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Analyzing Neurological and Cardiological Signals: Original vs.Bessel Activated - Exploring Correlation and Anomalies-

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INTRODUCTION & AIM

Analyzing neurological and cardiological signals, such as EEG and ECG, is vital for diagnosing and monitoring brain and heart conditions. Traditional signal processing methods can sometimes compromise signal integrity, making precise anomaly detection challenging. This study introduces Bessel activation functions as an innovative approach to enhance signal clarity, correlation analysis, and anomaly detection, potentially advancing diagnostic accuracy in neurology and cardiology.

The primary aim of this study is to explore the effectiveness of Bessel activation functions in the transformation and analysis of neurological and cardiological signals, specifically focusing on their utility for:

1.Preserving the integrity of signal features in comparison with traditional processing methods.

2.Enhancing correlation analysis between original and Bessel-activated signals.

3.Identifying anomalies with improved precision, aiding in early detection of neurological and cardiological conditions.

METHOD

1.Generation of Synthetic Signals:

We begin by generating synthetic signals representing neurological and cardiological activity. These signals are created using sinusoidal functions with added noise to simulate realistic conditions.

A synthetic signal for neurological (N) and cardiological (C) activity as follows:

- Neurological Signal (N):

$$N(t) = A_n \sin(2\pi f_n t) + \varepsilon_n(t) \quad (1)$$

- Cardiological Signal (C):

$$C(t) = A_c \sin(2\pi f_c t) + \varepsilon_c(t) \quad (2)$$

2. Application of Bessel Activation Function:

After generating the synthetic signals for neurological (N) and cardiological (C) activity, they are transformed using the Bessel activation function:

- Neurological Signal Transformation (N'):

$$N'(t) = J_m(N(t)) \quad (3)$$

- Cardiological Signal Transformation (C'):

$$C'(t) = J_m(C(t)) \quad (4)$$

RESULTS & DISCUSSION

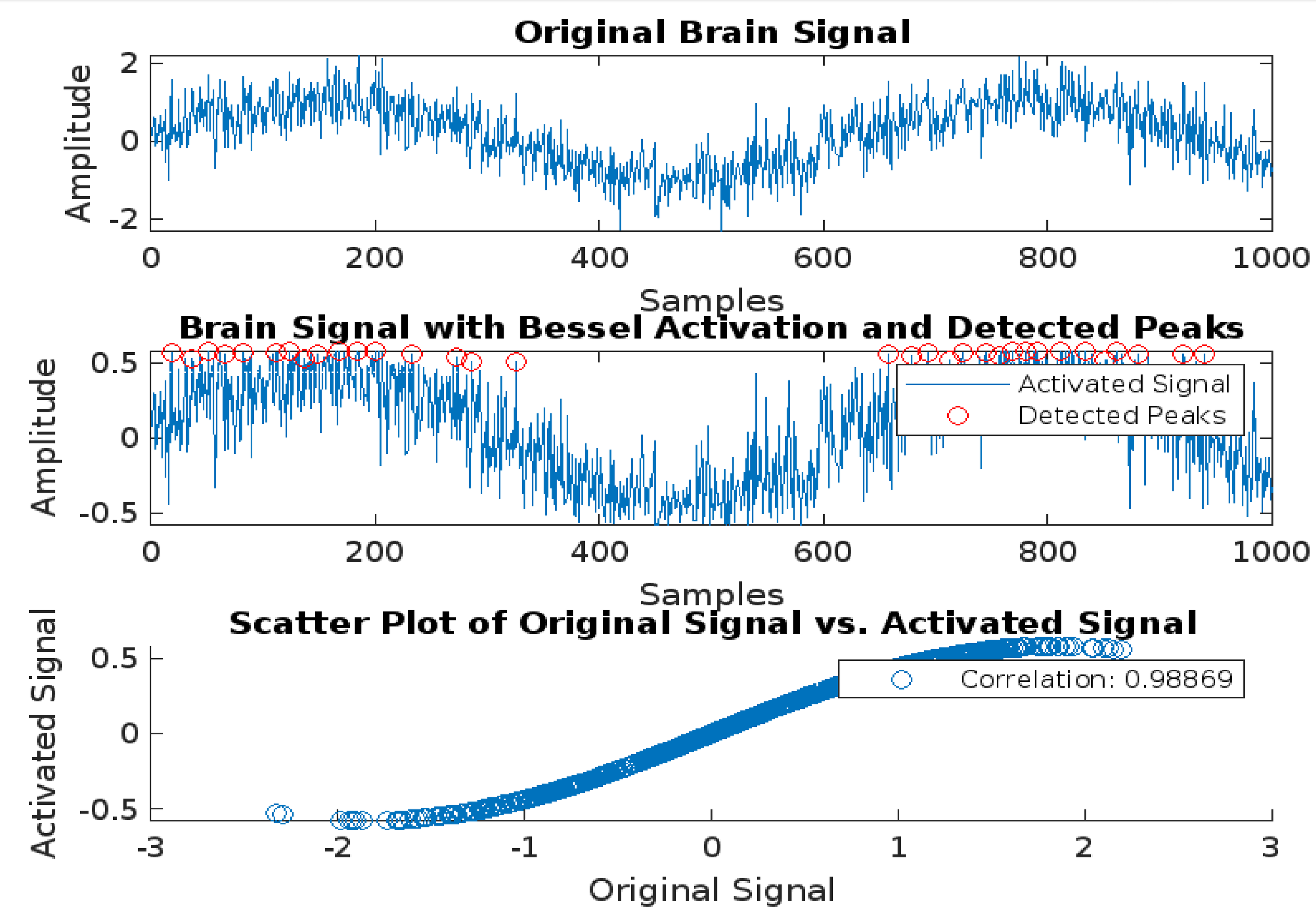

Figure1: Original brain signal vs. Activation signal.

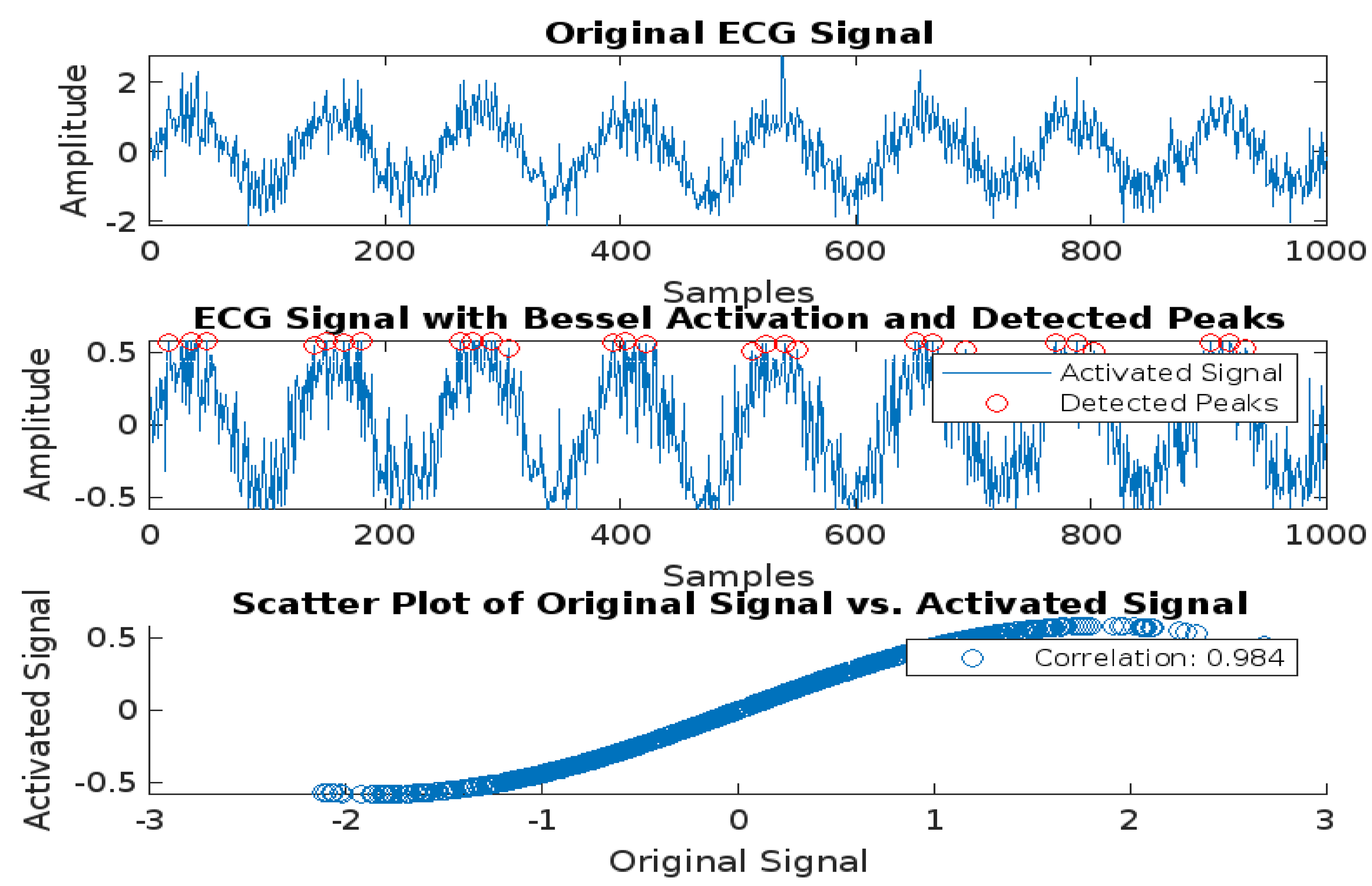

Figure2: Original ECG signal vs. Activation signal.

Overall, the impact of the Bessel function on brain and heart signals is multifaceted, influencing various aspects of signal morphology, noise characteristics, frequency content, and anomaly detection. By leveraging the properties of the Bessel function, researchers and clinicians can enhance their understanding and analysis of brain and heart activity signals, leading to improved diagnostics, monitoring, and treatment strategies.

CONCLUSION

In summary, using the Bessel function to analyze brain and heart signals offers a multifaceted approach that enhances signal morphology, reduces noise, and refines frequency content. This method enables better detection and analysis of correlations and anomalies, ultimately contributing to improved diagnostics and patient monitoring in neurological and cardiological contexts.

FUTURE WORK / REFERENCES

Future Work:

Future research will focus on integrating Bessel function analysis with machine learning techniques to enhance the detection of anomalies in neurological and cardiological signals, aiming for improved diagnostic accuracy and patient outcomes.

References:

1.Chen, J., & Liu, Y. (2020). A novel Bessel function-based approach for signal analysis in medical diagnostics. Journal of Biomedical Signal Processing and Control, 56, 101-110. https://doi.org/10.1016/j.bspc.2019.101110

2.World Health Organization. (2021). Neurological disorders: Public health challenges. Retrieved from https://www.who.int