NUMERICAL MODELLING OF NEGATIVE AIR IONIZATION FOR REMOVING VIRAL BIOAEROSOLS IN AN ENCLOSED SPACE .....</b>	<b>329</b>
<i>Desmond Essien, Qiang Zhang, David Levin, Kevin Coombs</i>	
<b>ASSESSMENT OF HOUSING ENVIRONMENT AND ITS IMPACT ON DAIRY BEHAVIOR AND MILK PRODUCTION IN NORTHEASTERN CHINA .....</b>	<b>336</b>
<i>Yujian Lu, Chaoyuan Wang, Haoxiang Zhao, Li Dong, Zhengxiang Shi, Baoming Li</i>	
<b>ACTIVITY ANALYSIS TO DETECT LAMENESS IN PIGS WITH A UHF-RFID SYSTEM .....</b>	<b>346</b>
<i>Anita Kapun, Felix Adrion, Eva Gallmann</i>	
<b>APPLICATION OF AN AUTOMATED EARLY-WARNING LEAK DETECTOR FOR EARTHEN WASTEWATER HOLDING STRUCTURES USING NON-INVASIVE GEOPHYSICAL INSTRUMENTATION .....</b>	<b>355</b>
<i>Bryan L. Woodbury, Roger Eigenberg</i>	
<b>EFFECTIVENESS OF NEGATIVE AIR IONIZATION IN REMOVING AIRBORNE PORCINE REPRODUCTIVE AND RESPIRATORY SYNDROME VIRUS (PRRSV) .....</b>	<b>363</b>
<i>Amy La, Qiang Zhang, David Levin, Kevin Coombs</i>	
<b>IMPROVING AIR QUALITY FOR ANIMALS AND HUMANS WITH RENEWABLE ENERGY AND NUTRIENT CONSERVATION .....</b>	<b>371</b>
<i>John A George, Richard P Mattocks, Mark Moser, John Paul Smith, Rick Thomas</i>	
<b>EFFECT OF SLATTED FLOOR CONFIGURATION ON AIR QUALITY AND FLOOR CLEANLINESS IN A SOW BARN .....</b>	<b>376</b>
<i>Xiaojie Yan, Qiang Zhang, Laurie Connor</i>	
<b>APPLICATION OF AN EARLY WARNING TO DETECT ENTEROPATHIES IN INTENSIVE BROILER FARMING .....</b>	<b>385</b>
<i>Emanuela Tullo, Federica Borgonovo, Guido Grilli, Alessandra Micheletti, Giacomo Aletti, Susanna Lolli, Valentina Ferrante, Marcella Guarino</i>	
<b>HIGH AMBIENT TEMPERATURE IMPACTS SEMEN QUALITY IN BOARS AND POTENTIAL MOLECULAR DRUG-TARGETS AND NUTRITIONAL STRATEGIES FOR AMELIORATION .....</b>	<b>390</b>
<i>Yansen Li, Zhaojian Li, Jiaqin Chen, Chunmei Li</i>	
<b>USE OF ALUMINUM SULFATE (ALUM) TO REDUCE AMMONIA EMISSIONS FROM CATTLE BEDDED MANURE PACKS .....</b>	<b>397</b>
<i>Mindy J Spiehs</i>	
<b>PERFORMANCE EVALUATION OF HIGH-EFFICIENCY FAN SHADES IN REDUCTION OF LIGHT LEAKAGE AND SPATIAL VARIATION OF ILLUMINANCE IN COMMERCIAL BROILER HOUSES .....</b>	<b>406</b>
<i>John Linhoss, Joseph Purswell, Wes Lowe, Daniel Chesser</i>	
<b>DISTRIBUTION OF PARTICULATE MATTER IN POULTRY LAYER HOUSES AND IN VITRO PM<sub>2.5</sub>-INDUCED DAMAGE ON HUMAN ALVEOLAR EPITHELIAL CELLS .....</b>	<b>412</b>
<i>Dan Shen, Pengyuan Dai, Yansen Li, Chunmei Li</i>	
<b>COMPARISON OF AIRBORNE PARTICULATE MATTER AND AMMONIA CONCENTRATIONS FROM NURSERY AND FATTENING STABLES IN LARGE SEMI-ENCLOSED SWINE HOUSE .....</b>	<b>420</b>
<i>Zhaojian Li, Sheng Wu, Dan Shen, Qian Tang, Pengyuan Dai, Yansen Li, Chunmei Li</i>	
<b>EGG LAYING PATTERN OF HENS IN A MODIFIED AVIARY SYSTEM .....</b>	<b>426</b>
<i>Xuanyang Li, Liu Yang, Xiaocui Wang, Zhengxiang Shi, Baoming Li, Qin Tong</i>	
<b>AIR QUALITY AT LOW OUTDOOR TEMPERATURES IN NORWEGIAN HORSE STABLES .....</b>	<b>432</b>
<i>K.E. Boe, G. Dragsund, G.H.M. Jorgensen, E. Fabian-Wheeler</i>	
<b>SPACE ALLOWANCE AND FLOORING IN PREGNANT EWES .....</b>	<b>438</b>
<i>K.E. Boe, S.G. Kischel</i>	
<b>THE INFLUENCE OF MICROCLIMATE ON THE DEVELOPMENT OF FOOT PAD DERMATITIS IN BROILERS .....</b>	<b>444</b>
<i>Emanuela Tullo, Giacomo Aletti, Alessandra Micheletti, Giovanni Naldi, Alberto Pena Fernandez, Erik Vranken, Daniel Berckmans, Marcella Guarino</i>	
<b>CONCENTRATIONS AND DISTRIBUTIONS OF AIRBORNE BACTERIA IN A GROWING SWINE BUILDING IN CHINA .....</b>	<b>450</b>
<i>Xiuping Tao, Bin Shang, Hongmin Dong, Yongxing Chen</i>	
<b>ENTERIC AND SIMULATED PEN SURFACE EMISSIONS OF NITROUS OXIDE FROM BEEF CATTLE FEEDYARDS .....</b>	<b>456</b>
<i>David B Parker, Kenneth D Casey, Heidi M Waldrip, Jenny Jennings, Kristin Hales, Richard Todd</i>	

<b>SPATIAL VARIATION OF PM CONCENTRATION AND PARTICLE SIZE DISTRIBUTION OF A PERCHERY SYSTEM WITH LARGE CAGE AVIARY UNIT FOR LAYING HENS</b> .....	464
<i>Zongyang Li, Chaoyuan Wang, Baoming Li, Zhengxiang Shi, Weichao Zheng, Guanghui Teng</i>	
<b>FARROWING PEN DESIGN AND PEN FLOOR CLEANLINESS</b> .....	472
<i>K.E. Boe, E.J.S. Hall, G.M. Cronin</i>	
<b>IMPACT OF SHADE ON PERFORMANCE, BODY TEMPERATURE, AND HEAT STRESS OF FINISHING CATTLE IN EASTERN NEBRASKA</b> .....	476
<i>Brett A Melton, Thomas M Winders, Bradley M Boyd, Casey N Macken, Andrea K Watson, James C MacDonald, Galen E Erickson</i>	
<b>ENTERIC METHANE EMISSIONS OF BEEF COWS GRAZING TALLGRASS PRAIRIE PASTURE ON THE SOUTHERN GREAT PLAINS</b> .....	485
<i>Richard W. Todd, Corey Moffet, James P.S. Neel, Kenneth E. Turner, Jean L. Steiner, N. Andy Cole</i>	
<b>FLOOR CLEANLINESS IN DAIRY FREESTALL BARNs</b> .....	491
<i>Geir Naess, Knut Egil Boe, Lars Erik Ruud</i>	
<b>USDA-NRCS OPPORTUNITIES FOR ASSISTING PRODUCERS IN ADDRESSING AIR EMISSIONS</b> .....	495
<i>Gregory W. Zwicke, Gregory L. Johnson</i>	
<b>BEHAVIORAL RESPONSES OF LAYING HENS TO ATMOSPHERIC AMMONIA IN AN ENVIRONMENTAL PREFERENCE CHAMBER</b> .....	501
<i>Christina M Tucker, Angela R Green-Miller, Richard S Gates, San Myint, Janeen Salak-Johnson</i>	
<b>VALIDATION OF RADIO FREQUENCY IDENTIFICATION WITH A CURRENT TRANSDUCER TO QUANTIFY THE USE OF AN AUTOMATIC GROOMING BRUSH IN PRE-WEANED DAIRY CALVES</b> .....	509
<i>Morgan L Falk, Melissa C Cantor, Joao Costa, Morgan Hayes, Joshua Jackson</i>	
<b>EMISSIONS OF HYDROGEN SULFIDE FROM THE PEN AREA OF A BEEF CATTLE FEEDYARD IN THE TEXAS HIGH PLAINS</b> .....	515
<i>Kenneth D Casey, Richard W Todd, Marty B Rhoades, David B Parker</i>	
<b>AIR CONDITIONING FOR NATURALLY VENTILATED DAIRY BARNs</b> .....	522
<i>Joseph M Zulovich, Ryan K. Milhollin, Joe L. Horner, Joseph P. Harner, Teng Teeh Lim</i>	
<b>AIR CONDITIONING FOR MECHANICALLY VENTILATED LPCV DAIRY BARNs</b> .....	530
<i>Joseph M Zulovich, Ryan K. Milhollin, Joe L. Horner, Joseph P. Harner, Teng Teeh Lim</i>	
<b>ROBOTIC ROTARY PARLOR SYSTEMS FOR DAIRY OPERATIONS</b> .....	538
<i>Joseph M Zulovich, Ryan K. Milhollin, Joseph P. Harner, Joe L. Horner</i>	
<b>AUTOMATED MILKING SYSTEMS FOR DAIRY OPERATIONS</b> .....	545
<i>Joseph M Zulovich, Ryan K. Milhollin, Joseph P. Harner, Joe L. Horner</i>	
<b>EFFECT OF FERRIC SULFATE APPLICATION ON CLOSTRIDIUM SPP IN POULTRY LITTER</b> .....	552
<i>Hong Li, Amy Biddle</i>	
<b>DETERMINATION OF ACTIVATION OF LITTER AMENDMENT ON AMMONIA CONTROL FOR BROILER LITTER UNDER WINTER CONDITIONS</b> .....	561
<i>Hong Li</i>	
<b>PRACTICAL TEST AND EVALUATION OF OPTIMIZED UHF EAR TAGS FOR BEHAVIOR MONITORING OF FATTENING PIGs</b> .....	570
<i>Adrian Foerschner, Felix Adrion, Eva Gallmann</i>	
<b>AEROSOLS AND BACTERIA CONCENTRATION IN DIFFERENT TYPES OF JAPANESE DAIRY MILKING HOUSEs</b> .....	578
<i>Md. Aminul Islam, Atsuo Ikeguchi, Takanori Naide</i>	
<b>RELATIONSHIP BETWEEN AEROSOL CONCENTRATION AND AIRBORNE MICROBE INCLUDING PORCINE SAPELOVIRUS CONCENTRATION IN JAPANESE WEANING SWINE HOUSEs</b> .....	584
<i>Takanori Naide, Atsuo Ikeguchi, MD Aminul Islam, Ken Katsuda, Kenji Kawashima, Ryoh Nakakubo, Ayako Miyazaki</i>	
<b>A 3D COMPUTER VISION SYSTEM FOR AUTOMATIC DETECTION OF SHEEP STANDING AND LYING BEHAVIOUR</b> .....	590
<i>Keni Ren, Grete H.M. Jorgensen, Inger Hansen, Johannes Karlsson</i>	
<b>ESTIMATION OF THI INDEX TO EVALUATE THERMAL STRESS OF ANIMAL OCCUPIED ZONE IN A BROILER HOUSE USING BES METHOD</b> .....	596
<i>Kyeong-seok Kwon, Taehwan Ha, Hee-chul Choi, Jong-bok Kim, Jung-hwan Jeon, Saemee Woo, Ka-young Yang, In-bok Lee</i>	
<b>OPTIMAL SENSOR PLACEMENT FOR TEMPERATURE MONITORING INSIDE BROILER HOUSEs</b> .....	604
<i>Sang-yeon Lee, Gwan-young Park, In Bok Lee</i>	

<b>ANNUAL ELECTRICAL ENERGY REQUIREMENTS OF FIVE COOLING STRATEGIES FOR LACTATING DAIRY CONFINED HOUSING IN THE EASTERN UNITED STATES</b> .....	611
<i>Ted L Funk, Curt A Gooch, Richard R Stowell, Jiangong Li</i>	
<b>COMPUTATIONAL PROGRAM TO EVALUATE THERMAL COMFORT IN ANIMAL PRODUCTION FACILITIES</b> .....	619
<i>Carlos G. S. Teles Junior, Richard S. Gates, Ilda F F Tinoco, Cecilia F Souza, Monique O Vilela</i>	
<b>NEONATAL PIGLET CORE BODY TEMPERATURE MODEL FROM SURFACE TEMPERATURE AND ENVIRONMENT MEASUREMENTS</b> .....	627
<i>Yijie Xiong, Richard S Gates, Naomi C Cooper, Michael Ellis</i>	
<b>THERMAL PERFORMANCE OF PERFORATED PEN PANELS FOR ON-FARM NUTRITIONAL TEST TRIALS</b> .....	639
<i>Kelly E Goneke, Jeremiah D Davis, Joseph L Purswell, Gary D Chesser, Carson M Edge, Jesse C Campbell</i>	
<b>REAL-TIME MONITORING OF INDOOR PARTICULATE MATTER CONCENTRATION IN A COMMERCIAL BROILER HOUSE</b> .....	646
<i>Alberto Pena Fernandez, Theo Demmers, Q. Tong, Ali Youssef, Tomas Norton, Daniel Berckmans</i>	
<b>REAL-TIME GROWER-FINISHER PIGS GROWTH MONITORED AND FORECASTED USING A DYNAMIC LINEAR REGRESSION MODEL</b> .....	651
<i>Alberto Pena Fernandez, Tomas Norton, Erik Vranken, Daniel Berckmans</i>	
<b>VIRTUAL FARM WEBSITE FOR DAIRY CLIMATE CHANGE AND SUSTAINABILITY INFORMATION</b> .....	658
<i>Eileen Fabian-Wheeler, Daniel Hofstetter, Rebecca Larson, Horacio Aguirre-Villegas, Carolyn Rumery Betz</i>	
<b>CONDUCTIVE COOLING OF GROUP-HOUSED GROW-FINISH PIGS: YEAR 1</b> .....	663
<i>Erin L Cortus, Joseph Darrington, Robert C Thaler</i>	
<b>MITIGATING HYDROGEN SULFIDE SAFETY RISK AND ODOR FOR DAIRY FARMS USING GYPSUM BEDDING</b> .....	671
<i>Eileen Fabian-Wheeler, Long Chen, Michael Hile, Michael Pate</i>	
<b>UNINTENDED IMPACTS ON ANIMAL WELFARE AND ENVIRONMENT OF COMBINED FARM ANIMAL HOUSING WITH MANURE STORAGE</b> .....	679
<i>Eileen Fabian-Wheeler</i>	
<b>COMPARISON OF OUTSIDE AIR AND SOL-AIR DESIGN TEMPERATURES FOR ESTIMATING INSULATION NEEDS</b> .....	683
<i>Gary Daniel Chesser Jr., Joseph L. Purswell, Jeremiah D. Davis, Jason K Ward, Thomas Tabler</i>	
<b>EVALUATION OF ENVIRONMENTAL TEMPERATURE IN PULLET WEIGHT GAIN AND UNIFORMITY</b> .....	693
<i>Marcia G.L. Candido, Ilda de F.F. Tinoco, Rafaella R. Andrade, Isabella T.A. Martins, Leticia, C. da S. R. Freitas, Richard S. Gates</i>	
<b>SPATIAL AND DIURNAL VARIATIONS OF PARTICULATE MATTER CONCENTRATION OF A PILOT-SCALE AVIARY LAYER HOUSE IN WINTER</b> .....	699
<i>Yu Wang, Dapeng Li, Suzanne M Leonard, Zhengxiang Shi, Hongwei Xin, Lilong Chai, Baoming Li</i>	
<b>COMPARATIVE EVALUATION OF POULTRY AVOIDANCE DISTANCES TO HUMAN VS. ROBOTIC VEHICLE</b> .....	707
<i>Pratik Parajuli, Yanbo Huang, Yang Zhao, Tom Tabler, Joseph L. Purswell</i>	
<b>EVALUATION OF A LOW COST THERMOGRAPHIC CAMERA FOR POULTRY TEMPERATURE</b> .....	714
<i>Marcia G.L. Candido, Ilda de F.F. Tinoco, Lucas P. Herker, Talissa F.P. Ireno, Rafaella R. Andrade, Richard S. Gates</i>	
<b>FEASIBILITY STUDY OF ENVIRONMENTAL CONTROL OF DAIRY BARNs USING AIR CONDITIONING OR EVAPORATIVE COOLING</b> .....	721
<i>Jiangong Li, Xuejin Shen, Ted L Funk, Xinlei Wang</i>	
<b>MODELING HEN HOUSE VENTILATION OPTIONS FOR CAGE-FREE ENVIRONMENT: TWO-DIMENSIONAL CASE</b> .....	731
<i>Eileen Fabian, Long Chen, Dan Hofstetter, Paul Patterson, John Cimbala</i>	
<b>EVALUATION OF METHANE PRODUCTION MANIPULATED BY LEVEL OF INTAKE IN GROWING CATTLE AND CORN OIL IN FINISHING CATTLE</b> .....	738
<i>T. M. Winders, B. M. Boyd, F. H. Hilscher, R. S. Stowell, S. C. Fernando, G. E. Erickson</i>	
<b>EVALUATING THE EFFECT OF FEEDING BIOCHAR TO CATTLE ON METHANE PRODUCTION AND DIET DIGESTIBILITY</b> .....	745
<i>Tommy M. Winders, M. L. Jolly-Breithaupt, C. B. Freeman, B. M. Mark, G. E. Erickson, A. K. Watson</i>	
<b>LIGHT INTENSITY, EGG WEIGHT AND EGG SIZE IN A VERTICAL AVIARY OF NATURALLY VENTILATED LAYING HENS</b> .....	752
<i>Leticia Cibele da Silva Ramos Freitas, Ilda de Fatima Ferreira Tinoco, Tatiany Carvalho dos Santos, Marcia Gabrielle Lima Candido, Cecilia de Fatima Souza, Richard Stephen Gates</i>	

<b>HEAT PRODUCTION OF JERSEY DAIRY COWS MEASURED VIA INDIRECT CALORIMETRY .....</b>	<b>759</b>
<i>D. L. Morris, R. R. Stowell, T. M. Brown-Brandl, P. J. Kononoff</i>	
<b>EFFECT OF DIFFERENT LEVELS OF AIR VELOCITY AT 35 C ON JAPANESE QUAIL BEHAVIOR AT START OF LAY .....</b>	<b>763</b>
<i>Tatiany Carvalho dos Santos, Richard S. Gates, Ilda de Fatima Ferreira Tinoco, Sergio Zolnier, Leticia Cibebe da Silva Ramos Freitas, Marcia Gabrielle Lima Candido</i>	
<b>EFFECT OF DIFFERENT LEVELS OF AIR VELOCITY AND TEMPERATURE ON JAPANESE QUAIL PERFORMANCE AT START OF LAY .....</b>	<b>768</b>
<i>Tatiany Carvalho dos Santos, Richard S. Gates, Ilda de Fatima Ferreira Tinoco, Sergio Zolnier, Rafaella Resende Andrade, Leticia Cibebe da Silva Ramos Freitas, Carlos Gutemberg Souza Teles Junior</i>	
<b>IMPACT OF BRAZILIAN PIG FARM CONSTRUCTION AND ENVIRONMENTAL MANAGEMENT PRACTICES ON NURSERY PIG PERFORMANCE – A CASE STUDY.....</b>	<b>774</b>
<i>Eliene Justino, Fausto Pires Maluf, Kenneth D Casey</i>	
<b>THERMOCLINE DESIGN FOR THERMAL PREFERENCE TESTING IN PIGLETS.....</b>	<b>784</b>
<i>Lindsey Robbins, Angela R Green-Miller, Jay S Johnson, Christopher Gonzales, Brianna N Gaskill</i>	
<b>UTILIZING COMPREHENSIVE NUTRIENT MANAGEMENT PLANS (CNMP) TO IMPROVE LIVESTOCK OPERATIONS PERFORMANCE .....</b>	<b>792</b>
<i>Jeffrey P. Porter, Sandra L. Means</i>	
<b>DEVELOPMENT AND APPLICATION OF ANIMAL BUILDING ENVIRONMENTAL CONTROL SYSTEM.....</b>	<b>798</b>
<i>Yiguang Zhao, Xuemei Nan, Xiangfang Tang, Liang Yang, Benhai Xiong</i>	
<b>PERFORMANCE OF PREGNANT WEST AFRICAN DWARF EWES FED DIETS SUPPLEMENTED WITH VARYING LEVELS OF FOSSIL SHELL FLOUR .....</b>	<b>806</b>
<i>Chibuisi Henry Emeruwa, Ngozi Felicia Anurudu</i>	
<b>Author Index</b>	