Development of an Electromagnetic Vortex Field Gradiometer Instrument

Kim Horsevad[1]

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

Abstract: ***This paper describes the development of an innovative electromagnetic vortex field gradiometer designed to measure electromagnetic field components that penetrate shielding in far-field conditions. The study addresses limitations in traditional measurements for mitigating stray currents, with applications in both agricultural and industrial settings. Findings reveal significant potential for enhancing our understanding of electromagnetic interactions and stray current impacts.***

Keywords: Electromagnetic vortex field, stray current mitigation, vortex gradiometer, magnetotelluric anomaly, water structure

1. Introduction

Over the past several years, our research has focused on understanding the mechanisms behind the detrimental biological effects of stray currents on farm animals, specifically examining the biophysical and electrotechnical mechanisms responsible for the observed adverse physiological and behavioral responses.

One of the main aspects of adverse stray current reactions in farm animals is related to the effects on the farm's drinking water supply caused by stray currents

In 2018, we conducted a project under the auspices of SEGES, involving a series of studies examining the impact of stray current-affected water on a cattle farm near Slagelse, Denmark. The effect on the water supply was visually distinctive, as the animals exhibited highly abnormal drinking behavior.

Interestingly, the adverse effects were not directly related to contact currents or voltages. The water remained affected even when removed from the farm or transferred to electrically isolated containers.

A sample of this water was sent to the Danish Agricultural University for further testing. However, veterinarians there had to abort their experiments due to animal welfare concerns, as the test animals outright refused to drink the affected water.

We performed extensive chemical analyses on the water samples but did not identify any anomalies explaining the observed effects.

2. Literature Survey

As electrical infrastructure rapidly evolves towards a more decentralized structure, stray current-related problems are becoming increasingly prevalent. Earlier research suggests that 65 to 75 percent of the total return current propagates through the earth as stray current, rather than through cables (1,2,3). Our ongoing, yet unpublished, analysis indicates an even higher percentage for modern decentralized electrical infrastructure.

We have developed robust methods and instruments for precisely locating the exact positions of stray current-propagating subsoil strata (4).

These streaks of electrically conductive subsoil strata, where foreign stray current produces measurable perturbations in the natural magnetic field, are termed *technogenic magnetotelluric anomalies* (TMA).

At the request of affected farmers, we investigated water positioned near these TMA. We discovered that such water acquires an unknown characteristic, causing farm animals to exhibit abnormal behavior and actively avoid drinking or contacting the affected water, regardless of whether the water is placed in electrically non-conducting vessels, or offered to animals on another location.

Individuals claiming radiesthetic abilities reported detecting different 'energies' in the affected water using biolocation instruments such as L-rods and pendulums. However, these methods lack scientific verification, and all available chemical analyses of the affected water failed to establish any discernible differences.

Even when faced with seemingly implausible scenarios where affected individuals remain convinced of unexplained phenomena despite conventional measurements yielding no results, it is incumbent upon researchers to maintain an open, curious, and inquiring mindset. This approach involves developing new experiments and measurements to explore the problem in greater depth, potentially constructing new knowledge in the process.

We successfully conducted the first analyses that technically demonstrated water can change its properties when exposed to stray current propagating through TMAs. Our investigations documented how TMAs affected internal water structure, measured both by pH shift (5,6) and by electrochemical spectroscopy (altered impedance characteristics) in the frequency range between 10MHz and 6GHz (7). To the best of our knowledge, these are the first published results documenting such changes in water structure due to exposure to TMAs

During classical electrotechnical measurements (Schlumberger Arrays and ground conduction) conducted in fields adjacent to the affected farms (8), we serendipitously discovered that certain phase shifts between incoming and reflected waveforms served as a reliable predictor of adverse animal behavior.

This observation led to the development of a working hypothesis aimed at furthering our understanding and facilitating experimentation regarding the significance of these observed phase shifts.

Phase shifts are readily explained by impedance discontinuities in the electrically conductive strata through which stray currents propagate. These shifts can be measured using various mainstream electrotechnical instruments, including Vector Network Analyzers, which are commonly employed for detailed electrotechnical measurements of antennas and other frequency-dependent electronic circuitry.

We hypothesize that phase-shifted, or even phase-conjugate, waveforms might induce changes in water structure or affect biological systems through yet unknown mechanisms. Technically, such phase-shifted waveforms are easily measurable. Due to their distinctive appearance on an oscilloscope in X/Y-mode, we have chosen to refer to these waveforms as *vortex fields* (9).

To further investigate this phenomenon, we have developed specialized instruments based on orthogonal parallel-plate capacitors. These devices can effectively measure the waveforms giving rise to the vortex field (9,10)

Through simple measurements, we can technically distinguish between left-handed vortex fields (Λ-vortex) and right-handed vortex fields (Δ-vortex).

While our working hypothesis and experimental setup are still in development, it's noteworthy that biological systems generally exhibit homochirality in their major macromolecular components. DNA, RNA, and their constituents display Δ-chirality, while amino acids exhibit Λ-chirality (11, 12). This observation may suggest an unknown biological susceptibility to electromagnetic fields with these peculiar waveforms.

Initial tests on simple model organisms (Lepidium sativum) and water structure (9,10) have confirmed statistically significant bioreactivity and water structure susceptibility to unbalanced occurrences of such vortex fields.

This hypothesis was further corroborated in experiments using more complex animals (Sus scrofa domesticus) as model organisms (13).

Additional testing, yet unpublished, aimed at understanding the exact mechanism by which the vortex field can elicit changes in water structure, has consistently demonstrated that shielding the water in Faraday cages, zero-gauss chambers, or any combination thereof shows no attenuation of the effect. In its most radical interpretation, this may serve as an impetus to explore potential non-classical phenomena related to such vortex fields.

3. Problem Definition

Based on the aforementioned results, the present study aims to design and construct an instrument capable of decisively elucidating whether the observed vortex fields have related components or phenomena that enable non-classical electromagnetic far-field penetration of both Faraday cages and zero-gauss chambers. This instrument will help further our understanding of the unique properties exhibited by these vortex fields and their potential implications for electromagnetic theory.

4. Methodology

We have previously developed instruments based on orthogonal parallel-plate capacitors (9,10), which, due to their specific antenna geometry, allow us to directly observe and measure the phase-shifted or phase-conjugate waveforms that give rise to the vortex field.

Furthermore, we have developed instruments utilizing differential laser diffraction, enabling direct measurements of the influences of Λ-vortex and Δ-vortex on the refractive index of water molecules suspended in air. This instrument allows for direct measurement of both the intensity of the vortex field and its inherent chirality.

While these instruments are proving useful, particularly for field measurements aimed at mitigating the adverse effects of stray current on farms, they both lack the ability to directly observe and measure the vortex field itself. The parallel-plate capacitor instrument measures the constituent phase-shifted electromagnetic waveforms, while the laser diffraction instrument measures effects on the refractive index of water molecules, which, although very useful in practical applications, is technically a proxy measurement.

Our aim, therefore, is to construct an instrument that measures the vortex field directly. To enable such direct measurements, the sensor array of this instrument should be enclosed in several layers of Faraday cages and mu-metal, safeguarding against any possible contamination by 'ordinary' electromagnetic energy.

We hypothesize that if any unknown component of an electromagnetic field is able to penetrate both several layers of mu-metal and Faraday cages, then the energy levels of any penetrating component must be very low. Furthermore, we posit that such small residual energy would be better detected by utilizing materials with known non-linearities rather than classical electromagnetic antennas.

Our experiments have demonstrated that several such non-linearities can be exploited for suitable instrument construction. An ordinary resistor placed in a fully electromagnetically shielded enclosure exhibits very slight changes in resistance when exposed to a vortex field. Similarly, both phototransistors and photodiodes can be utilized as vortex detectors via measurement of their dark current.

On the contrary, we did not succeed in obtaining any meaningful measurements from classical antenna-based sensors positioned in the same shielding enclosure as described below.

When performing such experiments, it is crucial to maintain very strict control of all environmental variables. Even small temperature variations in an otherwise thermostatically controlled room are sufficient to skew the measurements. Therefore, the sensor array should be placed in a temperature-controlled environment if any kind of time-series measurements are to be undertaken.

The final embodiment of the instrument used for measurements in this paper was based on selenium photodiodes with a specified spectral detection range from 450 nm to 1550 nm.

The photodiodes are arranged in a 720-degree array, meaning that there are photodiode sensors pointing each way for both X, Y and Z-axis, enabling detection from all directions.

The photodiode array is housed within four layers of YSHIELD® HNG100 Shielding mesh to ensure robust electromagnetic isolation, and four layers of magnetically shielding mu-metal.

The effectiveness of the magnetic shielding was verified with an Integrity Design IDR-322:AC/DC MilliGaussmeter.

The shielding structure is housed in a commercial off-the-shelf stainless steel thermos flask, equipped with a thermistor-controlled Peltier-Seebeck element for temperature control to within 0.1 degrees Celsius.

Current from the photodiode is transmitted to a transimpedance amplifier, which is housed in another fully shielded enclosure, via triaxial cables. The inner shield of these cables is connected to the instrument shielding, while the outer shield is connected to the amplifier housing shield.

Output from the transimpedance amplifier and subsequent signal conditioning circuitry is fed to a BNC connector on the amplifier housing, enabling connection to a spectrum analyzer or oscilloscope for waveform analysis.

5. Results & Discussion

A. Vortex fields in an aquifer

Figure 1 shows the level of vortex noise sampled with the described instrument placed at ground level above an aquifer. A well with a frequency inverter-controlled pump is installed 100 meters upstream from the sampling point. The aquifer runs at a depth between 4 and 5 meters. The nearest other technical installation is a barn 570 meters away.

Figure 2 shows the level of vortex noise sampled under identical conditions, except that the frequency inverter-controlled pump has been switched off.

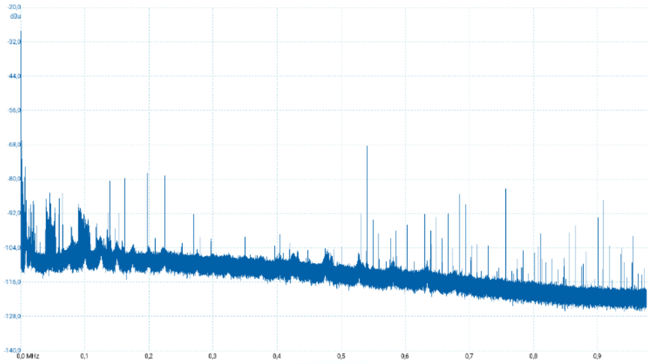

Figure 1: 1 MHz spectrum of vortex field noise sampled with the described instrument at ground level above an aquifer, 100 meters downstream of a frequency inverter-controlled well pump.

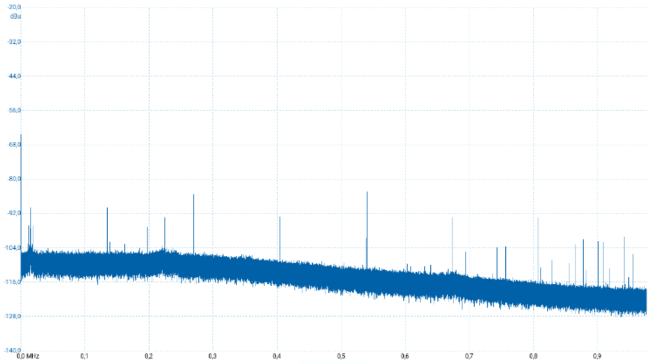

Figure 2: Same as Figure 1, except that the frequency inverter-controlled pump has been switched off.

A qualified electrical engineer thoroughly inspected the electrical installation of the frequency inverter pump motor controller, confirming that everything was installed in compliance with current electrical codes and standards.

These measurements, therefore, clearly demonstrate that levels of leak current from the frequency inverter pump motor controller, which are currently within acceptable limits set by electrical installation standards, impart a significant vortex field upon the water flowing in the aquifer.

This finding highlights a potential gap between current electrical safety standards and the unintended electromagnetic effects on surrounding environments, particularly water systems.

B. Vortex fields from a barn ceiling exhaust fan

Figure 3 illustrates the level of vortex noise sampled with the described instrument placed near galvanized pig pen railings, located 5 meters horizontally from a ceiling exhaust fan controlled by a frequency inverter.

Paper ID: SR241227055840 DOI: https://dx.doi.org/10.21275/SR241227055840

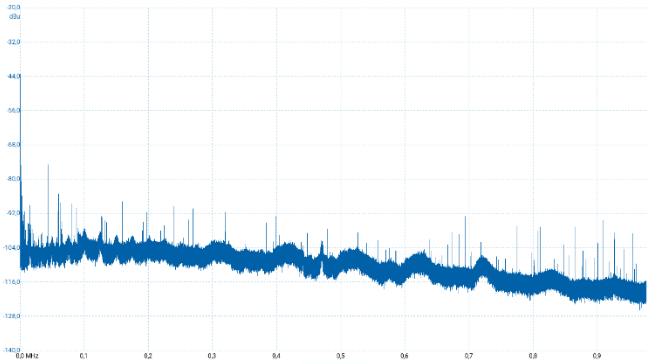

Figure 3: 1 MHz spectrum of vortex field noise sampled from galvanized pig pen railings at 5 meters distance from a ceiling exhaust fan with a frequency inverter motor controller.

All electrical connections and installations related to the frequency inverter motor controller were thoroughly inspected. Equipotential bonding between electrical ground level and electrically conductive barn equipment was verified. No voltage potential between different points of electrically conductive barn equipment could be detected.

The demonstrated presence of a distinct vortex field measured at the galvanized pen railings indicates that equipotential bonding and grounding of leak-current producing electrical infrastructure may not always be sufficient to mitigate stray current-related problems.

This finding suggests a need for further investigation into the propagation mechanisms of vortex fields and their potential impacts on agricultural environments.

C. Vortex Fields from a pig feed tube

The investigated system comprised a tube-based dry feed transport system connecting storage silos to feed dispensers. While the tubes were non-metallic, the conveyor chain inside was made of galvanized steel. The sensor array of the vortex gradiometer instrument was positioned near the operational transport tube during measurements.

Figure 4 illustrates the vortex noise spectrum obtained from these measurements.

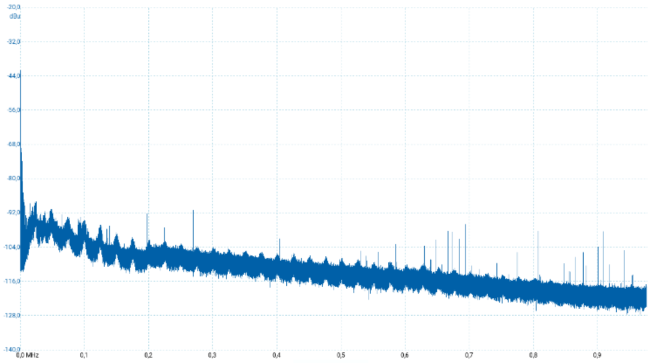

Figure 4: 1 MHz spectrum of vortex field noise sampled from conveyor chain-based feed tubes.

A frequency inverter controlled the electric motor driving the conveyor chain. It is worth noting that all three examples in this study involve frequency inverters.

Frequency inverters control AC electric motor speed by modulating the frequency of the supplied electrical power. The process involves converting input AC power to DC, then using an inverter section to convert the DC back to AC at variable frequency and voltage. This conversion typically employs Insulated Gate Bipolar Transistors (IGBTs) or similar power semiconductor devices. These IGBTs rapidly switch on and off, generating a pulse width modulated output.

While frequency inverters offer numerous advantages, including energy efficiency and precise speed control, it is evident that their inherent pulse width modulation produces significant phase-shifted electromagnetic fields. If the hypothesis presented in this paper reasonably approximates the complexities of vortex fields, which the obtained measurement data consistently corroborates, then frequency inverters, by their very design, generate substantial levels of unmitigated vortex noise.

D. Vortex reference levels

Figure 5 illustrates the vortex noise level obtained by the described vortex gradiometer instrument at a location several kilometers from the nearest electrical infrastructure.

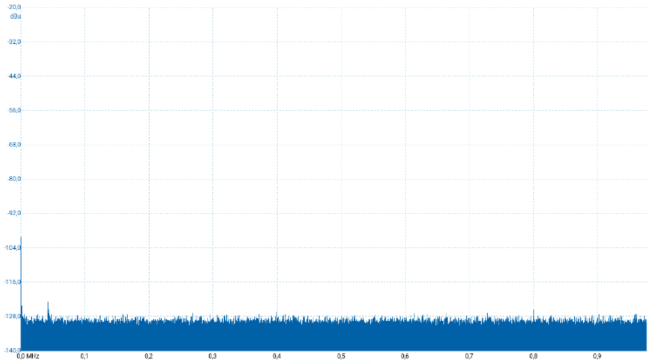

Figure 5: 1 MHz spectrum of vortex field noise sampled from ground level several kilometers from nearest electrical infrastructure.

Despite being located far away from electrical infrastructure, the instrument still detects a strong noise presence at 50Hz, which is the primary electrical infrastructure frequency in Europe.

50Hz noise, both electrical and magnetic, can be detected by everywhere in Europe, even in the depth of the remote mountain wilderness areas in Northern Sweden and Northern Norway. It is therefore not entirely unexpected to find this frequency in vortex noise even in remote areas.

6. Conclusion

This study successfully developed an electromagnetic vortex field gradiometer capable of detecting fields that penetrate advanced shielding. The instrument demonstrates practical utility in diagnosing stray current issues and opens new research avenues in electromagnetic field interactions and biological impacts. Future research will focus on enhancing sensitivity and exploring biological implications further.

Our hypothesis posits a relationship between vortex fields and the phase shift of parent electromagnetic waveforms. However, the current experimental setup does not allow for definitive proof of this correlation, indicating an area for future research.

To ensure the reliability of our findings and mitigate potential confounding factors, we implemented a robust validation process:

1. We constructed five distinct versions of the instrument, each employing:
   - Different sensor arrays
   - Unique transimpedance amplifier circuitry
2. All five versions consistently measure these fields, with the latest iteration achieving the lowest noise floor, enabling detection of weaker field intensities.
3. Importantly, there are no common components across the five instrument versions, reinforcing the validity of our results.

This multi-version approach safeguards against possible errors stemming from shielding deficiencies, amplifier design artifacts, and other unknown sources of interference.

The practical utility of the developed vortex gradiometer instrument is evident in its application to real-world scenarios. It enables rapid measurements and technical diagnostics of stray current-related problems that would be challenging to detect using conventional instruments.

This capability opens up new possibilities for identifying and addressing stray current related issues related to both farms and industrial complexes.

In conclusion, while further research is needed to fully understand the nature and behavior of vortex fields, our instrument provides a novel and effective tool for their detection and measurement.

It is furthermore worth noting that the readings from the developed vortex gradiometer instrument show a correlation with observations made by individuals claiming radiesthetic abilities. While these subjective observations lack objective verification, the apparent agreement between instrument measurements and human perception is intriguing. This correlation may suggest the possibility of a yet-unidentified biological sensitivity to these fields, presenting a potential avenue for future interdisciplinary research. However, it is crucial to emphasize that this observation is preliminary and requires rigorous scientific investigation to establish any definitive conclusions.

7. Future Scope

Future research directions to substantiate and expand upon the current findings include:

Theoretical Modeling: Developing a comprehensive theoretical framework to explain and predict the observed vortex field behavior. This model would aim to provide a mathematical foundation for the empirical results obtained.

Enhanced Instrument Sensitivity: Further refinement of the vortex gradiometer instrument to increase its sensitivity. This improvement could potentially enable direct measurement of subtle phenomena, such as water structure changes induced by vortex fields.

Reproducibility and Validation: Given the unconventional nature of these findings, independent verification is crucial. To facilitate this, customized versions of the vortex gradiometer instrument described in this paper can be made available to other researchers. This approach aims to encourage collaborative efforts in furthering the understanding of vortex fields and validating the results presented herein.

Biological Interactions: Investigating the potential biological effects of vortex fields, including the possibility of human sensitivity to these fields, as suggested by the correlations observed with radiesthetic claims.

Acknowledgements

While the present study is entirely self-funded, the author would like to thank SEGES and especially Kenneth Poulsen for the financial support and encouragement during the first experiments on this matter back in 2018.

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] Horsevad, Kim. & Rødbro, Tage. 2023. "Increased Levels of Stress in Domestic Pigs Exposed to Magnetotelluric Anomalies caused by Stray Current", International Journal of Science and Research (IJSR), Volume 12 Issue 11, November 2023, pp. 460-467.

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.