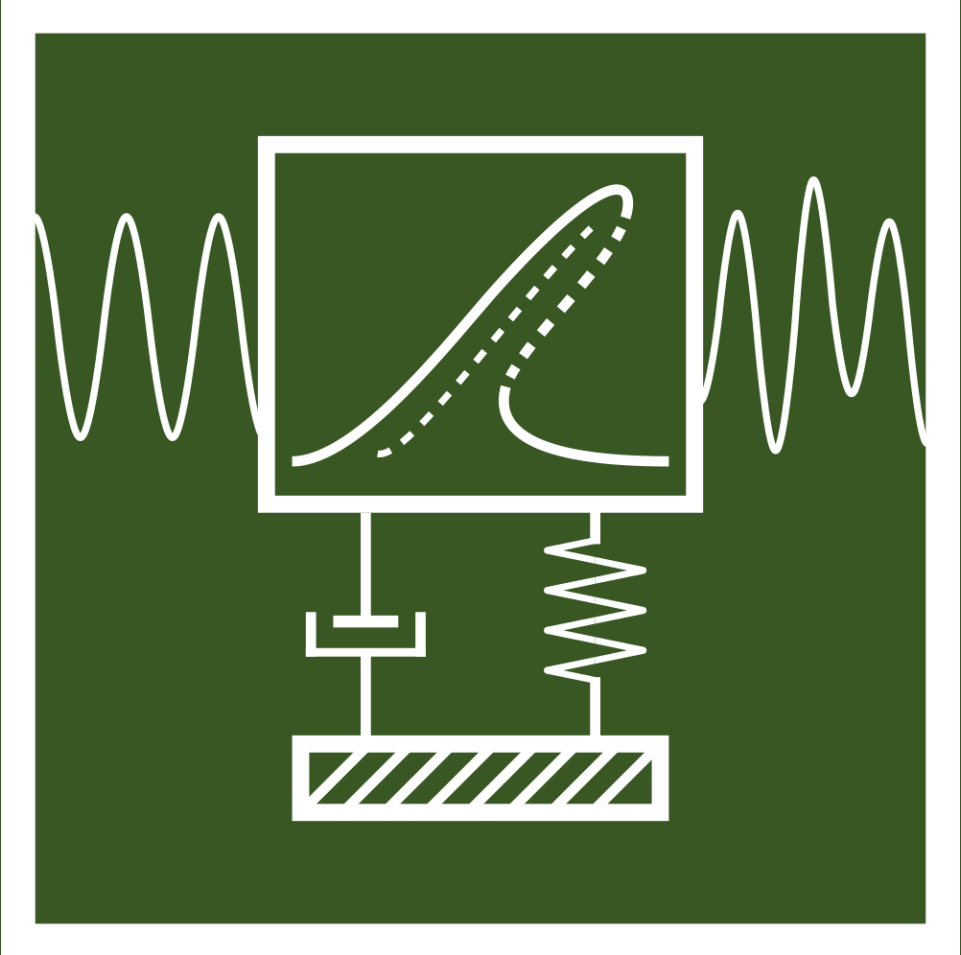


The Relationship between the Local Earth Magnetic Field and Acute Myocardial Infarction

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Abstract

This study investigated the relationship between the local magnetic field (LMF) and acute myocardial infarction (AMI). Statistical analyses indicated that the association between LMF and AMI remained consistent over long-term observation windows. The study analyzed data from two hospitals and one Lithuanian public health institution collected between 2014 and 2019, together with daily averages of the local magnetic field and Schumann resonance measurements obtained from a magnetometer in Lithuania.

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Methods

A well-known group of spectral peaks, known as Schumann resonances, was recorded as part of the experimental protocol. The measured Schumann resonances were used as the data to be analyzed in conjunction with the number of patients admitted to the hospital with acute myocardial infarction (AMI). The local magnetic field (LMF) can be measured in two directions: north/south and east/west. In this study, the east/west detector was used for LMF measurements. Details of the different frequency ranges of the Schumann resonances are presented in Table 1.

Input Variable	Different Frequency Ranges of the Schumann Resonance	Frequency Range (Hz)
X_1	SDelta (δ)	0–3.5
X_2	STheta (θ)	3.5–7
X_3	SAlpha (α)	7–15
X_4	SBeta (β)	15–32
X_5	SGamma (γ)	32–65
Output variable		
Y	The total number of patients hospitalized in Lithuania per day with the diagnosis of AMI	

Table 1. Description of the input and output variables.

A linear regression model was fitted to the data:

$$Y = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + \varepsilon \quad (1)$$

where $b_0, b_1, b_2, b_3, b_4, b_5 \in R$; ε is the residual of approximation; $\varepsilon \sim N(0, \sigma^2)$.

The linear regression model (1) parameters $b_0, b_1, b_2, b_3, b_4, b_5$ are determined by the method of least squares.

02

Results

The Pearson correlation coefficient was used to assess the relationships between the variables. It was found that variables X_1, X_2, X_3 and X_4 are strongly positively and linearly correlated. However, relationships between X_5 and X_1, X_2, X_3, X_4 were weak. According to the hypothesis test, the null hypothesis that the correlation between the variables is equal to zero was rejected at a significance level of (p-value) < 0.05 . Therefore, the Pearson correlation coefficients are statistically significant. Because the correlations among X_1, X_2, X_3 , and X_4 are strong, these variables are multicollinear, so some of them must be dropped from regression equation (1). After dropping X_2, X_3 , and X_4 , the regression equation reads:

$$Y = b_0 + b_1X_1 + b_5X_5 + \varepsilon \quad (2)$$

In this work, the association between the averaged magnetic field on the individuals experiencing the heart attack becomes evident over long observation windows [1]. The length of the observation window used for the averaging L is 180 days. Least squares estimation of regression model (2) at $L = 180$ yields the following parameter estimates: $\hat{b}_0 = 18.0921$, $\hat{b}_1 = -0.0314$, $\hat{b}_5 = -0.0004$.

The null hypotheses that the model is not statistically significant and that the regression coefficients are equal to zero were tested at a significance level of $\alpha = 0.05$. All null hypotheses were rejected ($p < 0.05$). The regression equation obtained with a 180-day moving average reads:

$$\hat{y} = 18.0921 - 0.0314x_1 - 0.0004x_5 \quad (3)$$

The variation intervals of variable x_1 is [18.5; 68.3] and x_5 is [131.2; 297.2] accordingly. The model has an R^2 value of 0.744. The variance inflation factor (VIF) is computed for each variable. $VIF = 1.0734 < 4$ for both variables X_1 and X_5 . Therefore, those variables are not multi-collinear.

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Discussion

The purpose of the study is to find the long-term relationship between the LMF and the AMI. As a result, the paucity of instantaneous correlations leads to the necessity to investigate the long-term relationship between AMI and LMF. Therefore, we transformed the governing equations to a time-averaged regression model, which is the essence of the study. The averages of the relevant Schumann resonances SDelta (0–3.5 Hz) and Sgamma (32–65 Hz) influence the average number of patients (3).

Like any other scientific work, this study has limitations. First, only data from individuals diagnosed with AMI and admitted to hospital were collected. Some individuals may have developed AMI symptoms without being admitted, so unreported cases are not accounted for in this study.

Another limitation of the study concerns the derived model. The residuals of the model are not normally distributed, although they are close to normal. This problem would likely diminish with a larger number of observations.

04

Conclusions

The study's findings revealed significant long-term relationships between the LMF and AMI. Furthermore, not all Schumann resonance bands were associated with AMI incidence. For example, the SDelta (0–3.5 Hz) and SGamma (32–65 Hz) bands were found to be significantly associated with the long-term relationships. The study also found that the instantaneous relationships between geomagnetic variations and AMI were not significant.

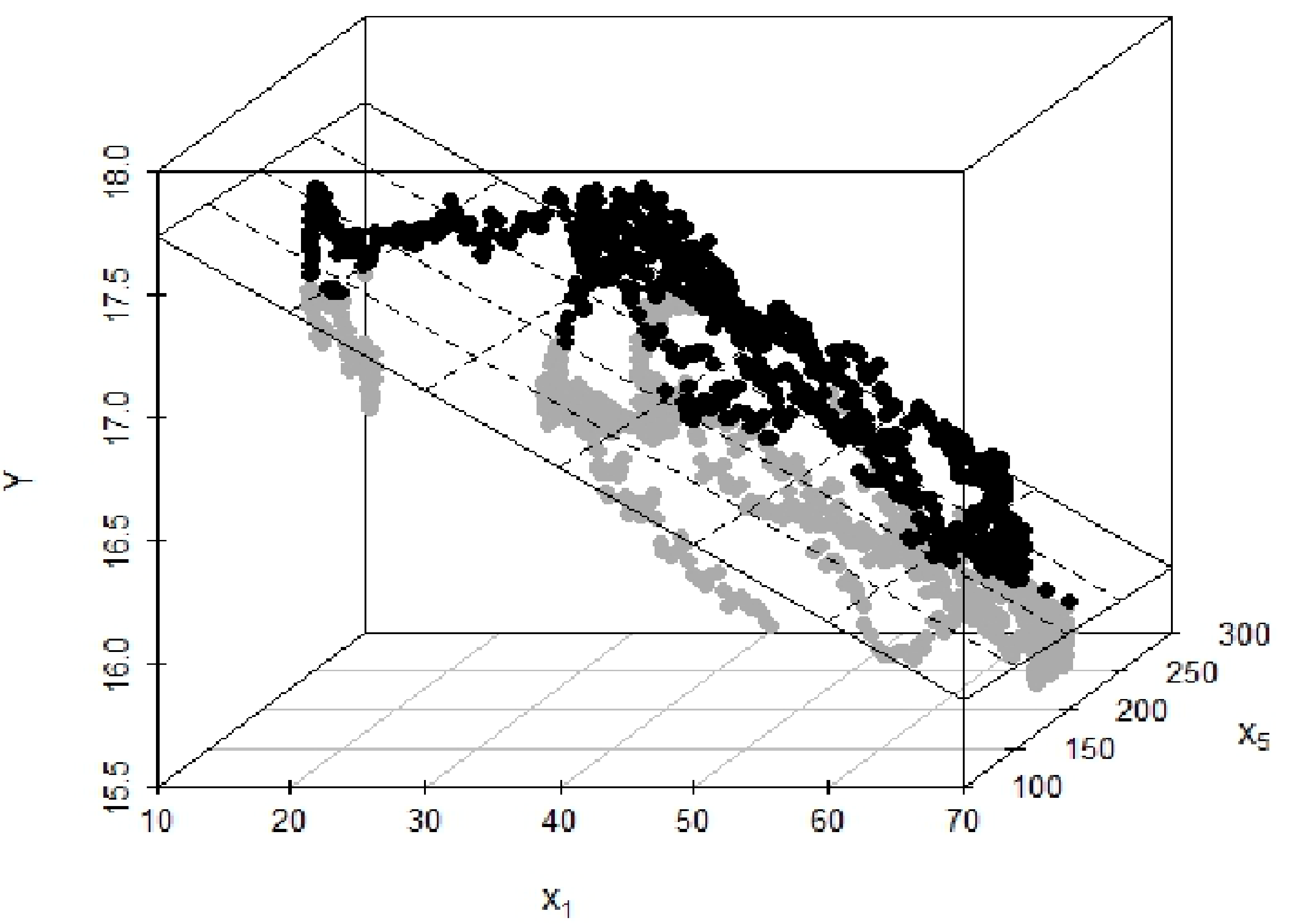


Fig1. The regression plane is plotted for the time-average model for parameters X_1, X_5 , and Y . The points above the plane are represented in black, whereas the points below the plane are represented in gray.

References

[1] McCraty, R.; Atkinson, M.; Stolc, V.; Alabdulgader, A.A.; Vainoras, A.; Ragulskis, M. "Synchronization of Human Autonomic Nervous System Rhythms with Geomagnetic Activity in Human Subjects". Int. J. Environ. Res. Public Health 2017, 14, 770.