Smart Systems in Pig Production

Saskatchewan Pork Symposium
Saskatoon, SK
November 15, 2018

Tom Stein DVM, MS, PhD
Senior Strategic Adviser
Maximus Systems
New Technology Available Now
Belgian firm SoundTalks has signed an agreement with Boehringer Ingelheim to monitor respiratory health in pigs using its audio detection system.

In trials, the company’s pig cough monitor gave automated warnings for respiratory problems on 10 pig farms across Europe at around two to 14 days earlier when compared to the visual observations made by farmers or veterinarians.
Sudden decrease in outside temperature $\rightarrow$ increased coughing in pigs
Swine Tech, Inc
Cedar Rapids, Iowa

Reduce pre-wean loss by preventing crushing deaths in baby pigs
Real-Time Sound Processing with Artificial Intelligence
Sow behavior, heart rate, and cortisol responses to a novel piglet crushing prevention technology to reduce pre-weaning mortality

1) Kansas State University, Manhattan, KS. (2) SwineTech Inc., Cedar Rapids, IA

Introduction

Among (ear born piglets, 1 in 10 piglet deaths are a result of being last on the sow and 48.7% of those deaths occur during the first three days after birth (Jenney et al., 1994; Krauer et al., 2013; Bos et al., 2015).

Researchers concluded that the farrowing stall is necessary for at least the first three days after birth to reduce the number of pigs crushed to death by their mothers (Jenney et al., 1994; Spannhof et al., 2009; Singh et al., 2017).

The conventional (CC) strategy is to use the stall to prevent the sow from reaching the litter (Hulten et al., 1992).

- *Human frustration* from sow that do not respond can lead to mistreatment of the sow.
- Artificial intelligence technology (AI) (SwineTech Inc., Cedar Rapids, IA USA) identifies a piglet distress call. ECHO first provides a vibration (VIB) stimulus. If she does not rise, it then uses an electrical impulse (IE) stimulus. This potentially reduces the risk of human mistreatment.

Does ECHO cause distress that is more disruptive than CONV?

**Objective**

To determine the sow’s behavioral, physiological, and performance outcomes of mitigating a simulated crush event with either VIB (sham-control), CONV, and ECHO (VIB+IE) stimuli.

Materials & Methods

- **Experimental Animal**: Sow parity 1-4, 64 kg (n = 138). Sows were offered the first 3 days after birth. Sows were offered 1.5% of the sow’s body weight per day. The environmental parameters were controlled to minimize the risk of sow and farrowing. Data from sow-collected in a representative of the herd. For all experiments, the sow was assayed and monitored with continuous video recording.

- **Materials**: The piglet distress call as a means of mitigating the risk of sow and farrowing. Sows were observed in sow-collected in a representative of the herd. For all experiments, the sow was assayed and monitored with continuous video recording.

- **Methods**
  - 56 multiparous sows (parity 1-4, 64 kg) housed at Kansas State University Laboratories (KCSL 4 389E), were enrolled three days before the first farrowing and were randomized into treatments after the last sow was farrowed.
  - Euthanasia was performed immediately after the last sow was farrowed.
  - VIB: Play-by-play distress piglet call for 60 sec; stimulated by vibration only.
  - CONV: Play-by-play distress piglet call for 60 sec; stimulated by three head-shocks.
  - ECHO: Play-by-play distress piglet call for 60 sec; stimulated by vibration followed by electric impulse.

- **Acute Stress Response** (before and after treatment)
  - **Starter response** (free observation, corral reaction, corral response, heart rate, and cortisol levels).

- **Disruptive stress response** (distress) and residual effects.
  - **Circadian cortisol (under the Carc, AVIC from all blood samples)**, head-movement-circadian activity of sow, milk passage transfer to piglet (xia total plasma protein, TPS), piglet bodyweights, sow feed intake, weight, and reproductive performance measures.

- **ECHO** started expressing oral behaviors sooner than VIBV (Table 2) and spent more time eating in the 30 minutes after treatment than CONV and VIBV (Figure 4).

- **Disruptive stress response** (distress).
  - **Cortisol**: Lowest among CONV and VIBV (P<0.01).

- **Sow behavior** and heart rate were monitored continuously for 24 hours after treatment.

- **ECHO stimulation** was the most effective at motivating the sow to get up during distress calls (Table 1).

- **Acute stress response** (before and after treatment).
  - **Starter response** was greatest among ECHOV- (Figure 3).

- **VIBV’s heart rate trended higher (P = 0.07)** to return to resting levels after treatment (Figure 5).

Conclusions

- **Heart rate and cortisol responses** were observed among VIBV after treatments.
  - Distress call and vibration does not disturb most of the sow’s current state of rest, which is confirmed with behavior results; therefore, they were appropriate controls for experiments.

- The starter response was the greatest among ECHOV- sows, followed by CONVV sows.

- The ECHO stimulus was not as effective at motivating sow to stand or jump, while VIB was effective at motivating sow to stand during a distress call.

- ECHO can be offered as an acute stressor because:
  - ECHOV-stress with the stressor through eating and performing MRR. This may be a positive nutritional response such as sows are active after farrowing.
  - ECHOV-stress had similar plasma cortisol measures as VIBV, as well as similar percentage of sows with no VIB in pigs T9P.

- **Stimuli** for CONVV is a disruptive stress.
  - **AI** measures are indicators of a disruptive stressor or distraction role.
  - ECHOV had more piglets with no change in TPS than expected.
  - CONVV’s VIBV come into extras later than VIBV and ECHOV.

The brain-study method may cause sow to generalize and associate the negative experience with humans, and humans are rarely present in the farrowing barn.
### PIGLET LOSS

#### SWINETECH

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</table>

#### PWM

- **5% PWM**: 277
- **11% PWM**: 283
The leading edge in health
A global first in automatic livestock medication systems
A “Brain in the Barn”

- Heat Stress Index
- Lights
- Truck Wash Management
- Ventilation-Heating
- Water management
- Bin weighing
- Growth curves
- Bio-security/Chore monitoring
- Hog Sorter
- Generator monitoring
- Internet
- Micro Climate zone
- Sow feeding management
- Power consumption
- Medication cooler
- Semen storage
Dr. Andrea Arruda
The Ohio State University

Tracking movements of barn staff and service techs

Risky movements v. Acceptable movements

“Risky” = from nurseries or loading areas to farrowing rooms

“Acceptable” = within the same health status, age group, and building
Preliminary Results

Combining within-farm movement and production data

Statistical model results:

An increase in “risky” movements in a previous week increased pre-weaning mortality in a current week by approximately 3%.

An increase in “risky” movements also tended to decrease the number of piglets per litter by 0.37.
## Finishers Welfare Dashboard

**Farm:** Pig Farmer  
**Compartment number:** 2  
**Number of pigs at startup:** 144  
**Starting date:** 11-12-2011  
**Current date:** 22-12-2011  
**Day number:** 11

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<th>Indicator</th>
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<td>Feed availability</td>
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<tr>
<td>Absence of prolonged thirst</td>
<td>Water intake</td>
<td>0,6</td>
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<tr>
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<td>Water availability</td>
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<td>Comfort around resting</td>
<td>Maximal occupation density</td>
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<td>Thermal comfort</td>
<td>Temperature within comfort zone</td>
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<td>CO2 concentration within comfort zone</td>
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<td>Ease of movement</td>
<td>Average activity index (eYeNamic)</td>
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<td></td>
<td>Average occupation density (eYeNamic)</td>
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<tr>
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<td>Space allowance (kg/m²)</td>
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<td>Absence of diseases</td>
<td>Mortality</td>
<td>0,7</td>
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<td>Number of coughs</td>
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<tr>
<td><strong>Average welfare score</strong></td>
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<td><strong>0,8</strong></td>
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New Technology Within 3 Years

- Behavior & Activity Monitoring
- Voice Data Entry
- Voice Workflow
- Automated Interpretation of Production Data
Early Detection of Illness in Pigs – Tracking Behavior with RFID

Jaryssa Maselyne – Leuven University, Belgium
Early Detection of Illness in Pigs – Tracking Behavior with RFID
Early Detection of Illness in Pigs – Tracking Behavior with RFID
Early Detection of Illness in Pigs – Tracking Behavior with RFID
Early Detection of Illness in Pigs – Tracking Behavior with RFID

Early Warning System

- Pig 1: PK OK, Number of meals: 24, Duration of meals: 1:07.31
- Pig 2: PK OK, Number of meals: 24, Duration of meals: 1:10.00
- Pig 3: PK OK, Number of meals: 19, Duration of meals: 1:38.65
- Pig 4: PK OK, Number of meals: 14, Duration of meals: 1:38.65
- Pig 5: PK OK, Number of meals: 15, Duration of meals: 1:37.37

Graphs showing numbers of meals and average gap between meals for Pig 74.
Early Detection of Illness in Pigs – Tracking Behavior with RFID

Successful treatment after an alarm!
Request for Proposals: The National Pork Board is soliciting proposals from investigators to develop novel or adapt existing technologies to identify and monitor indicators of pig health, wellbeing and productivity with the overall goal of improving pig livability.

Technology has advanced to the point where it may provide advanced notification of problems that affect animal health, wellbeing and productivity more quickly than even the most highly trained animal caretakers.
New Technology Within 5 Years

• Automated counting of pigs

• Automated weighing of pigs
Automated weighing

3D machine vision
- $1,400/unit
- 1 unit/pen
- 18 pigs/pen
- avg pen weight
- standard deviation
Ro-Main smaRt suite

Lead the herd.
Real-Time Data Acquisition – Sow Farms
Real-Time Data Acquisition – Sow Farms
Real-Time Data Acquisition
A “Brain in the Barn”

- Heat Stress Index
- Ventilation-Heating
- Water management
- Bin weighing
- Growth curves
- Bio-security/Chore monitoring
- Generator monitoring
- Micro Climate zone
- Sow feeding management
- Power consumption
- Medication cooler
- Semen storage
"Brains in the barns"

- sow management
- nursery & finishing
- movements, sales
- feed
- controllers & data
- health & disease
- employees, growers

"Brains in your hands"

"Brain in the office"

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Communication Network – The Next Big Advance

Notifications & Reminders

Just a reminder, a group of pigs is scheduled to arrive between Today and 11/11/2018 at your farm Johnson Farms.

Group ID: EP-346-144
Farm: Johnson Farms
Est. Delivery: 11/05/18—11/11/2018

Start this group now!
### Communication Network

#### Daily Check-In

<table>
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<th>Groups</th>
<th>Number of Pigs</th>
<th>On-time</th>
<th>Status</th>
<th>Action</th>
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<td>296</td>
<td>30%</td>
<td>In Progress</td>
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<td>Group EF-0002-0006</td>
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<td>18%</td>
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</table>

- **Groups Disputed for Inventory Reconciliation**
  - Group EF-0002-0002
  - Group scheduled for delivery Jan 30-Feb 03, 2018

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www.maximus-solution.com
# Communication Network

## Health Alert @ Temple Farms

**Mike Brown** has reported Chronic Deaths • 3

### Farm Details:
- **EF-0002-0005**
- **Pigs Under Care**: 197
- **Est. Avg. Weight**: 40 lbs
- **Current Mortality**: 2.30%

### Sources:
- Pennsylvania Dutch

### Dead Pigs:
- **Chronic**: 3
- **Acute**: 0
- **Euthanasia**: 0
Mike Brown @nicbartlett Sounds good. Thanks for the quick response!

Nic Bartlett @mikebrown Thanks. Please treat this site as PED positive. Neo was run for 6 days. The looseness should start to dry up, but let us know if it does not dry up. Increase set point and move a little more air to dry out the barn. Pigs also just off Pennclor, recommend Oral Pro sodium salicylate for 5 days in south barn.

Write a comment
Communication Network – The Key to Success

Chore Tracking, Compliance, & Reporting
Best to Worst -- 37 Sow Farms, Midwest Pork Producer
Ranked on PWSY

$10 - $15 higher cost per pig weaned
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<th>Bottom 25%</th>
<th>Average</th>
<th>Top 25%</th>
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<tr>
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<td>DOF</td>
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<tr>
<td>Mortality %</td>
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<td>2.1%</td>
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<tr>
<td>ADG (g/d)</td>
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<tr>
<td>FCR</td>
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<tr>
<td>ADFI (kg)</td>
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## Benchmarking Closeouts – Finishing Phase

### FINISHING

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Ranking Growers by Performance & $ Value

$12 - $18 higher cost per pig sold
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<th>Process Control</th>
<th>Mortality</th>
<th>Health</th>
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<tbody>
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<td>Site Evaluation</td>
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<td>Packs (List)</td>
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<td>Sheets (Lots)</td>
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<td>Sheet Comparison</td>
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<td>Marketing Report Card</td>
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<td>Marketing by WOF</td>
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<td>Weight Distributions</td>
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<td>COP Comparison</td>
<td>Invoices (List)</td>
<td>Projected Feed Use</td>
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<td>Feed Use by Diet</td>
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<td>Feed Cost by Diet</td>
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<td>Diet Cost by Mill</td>
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<td>Ingredient Cost by Mill</td>
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<td>Diet x Energy</td>
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<td>Closeouts</td>
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</table>
Process Control & Data Management for Wean-to-Finish Production

**WEEKLY**

1. Weekly Site Evaluation
2. Weekly Inventory Update

**ONE-TIME**

1. Pre-Fill Checklist

   → MOVE PIGS INTO THE BARN

2. Post-Fill Checklist

3. Pig Arrival Checklist

4. Injectable Vaccination Observation

5. Ileitis/Salmonella Vaccination

   → SELL PIGS

6. Load-Out Audit

**ENTER DATA**

- Group ID (Start Date, No. Started, Age)
- Start Date
- No. Started
- Age at Entry
- Mortality
- Sales/Culls
- End Date

**Real-Time Data**

- Inside Temperature (Min, Max, Avg)
- Inside Temperature Set Point
- Inside Humidity (Min, Max, Avg)
- Outside Temperature
- Outside Wind Speed/Direction
- Amount Feed in Bin
- Feed Delivered
- Feed Consumption (ACTUAL)
- Feed System run-times
- Lights (Lux, Time On/Off)
- Water Consumption
- Water Quality (Temp, pH, chlorine)
- Electricity Use
- Manure Pit Level
- Stand-By Generator (fuel level, oil pressure, status, run-time)
- Alarm: Critical Temperature e.g > 26.7 C

**SMART CONTROLLER**

- Real-Time Data

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Precision Farming – Leading the Way
Precision Farming – Leading the Way

Technology Integration Is Key To Success

Irrigation

Spraying

Harvest

Drainage

Fertilizer Application

Agronomic Recommendations

Planting

vantage

Land Forming

Trimble

AGRI-TREND

Software

Transforming the Way the World Works
21st Century Pork Production

• Whatever can be tracked, will be tracked

• Whatever can be measured, will be measured

• Whatever can be automated, will be automated

• Whatever can be done with precision, will be
  • Process Management
  • Feeding
  • Selling
New Traceability Coming Soon
Ex-Googler Wants to Upend Pigs and Hotels With the Blockchain

By Cindy Wang
March 22, 2018, 6:30 PM CDT
Product Owner | Nice Garden Industrial Co., Ltd
Producer | Nice Garden Industrial Co., Ltd
Product Name | Choice Pig Pork jowl

AMIS Blockchain Info:
Transaction
0x89bedd084a5daee9c3483f296b9c0f1f7fb4d088f2291cf9cc36d684d2e
Block Hash
0x2661b8336c23d480cd9c7d1b59b28ed9d8b26fe348158439bd2a9cc05
Production record  
Breed: LYD (LYD crossbred pig: Landrace - Yorkshire - Duroc)

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
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<tbody>
<tr>
<td>2016/7/22</td>
<td>Birth</td>
<td>Xin He Xing Farm</td>
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<tr>
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<td>Suckling Piglets</td>
<td>Pre-starter feed and sow milk</td>
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<tr>
<td>2016/8/7</td>
<td>Vaccination</td>
<td>AR</td>
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<td>PCV2</td>
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<td>Porcine Circovirus Type 2</td>
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</table>
2016/8/25

**Starter Feed**

Feed contains OVN™ concentrate for suckling piglets, including high-performance Vitamin D3 and organic minerals that can activate physiological functions and strengthen bone formation.

Feed (raw materials): corn, soybean meal, etc.

Concentrate: vitamins, minerals, organic minerals, amino acids, enzymes, probiotics, organic acids, calcium, phosphorous, salt, etc.

2016/10/20

**Vaccination**

CSF

Classical Swine Fever

**Vaccination**

SE

Swine Erysipelas
2016/11/8

**Finisher Feed**

Feed contains OVN™ concentrate for finisher pigs, including high level organic minerals and Vitamin E that improve meat quality, meat color and water holding capacity.

Feed (raw materials): corn, soybean meal, etc.

Concentrate: vitamins, minerals, organic minerals, amino acids, enzymes, probiotics, organic acids, calcium, phosphorous, salt, etc.

2016/11/17

**Vaccination**

FMD

**Foot And Mouth Disease**

2017/1/24

**Leaving**

Fattener pig

Xin He Xing Farm
Slaughter

2017/1/24

Arrival
Fattener pig
Sheng Hui Food Co., Ltd.(Slaughterhouse)

Leaving
Pig carcass
All the SOPs are complied with the Rules of Meat
Inspection by Council of Agriculture and Department
of Health
Sheng Hui Food Co., Ltd.(Slaughterhouse)
[ Pork cutting and processing ]

2017/1/24
Arrival
Pig carcass
Carcass chilling at -2°C ~ -5°C
Nextland (Cutting and Processing Plant)

2017/1/25
Cutting
Choice Pig Pork jowl
Chill meat cutting at <15°C
Nextland (Cutting and Processing Plant)
Product Owner | Nice Garden Industrial Co., Ltd
Producer | Nice Garden Industrial Co., Ltd
Product Name | Choice Pig Pork jowl

AMIS Blockchain Info:
Transaction 0x89bedd084a5daee9c3483f296bbc0f1f7fb84d088f2291cf9cc36d684d2e
Block Hash 0x2661b8336c23d480cd9c7d1b59b28ecd9d8b26fe348158439bd2a9cc05
Thank you!