International Journal of Science and Research (IJSR)
ISSN: 2319-7064
SJIF (2022): 7.942

Increased Levels of Stress in Domestic Pigs Exposed to Magnetotelluric Anomalies caused by Stray Current

Kim Horsevad[1], Tage Rødbro[2]

[1]Horsevad Independent Technical Research & Analysis, Tryvej 96, DK-9750 Denmark, www.horsevad.net
Email: *kim[at]horsevad.dk*

LVK, Agricultural Veterinarian Consulting Service in Denmark, Fynsvej 8, DK-9500 Hobro, www.lvk.dk
Email: *tr[at]lvk.dk*

Abstract: ***It is hypothesized that magnetotelluric anomalies from stray currents causes physiological stress in pigs causing stress behavior. This experimental study was conducted in three Danish pig herds, affected by magnetotelluric anomalies. The vocalization response was measured as a proxy for stress before and after neutralization of vortex field emitted from magnetotelluric anomaly. The results indicate that exposure to magnetotelluric anomalies caused by stray current increases stress in domesticated pigs (Sus scrofa domesticus). Analysis of animal vocalization can be used as a non-invasive procedure for monitoring effectiveness of mitigative strategies for stray current.***

Keywords: Magnetotelluric Anomaly, Domesticated pig, Sus scrofa domesticus, Stray Current.

1. Introduction

Since 2018 we have been engaged in a research project aiming at both I) elucidating the mechanism of adverse biological effect behind the apparent physiological and behavioral response to stray currents and II) developing robust, effective and well-documented strategies for technical mitigation of such adverse effects.

Stray current can be both endogenic and exogenic with respect to the affected farm. Endogenic stray current is defined as stray current produced by electrical installations within the farm. Such scenarios are comparatively easy solved by upgrading the electrical installation.

Stray current produced by sources foreign to the affected farm is considerably more challenging to mitigate. Such scenarios seem to be much more common than previously thought, - Especially as some 65 to 75 percent of the combined electrical infrastructure return current is propagated through conductive subsoil strata instead of via cables (1, 2, 3). Unpublished results from investigations close to the affected farms indicate even higher levels of return current propagated through subsoil strata.

Quite early in the project, we developed measurement protocols to locate and investigate locations of such stray current conducting strata to enable further research (4).

Electrical resistivity for samples of these electrically conductive layers was, as a mean of 5 different samples, measured to ~4.3×10-6 Ω•m for the ocher layer and ~2.7×10-3 Ω•m for the carbon deposits. This means that such layers, in specific instances, may offer the electrical return current a path of less resistance than through designated electrical infrastructure.

The areas, where such foreign stray current manifests measurable perturbations in the natural magnetic field (figure 1), were termed *magnetotelluric anomalies*.

Figure 1: Measurement of magnetic field intensity directly upon an electrically conductive layer of ocher in 2, 7 meters depth. A maximum reading of 135, 4 µT (1354 mG) was recorded. Image from (8)

At the request of the affected farmers it was later determined that water positioned close to such magnetotelluric anomalies acquires an unknown characteristic, whereby farm animals exhibits abnormal behavior and actively avoids drinking or otherwise getting into contact with such affected water.

Investigations of the phenomenon documented how magnetotelluric anomalies affected internal water structure, measured both by pH shift (5,6) and by electrochemical spectroscopy (altered impedance characteristics) in the frequency span between 10MHz and 6GHz (7).

To enable further analysis of the multiple processes involved in both anthropogenic and telluric occurring formation of magnetotelluric anomalies, several ground current measurement arrays was constructed to characterize the magnetotelluric anomalies from a electrotechnical perspective (8)

During the comprehensive electrotechnical measurements, it was observed than phase differences between an incoming and reflected waveform was a better predictor of observed animal adverse behavior than any of the parameters measuring either voltage, current, electrical field intensity or magnetic field intensity. This led to the formation of a hypothesis, which intend to explain the importance of the phase difference.

It is known that impedance differences in the conductive medium results in phase differences between an incoming and reflected waveform. This is the central working principle behind a Vector Network Analyzer used for electrotechnical characterization of electronic components and antenna.

It is furthermore known that a 4-dimensional (three geometric dimensions and time) projection of two phase conjugate waveforms produces a peculiar electromagnetic field with a spiraling or rotating Poynting vector.

Hypothetically, such peculiar electromagnetic fields might elicit a yet unknown biological response. Due to the visual appearance of phase conjugate waveforms in X/Y viewmode on an oscilloscope it was chosen to designate such a phenomenon as a *vortex* field (9)

Our initial investigations made it possible to detect these fields by their perturbations of the natural DC magnetic field.

Furthermore, in resent research we have succeeded in developing more precise measurements, which means that the spiraling nature of the vortex field now can be readily measured and shown on an oscilloscope by utilizing a specially developed instruments based on orthogonal parallel-plate capacitors (9, 10).

Depending on the exact geometry of the phase conjugate waveforms we can observe two forms of vortex fields, differed by their rotation direction or chirality. We can therefore distinguish between left-handed vortex fields (*Λ-vortex*) and right-handed vortex fields (*Δ-vortex*)

Although we currently lack the resources to implement large-scale experiments, our current knowledge indicates (with quite high certainty) that any deviation from balance (Λ or Δ) is detrimental to biological systems.

This might be related to the generally observed homochirality of macromolecules in biological systems, where DNA, RNA and their components shows Δ-chirality, while amino acids shows Λ-chirality. (11, 12)

Accordingly, we hypothesize that the majority of the adverse bioreactivity observed when farm animals are exposed to magnetotelluric anomalies are related to basic biological functions being disturbed by vortex imbalances.

Tests on herbs (Lepidium sativum) as model organisms has so far confirmed this hypothesis (9).

One key quality of a scientific hypothesis is the ability to make technical calculations and predictions. On this basis we tested the vortex hypothesis by constructing relatively simple technical apparatus causing a collapse of the phase conjugate waveforms giving rise to the vortex-like structure.

Tests on both water structure and plants as model organisms has so far confirmed the effectiveness of this approach. (9,10)

To further establish the efficacy of the phase conjugate collapsing methodology for mitigating adverse biological effects from magnetotelluric anomalies it was deemed necessary to conduct further tests on pigs (Sus scrofa domesticus) as model organisms.

The objective was to investigate the hypothesis, that magnetotelluric anomalies are causing adverse biological effects which in turn causes stress in the animals.

Using live animals as model organisms is a very complex field, both regarding the practical and ethical aspects. Much time has been devoted to devise a research methodology which both enables strict scientific control and is ethically defensible by subjecting the animals to as little inconvenience as possible.

Therefore, this study was performed as an intervention study in farms experiencing magnetotelluric anomalies.

2. Literature Survey

Many solutions for technical monitoring of animal wellbeing has been developed, but most of these methods require some kind of invasive procedures (blood or saliva samples). In order to keep any inconveniences conferred upon the animals at an absolute minimum, we chose quantitative analysis of the affected pigs (Sus scrofa domesticus) vocalizations as primary outcome variable.

This approach has already been established in other research, where the non-invasive nature of vocalization analysis as a tool for monitoring animal welfare status has been thoroughly explored (13).

Likewise, it is established that increased high-frequency vocalizations is a reliable indicator of pain (14) and that stress screams from pigs may be used as an indicator of disturbed welfare (15, 16).

It has furthermore been documented that increasing rates of squeal indicated increased levels of adrenaline (17).

Utilizing different kinds of electronic tools for quantifying pig vocalizations has been studied, and different possible technical solutions for developing automated tools for animal welfare monitoring via vocalization analysis has been investigated (18, 19)

3. Problem Definition

This study aims to elucidate to which extent effects from magnetotelluric anomalies increases stress levels in domestic pigs as measured by vocalization analysis.

By utilizing the same methodology, based on vocalization analysis, we further aimed to investigate whether technical mitigation of vortex imbalance represents a viable strategy for minimizing possible increase in stress levels caused by effluences from magnetotelluric anomalies.

4. Methodology

Sometimes it is necessary to use live animals as model organisms in order to further scientific understanding of a specific subject, but in the course of this investigation it is the responsibility of the researcher that the animals are subjected to as little discomfort and inconvenience as possible.

To this end, we decided to avoid a research methodology based on deliberate, artificially exposure of the animal to an agent (vortex-fields) which is presumed deleterious to the wellbeing of the animal.

Instead, the study was conducted as an interventional study, in which we initially analyze the situation where farm animals are troubled by magnetotelluric anomalies caused by stray current and afterwards note the difference in levels of animal stress when the effects from the magnetotelluric anomaly has been fully neutralized.

As previous research has documented the effectiveness of using animal vocalization as a non-invasive tool for monitoring animal stress levels we utilize this approach for quantifying the level of stress.

To ensure a methodological approach where only the specific effects of the magnetotelluric anomaly are investigated, we ascertained that there, during the course of the experiment, are no changes to the general barn management or normal feeding and handling procedures routinely carried out by the farm personnel.

We decided to focus on the high-pitched, high-frequency screams or squeals shown in (17) to be correlated with the levels of adrenaline.

Observation sessions where more than 1/4 of the recorded screams were emitted by the same individual pig was discarded, as it cannot be ascertained that the screams are caused by the magnetotelluric anomaly and not by some condition specific to that individual pig.

Screams were counted for 15 minutes, in which the observer (located in the aisle between the pens) remained silent and as still as possible.

To support follow-up analysis, the observation session was recorded with a wide-area electret microphone with a flat frequency response between 20Hz and 22 KHz.

To obtain quantifiable information about the intensity and chirality of the vortex field emitted from the magnetotelluric anomaly we utilized the Differential Laser Diffraction Method, as described in (10).

The working principle behind this method is based on the fact that any changes in water structure will be readily measurable by altered scattering and diffraction characteristics. This means that we can use water structure measurements as a proxy for vortex field influence.

The instrument is comprised of two identical sets of monochromatic lasers and photomultiplier sensors. One beam traverses the area (or water sample) to be measured, while the other beam (of similar length) traverses an airtight tube shielded from both magnetic, electric, electromagnetic and vortex-based fields. A differential amplifier and computer-based data-logging hardware completes the system.

Negative readings indicate a Λ-vortex, while positive readings indicates a Δ-vortex.

This instrument is the first instrument capable of technical/objective measurements of both intensity and chirality of a vortex field.

The experiments therefore consisted of the following phases.

1) Measurement of vortex field characteristics by Differential Laser Diffraction Method to ascertain the occurrence of magnetotelluric anomalies and the intensity of vortex fields emitted from the magnetotelluric anomalies.
2) 15 min. observation session “Exposed” with supporting recording. Time of each scream was noted for later audio analysis of the recorded material.
3) Neutralization of the “vortex”-field by causing a collapse of the waveforms giving rise to the rotating Poyinting vector electromagnetic field.
4) Measurement of vortex field characteristics to ensure the effectiveness of the intervention.
5) Relaxation period. To ensure that any effects from the magnetotelluric anomaly were fully dampened we waited 30 minutes before conducting next observation.
6) 15 min. observation session “Unexposed” with supporting recording. Time of each scream was noted for later audio analysis of the recorded material.

In order to achieve fully quantifiable results for statistical processing, we repeated the above procedure five times. The protection device was turned off for 30 minutes between each measurement, so that the animals was subjected to unneutralized exposure from the magnetotelluric anomaly for at least 30 minutes before the next observation session.

To further ascertain the validity of the approach we repeated the experiment on three different farms.

This methodology provides a very robust statistical measure of the correlation between the effluences from the magnetotelluric anomaly and the behavioral changes quantified by vocalization analysis.

5. Results & Discussion

5.1 Defining a scream

Our experience is that vocalizations from domesticated pigs are non-discrete with regards to specific categorization schemes. This means that we need quite specific criteria in order to avoid subjective judgment about whether a specific pig vocalization should be counted as a scream or not.

To assist in this endeavor, we utilized audio recording and subsequent spectrum analysis of the recorded audio.

For each recorded scream we noted the exact time, so that every counted scream could be traced back to a specific point on the spectrogram. This enables a very high degree of certainty in that only the specific types of vocalizations are included in the count.

We used the computer program "Audacity" (20) to perform the audio analysis. We used three different ways of characterizing the specific animal vocalization, namely amplitude versus time (figure 2), amplitude versus frequency (figure 3) and an overall spectrogram (figure 4) showing both amplitude and frequency viewed in the time domain.

By drawing information from all of these analysis methods, classification of individual screams can be done with a very high degree of objectivity

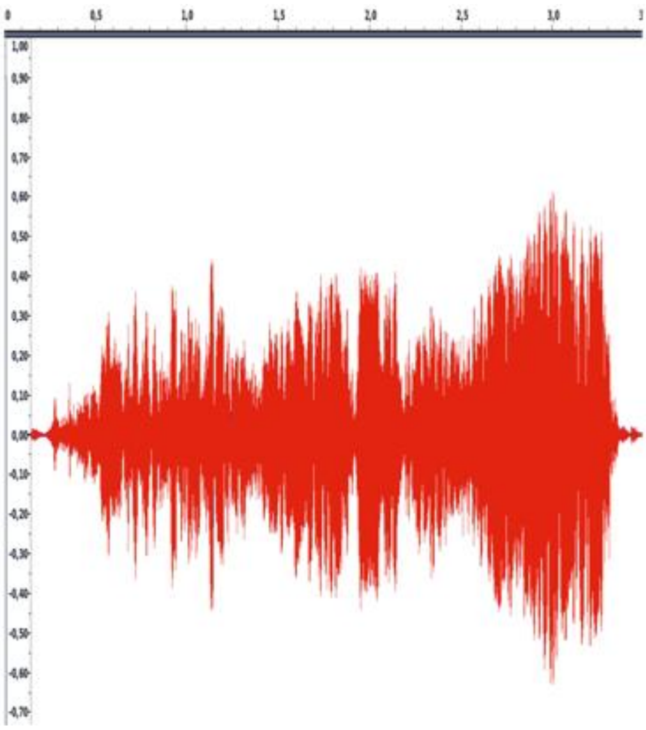

Figure 2: X-axis represents seconds, while Y-axis represents amplitude (arbitrary scale). This recorded scream starts with relatively low amplitude, but rises continually in amplitude throughout the duration of the scream.

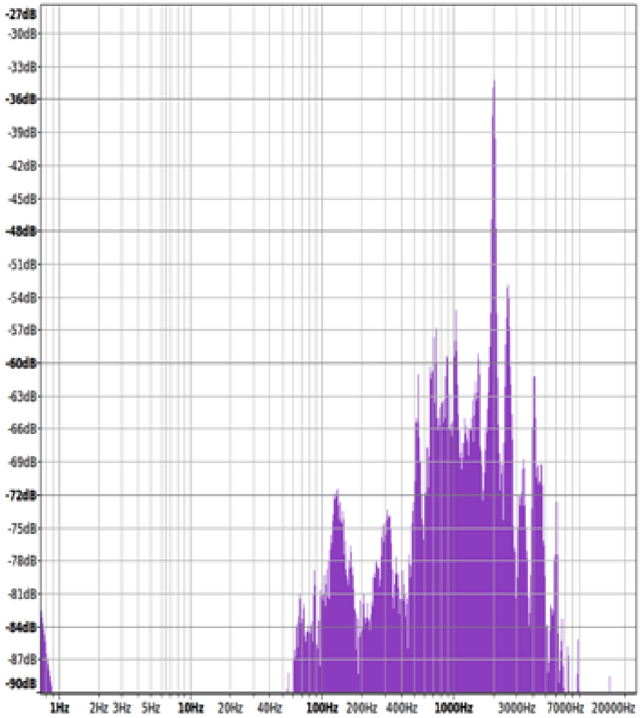

Figure 3: X-axis represents frequency, while Y-axis represents amplitude in dB. This recorded scream is comprised of relatively high frequency sound.

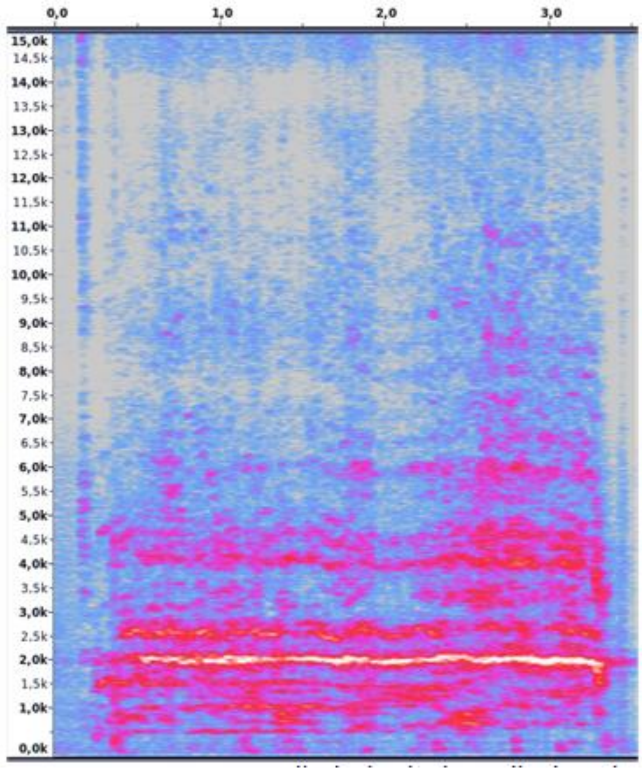

Figure 4: Spectrogram displaying both amplitude and frequency in the time domain. X-axis represents time in seconds, while Y-axis represents frequency. Colour scale indicates amplitude, where gray represents noise floor and white represents the highest recorded amplitude.

5.2 Investigations at site 1

The first site visited was a farm troubled by multiple magnetotelluric anomalies. We selected a suitable location in a barn section composed of 24 pens with nominally 16 individual animals in each pen.

Although not immediately quantifiable, we observed a remarkable difference in animal behavior as soon as the technical mitigation solution was installed.

Scream count yields similar result, with statistical significant difference between exposed and non-exposed scream counts, as noted in table 1.

Table 1: Scream counts for site 1 shows statistical significant difference between number of screams when the pigs are exposed to the magnetotelluric anomaly and when the effects of the magnetotelluric anomaly are mitigated by a technical solution

Scream count at Site 1		
	Exposed	Unexposed
Session 1	34	26
Session 2	36	19
Session 3	37	31
Session 4	36	22
Session 5	41	14
Mean	36,8	22,4
P (two-tailed)		0,018

By utilizing the Differential Laser Diffraction Method we obtain detailed information about the vortex field characteristics during the experiment.

Our data (Figure 5) document the presence of a strong Λ-vortex field and furthermore demonstrates the effectiveness of the technical solution in bringing the vortex field in balance.

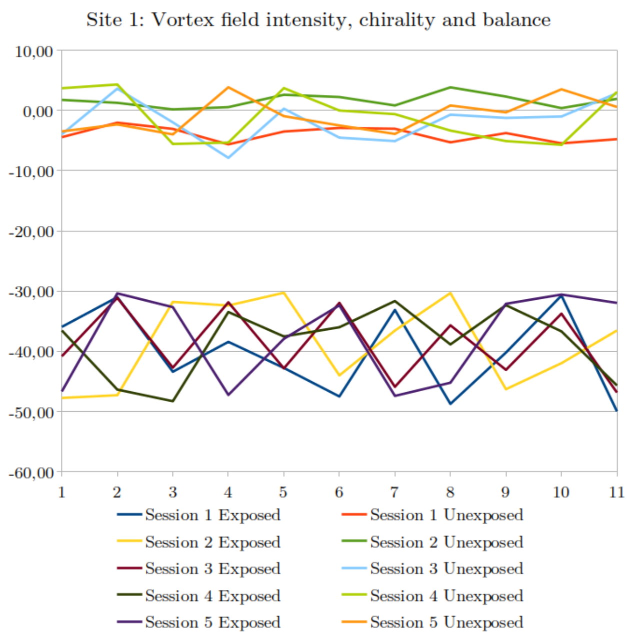

Figure 5: X-axis represents minutes, while Y-axis represent vortex intensity (arbitrary indexed scale). Positive numbers represents Δ-vortex, while negative numbers represents Λ-vortex.

The acquired data from site 1 therefore supports our initial hypothesis, and demonstrates both that animals exposed to an unbalanced Λ-vortex field suffers from increased levels of stress and that such vortex imbalance can be successfully mitigated by technical solutions.

5.3 Investigations at site 2

Investigations at farm site 2 was conducted as similar to site 1 as possible, to ensure data comparability. The only parameters which changed between different sites was the building layout and number of animals. For monitoring we selected a barn section with 18 pens with nominally 12 individual animals in each pen. The results (Table 2) were nearly identical to those obtained at site 1, although the overall number of screams inherently were lower as the total amount of animals in the particular barn section is lower than at site 1.

Table 2: Scream counts for site 2. The difference in scream counts for exposed and unexposed settings are statistical significant

Scream count at Site 2		
	Exposed	Unexposed
Session 1	21	13
Session 2	27	11
Session 3	18	19
Session 4	23	12
Session 5	24	16
Mean	22,6	14,2
P (two-tailed)		0,039

Vortex intensity (figure 6) affirms the presence of a Λ-vortex field.

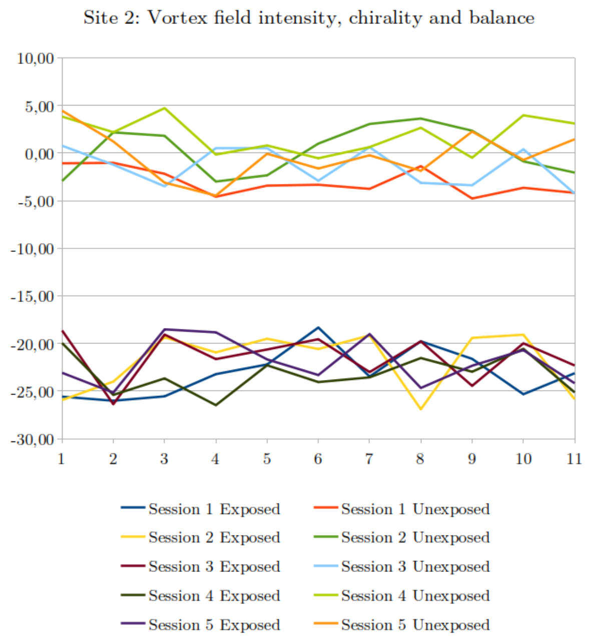

Figure 6: X-axis represents minutes, while Y-axis represent vortex intensity (arbitrary indexed scale). Positive numbers represent Δ-vortex, while negative numbers represents Λ-vortex. It is readily evident that technical mitigation of the vortex balance achieves a better balance than the unmitigated scenario.

Overall, the data from site 2 seems to be in accordance with the data obtained at site 1. Balancing the vortex field results in significantly lower scream counts.

5.4 Investigations at site 3

The final site was a farm were the animals were visibly distressed and presented a very aggressive behavior.

Our monitoring station was in the walkway of a barn section composed of 30 pens each with nominally 12 individual animals. Scream counts (table 3) shows the numerically largest amounts of screams encountered in the investigation.

Table 3: Scream counts for site 3. Difference between exposed and unexposed settings are highly significant

Scream Count at Site 3		
	Exposed	Unexposed
Session 1	36	11
Session 2	40	9
Session 3	35	9
Session 4	31	12
Session 5	43	8
Mean	37	9,8
P (two-tailed)		0,00057

We encountered unusually strong vortex fields (figure 7) which likely explains the comparatively high number of screams.

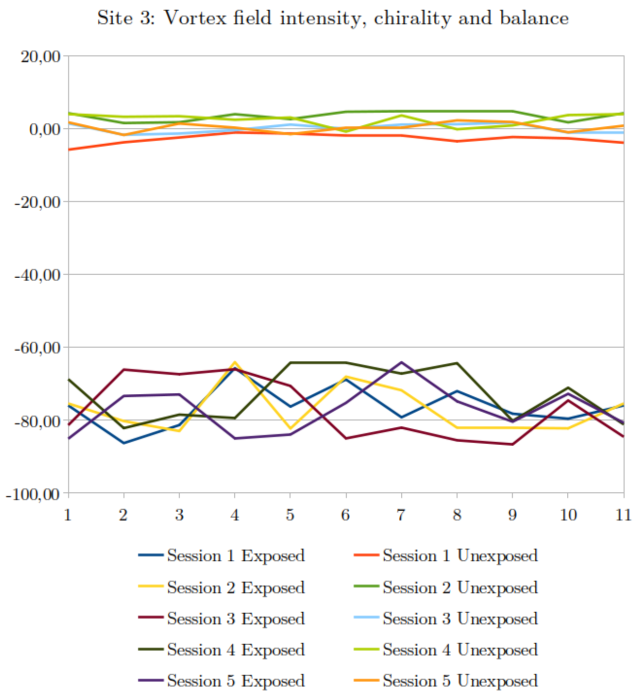

Figure 7: X-axis represents minutes, while Y-axis represents vortex intensity (arbitrary indexed scale). Positive numbers represents Δ-vortex, while negative numbers represents Λ-vortex. The Λ-vortex encountered at this site was considerably more intense than what has been encountered at the other two sites.

The results points to a very high degree of correlation between scream counts and vortex unbalance.

5.5 Limitations of the technical mitigation solution

The technical solution we utilize for mitigation of unbalanced vortex fields is described in detail in (9).

It should be noted that this mitigation strategy only is viable for the vortex field emitted from stray current conducting strata in the subsoil. Other, more conventional problems arising from endogenic stray current, such as: Voltage potential differences between barn structures, magnetic and electric fields in barn structures and voltage potential between drinking faucets and barn structures, should be solved first.

All of the farms included in this study had well-maintained electrical systems, and the absence of endogenic stray current in the actual barn structure was ascertained by electrotechnical measurements before the investigations was commenced.

The data obtained in this study can therefore be viewed as a strong indicator of the occurrence of a specific kind of stray current related problems, which cannot be solved by equipotential bonding or other improved electrotechnical installation practices, as the stray current is foreign to the farm and propagated in electrically conductive layers deep under the farm buildings.

5.6 Considerations on measurement uncertainty

Although the Differential Laser Diffraction Method is a new invention and the measurement values therefore cannot be compared to a calibrated standard, it is still relevant to assess and evaluate the accuracy and precision of the values obtained.

By measuring the same vortex imbalance with several similarly constructed instruments it is possible to ascertain that the instrument has research grade precision. Generally, we see errors below 1% between different instruments measuring the same vortex imbalance.

The lack of calibrated standard makes it considerably more difficult to analyze the amount of accuracy provided by the instrument, but since we are measuring effects on water molecules as a proxy for vortex intensity and imbalance it is evident that any large variation in the amount of water molecules suspended in the air could affect the accuracy of the instrument. To avoid this problem all measurements were conducted in meteorological circumstances with comparable levels of humidity and temperature.

Scream counts are done manually, and can therefore be viewed as affected by subjective judgment of the observer. The recordings, and the spectrograms produced by audio analysis software are, however, very valuable tools for obtaining data which are as objective as possible.

6. Conclusion

The obtained data strongly indicate that our initial hypothesis was correct.

As the obtained results demonstrates a significant insight to an important mechanism of animal stress, we will endeavor to initiate replication studies.

Magnetotelluric anomalies, caused by anthropogenic exogenic stray current, can cause very substantial increases in pig stress as evidenced by increased levels of specific animal vocalizations.

This present study is, as far as the authors know of, the first study to conclusively demonstrate significant correlation directly between exposure to magnetotelluric anomalies and stress levels in farm animals.

We note that the farms, where the investigations were conducted, had modern and well-maintained electrical systems installed in concordance with relevant building codes, and that electrotechnical measurements on the barn structure confirmed absence of stray current in the barn structure itself. Thus, the results indicate that all of the measured increased levels of stress were caused by exogenic stray current propagated along electrically conductive strata in the subsoil. The vortex-field emitted in such a scenario cannot be mitigated by equipotential bonding or improved electrical installation practice alone, it must be mitigated by collapsing the conjugate waveform giving rise to the vortex field.

The study demonstrates that in situations where all electrotechnical components of the electrical installation have been installed correctly and according to electrical code, it is relatively simple to implement technical solutions to achieve vortex balance by collapsing the conjugate waveform arising from the stray current propagated in the subsoil.

As the number of farms affected by stray current related problems is rising quasi-exponentially (4) these findings could have profound implications for a relatively vast number of farms and affected animals.

7. Future Scope

As is commonly the issue for research detailing emerging technology or emerging knowledge, further research conducted with a methodology allowing higher statistical powers is highly warranted.

It is known that humans and domestic pigs share some 97% of their genome, which point to a obvious question, as to which extent human biological systems too are affected by the relatively common vortex imbalances caused by stray current.

References

[1] Gonen, Turan. 1986. Electric Power Distribution System Engineering. Hightown, NY: McGraw Hill
[2] Morrison, C. 1963. "A Linear Approach to the Problem of Planning New Feed Through Points Into a Distribution System." AIEE Trans. III. (PAS) Dec. 1963 p 819-832
[3] Hendrickson, R.C., Mike Michaud and Alvin Bierbaum. 1995. Survey to Determine the Age and Condition of Electric Distribution Facilities in Minnesota: Report 1: Analysis of Overhead Distribution Feeder Testing Data. Minnesota Public Utilities Commission. May 18, 1995
[4] Horsevad, Kim. 2020. "Analysis of Stray Current, its Aetiology, Propagation, Relevant Measurement Protocols and Mitigative Efforts at a Pig Farm in Northern Denmark", International Journal of Science and Research (IJSR), Volume 9 Issue 1, January 2020, pp. 1234-1244.
[5] Horsevad, Kim. 2022. "Exploration of Water pH Shift When Influenced by Short Exposure to Magnetotelluric Anomaly", International Journal of Science and Research (IJSR), Volume 11 Issue 1, January 2022, pp. 246-249.
[6] Horsevad, Kim. 2022. "Short Exposure to a Magnetotelluric Anomaly Changes Water pH by Unknown Mechanism", International Journal of Science and Research (IJSR), Volume 11 Issue 8, August 2022, pp. 282-284.
[7] Horsevad, Kim. 2019. "Pilot Study Indicating Possible Effects on Water Impedance Characteristics from Stray Current", International Journal of Science and Research (IJSR), Volume 8 Issue 5, May 2019, pp. 1154-1157
[8] Horsevad, Kim. 2021. "Electrotechnical Characterization of a Stray Current Propagating Magnetotelluric Anomaly", International Journal of Science and Research (IJSR), Volume 10 Issue 1, January 2021, pp. 315-322.
[9] Horsevad, Kim & Pedersen, Juelie S. Renkilde. 2023. "Hypotheses for Mechanism of Influence and Technical Mitigation of Negative Bioreactivity from Stray Current Propagated along Magnetotelluric Anomalies", International Journal of Science and Research (IJSR), Volume 12 Issue 2, February 2023, pp. 572-576.
[10] Horsevad, Kim. 2023. "Metrology, Aetiology and Mitigation of a Vortex Field Emitting Magnetotelluric Anomaly", International Journal of Science and Research (IJSR), Volume 12 Issue 3, March 2023, pp. 537-543.
[11] Blackmond DG. The Origin of Biological Homochirality. Cold Spring Harb Perspect Biol. 2019 Mar 1;11(3):a032540.
[12] Ozturk SF, Liu Z, Sutherland JD, Sasselov DD. Origin of biological homochirality by crystallization of an RNA precursor on a magnetic surface. Sci Adv. 2023 Jun 9;9(23):eadg8274
[13] Düpjan S, Schön P-C, Puppe B, Tuchscherer A, Manteuffel G (2008) Differential vocal responses to physical and mental stressors in domestic pigs (Sus scrofa). Applied Animal Behaviour Science 114: 105–115.
[14] Weary DM, Braithwaite LA, Fraser D (1998) Vocal response to pain in piglets. Applied Animal Behaviour Science 56: 161–172.
[15] Schön PC, Puppe B, Manteuffel G (2004) Automated recording of stress vocalisations as a tool to document impaired welfare in pigs. Animal Welfare 13: 105–110.

[16] Manteuffel G, Puppe B, Schön PC (2004) Vocalization of Farm Animals as a Measure of Welfare. Applied Animal Behaviour Science 88: 163–182.
[17] Schrader L, Todt D (1998) Vocal Quality is Correlated with Levels of Stress Hormones in Domestic Pigs. Ethology 104: 859.
[18] Briefer, E.F., Sypherd, C.C.R., Linhart, P. et al. Classification of pig calls produced from birth to slaughter according to their emotional valence and context of production. Sci Rep 12, 3409 (2022)
[19] Tallet C, Linhart P, Policht R, Hammerschmidt K, Šimeček P, Kratinova P, et al. (2013) Encoding of Situations in the Vocal Repertoire of Piglets (Sus scrofa): A Comparison of Discrete and Graded Classifications. PLoS ONE 8(8): e71841.
[20] https://www.audacityteam.org/

Author Profile

Kim Horsevad is the owner and chief technical analyst at Horsevad Independent Technical Research & Analysis (www.horsevad.net). Current research aims for developing methods for quantifying interactions between electromagnetic fields and biological systems.

Tage Rødbro is a licensed veterinarian, Doctor of Veterinary Medicine and Swine practitioner at lvk.dk. He holds a Certificate in Swine Health Management from the Danish Veterinary Association's (DVA's) two-year certification programme.