frontiers | Frontiers in Signal Processing

TYPE Correction
PUBLISHED 15 October 2024
DOI 10.3389/frsip.2024.1496320

OPEN ACCESS

EDITED AND REVIEWED BY
Sri Krishnan,
Toronto Metropolitan University, Canada

*CORRESPONDENCE
Manob Jyoti Saikia,
msaikia@memphis.edu

RECEIVED 14 September 2024
ACCEPTED 30 September 2024
PUBLISHED 15 October 2024

CITATION
Joshi RC, Awasthi N, Parida P and Saikia MJ (2024) Corrigendum: Editorial: Physiological signal processing for wellness.
Front. Sig. Proc. 4:1496320.
doi: 10.3389/frsip.2024.1496320

Corrigendum: Editorial: Physiological signal processing for wellness

Rakesh Chandra Joshi[1], Navchetan Awasthi[2,3], Priyadarsan Parida[4] and Manob Jyoti Saikia[5,6]*

[1]Amity Centre for Artificial Intelligence, Amity University, Noida, UP, India, [2]Faculty of Science, Mathematics and Computer Science, Informatics Institute, University of Amsterdam, Amsterdam, GH, Netherlands, [3]Department of Biomedical Engineering and Physics, Amsterdam UMC, Amsterdam, HV, Netherlands, [4]Department of Electronics and Communication Engineering, School of Engineering and Technology, GIET University, Gunupur, Odisha, India, [5]Electrical and Computer Engineering Department, University of Memphis, Memphis, TN, United States, [6]Biomedical Sensors and Systems Lab, University of Memphis, Memphis, TN, United States

KEYWORDS

medical diagnostics, fitness monitoring, brain-computer interfaces, sleep monitoring, digital health, eeg signals

A Corrigendum on
Editorial: Physiological signal processing for wellness

by Parida P (2024). Front. Sig. Proc. 4:1391335. doi: 10.3389/frsip.2024.1391335

In the published article, there was an error in the **Author** list, and author Rakesh Chandra Joshi, Navchetan Awasthi, Manob Jyoti Saikia was erroneously excluded. The corrected author list appears below.

"Rakesh Chandra Joshi, Navchetan Awasthi, Priyadarsan Parida, Manob Jyoti Saikia."

The published editorial on the **Research Topic** "Physiological Signal Processing for Wellness" has also been updated as the authors wish to inform readers that the editorial article has been re-written and republished to reflect a more unified and comprehensive perspective from all the editors involved. While the original version was accurate, the updated editorial provides a broader illustration of the editors' collective viewpoints, offering a deeper insight into physiological signal processing for wellness.

The authors would like to state that the conclusions and points made in the original editorial remain valid. However, this new version seeks to enhance the narrative and offer readers a more complete understanding of the issue at hand.

The article previously stated:

"For centuries, humans have sought to understand the secrets whispered by our own bodies. Now, through the lens of physiological signal processing, we are closer than ever to unlocking these secrets and transforming the way we approach wellness. This burgeoning field harnesses the power of advanced algorithms to analyze signals like heart rate, brain activity, and even skin temperature, providing a window into our internal state and paving the path for personalized, data-driven wellbeing solutions."

Imagine a world where wearable devices do not just track steps, but detect the onset of stress before you even feel it, prompting personalized interventions like guided meditations or calming music. Physiological signal processing holds the potential to do just that. By analyzing subtle changes in heart rate variability or electrodermal activity, researchers are developing algorithms that can identify stress in real-time, empowering individuals to proactively manage their mental wellbeing.

This technology extends far beyond stress management. By analyzing brainwave patterns, researchers are exploring ways to optimize cognitive performance, personalize learning experiences, and even identify early signs of neurological disorders. Imagine athletes fine-tuning their training based on real-time feedback from their brains, or students receiving personalized learning plans based on their cognitive strengths and weaknesses. The possibilities are truly endless.

However, like any powerful tool, physiological signal processing comes with its own set of challenges. Data privacy and security are paramount, as these signals offer deeply personal insights into our health and wellbeing. Additionally, ensuring the accuracy and generalizability of algorithms across diverse populations is crucial to avoid exacerbating existing health disparities.

Despite these challenges, the potential of physiological signal processing for wellness is undeniable. As we move forward, collaboration between scientists, engineers, ethicists, and policymakers is essential to ensure this technology is developed and deployed responsibly and equitably. By harnessing the power of our body's whispers, we can unlock a future where personalized wellbeing is not a dream, but a reality accessible to all.

Tiwari and Falk investigated on Predicting Mental States in Real-World Settings: New Measures for Robust HRV Analysis. This paper tackles the challenge of accurately predicting mental states like stress and anxiety using heart rate variability (HRV) in uncontrolled, "real-world" environments. While wearable sensors offer exciting possibilities, factors like noise, physical activity, and other mental states can significantly hinder traditional HRV measures.

To address this, the researchers propose two new ways to compute HRV proxies: one focusing on spectral characteristics and the other on complexity features. These new measures, they argue, are more robust to the challenges of real-world data.

Testing on two separate datasets, the study shows that their proposed features not only outperform traditional HRV metrics but also provide complementary information, leading to significantly higher accuracy when combined. Additionally, feature ranking analysis confirms the importance of their new measures, especially those based on the high-frequency band, which proved crucial in the presence of confounding factors like fatigue and physical activity.

This study highlights the potential of advanced HRV analysis for reliable mental state assessment in realistic scenarios, paving the way for improved wellbeing monitoring and intervention in critical fields like healthcare and emergency response.

Sharan provided a mini review on AI Cough Detective: Can We Spot COVID-19 Early? This research review explores the potential of AI-powered cough analysis to detect COVID-19, particularly during the crucial infectious but asymptomatic stage. With the virus's long incubation period and rapid spread, identifying early carriers is crucial for containment. Daily testing being impractical, the authors investigate.

1. Can we automatically identify coughs in audio recordings? Yes, various algorithms like k-NN, neural networks, and random forests successfully detect coughs.
2. Can we distinguish COVID-19 coughs from other coughs? While promising, the "best" method remains unclear. Existing research uses datasets like ESC-50 and FSDKaggle to train algorithms, but further research is needed to refine accuracy and effectiveness.

This review highlights two key points.

1. Existing methods offer a promising foundation for building a highly accurate and accessible AI tool for COVID-19 cough detection.
2. More research is crucial to identify the optimal algorithm and address ongoing challenges like data limitations and the complexities of distinguishing cough types

By advancing this research, we can potentially develop a valuable tool for early COVID-19 identification, aiding public health efforts and individual wellbeing.

Varshney and Khan provided an interesting investigation on Decoding Silent Thoughts: A New Dataset for Imagined Speech Recognition. This research delves into the exciting field of imagined speech recognition, where brain signals are used to understand silent word formation. While still in its early stages, this technology holds immense potential for communication and assistive technology.

Recognizing the need for open-access resources, the authors present a new electroencephalography (EEG) dataset containing brain activity from 15 participants imagining six distinct words. These words were carefully chosen to maximize phonetic diversity and minimize emotional bias.

EEG signals were recorded while participants imagined speaking each word multiple times. A preliminary analysis showed encouraging results, with classification accuracy exceeding random chance for all participants. This suggests that the dataset captures distinct brain patterns associated with specific imagined words.

This openly accessible dataset provides valuable tools for researchers to advance imagined speech recognition. Its contributions include:

- Facilitating further research: Open availability encourages collaboration and accelerates progress in this emerging field.
- Enhancing understanding: The diverse word selection expands knowledge about how the brain represents different sounds and words.
- Boosting innovation: The dataset can be used to develop more accurate and robust imagined speech recognition algorithms.

By building upon this foundation, research on imagined speech can unlock new possibilities for communication and interaction, empowering individuals with limited speech capabilities and shaping the future of human-computer interfaces.

Song and Lee investigated on Deep Learning Detects Heartbeat Irregularities: Overcoming Challenges for Reliable ECG Analysis. Traditional ECG interpretation methods can be prone to errors and inefficiencies, potentially leading to misdiagnosis. This study highlights the potential of Deep Learning, specifically Convolutional Neural Networks (CNNs), to offer more accurate and automated ECG signal classification.

However, a major challenge lies in converting the one-dimensional ECG signal into a format suitable for 2D-CNNs, typically designed for image analysis. The study addresses this by:

- Comparing time-frequency methods: Evaluating different methods for transforming ECG signals into 2D representations, the study identifies the Ricker Wavelet function as the most effective, achieving an accuracy of 96.17% in detecting abnormal heartbeats (PVCs).

- Exploring fine-tuning techniques: The study demonstrates the significant improvement in performance gained by fine-tuning pre-trained CNNs on specific ECG datasets compared to directly applying them.

These findings offer valuable insights for researchers and practitioners working on ECG analysis using 2D-CNNs.

- Importance of hyperparameter selection: Choosing the right time-frequency function is crucial for accurate image representation.
- Effectiveness of fine-tuning: Adapting pre-trained models to specific tasks significantly improves performance.

The study emphasizes the potential of this Deep Learning approach for improving ECG analysis and suggests promising future directions.

- Advanced visualization techniques: Implementing better visualization methods can shed light on how CNNs learn to identify heartbeat patterns.
- Multiclass classification: Extending the approach to recognize various types of arrhythmias could significantly enhance its diagnostic utility.

By addressing the challenges and highlighting the potential, this study paves the way for more accurate and efficient ECG analysis using Deep Learning, ultimately contributing to better diagnosis and patient care.

Author contributions

PP: "Writing–original draft, Writing–review and editing"

The corrected **Editorial** appears below:

"In the rapidly growing field of wellness, a new frontier is emerging—where subtle physiological signals can be effectively used for personalized health management. The core of this revolutionary shift is the use of advanced algorithms to analyze the complex signals hidden in bodily cues, lay the foundation for novel approaches to improve health and wellness. In the present advanced technological era, wearable devices and health monitoring tools have progressed beyond their original functions, becoming smart tools that can accurately analyze real-time data streams. Imagine a situation where a smartwatch can detect even very small changes in heartbeat and provide individuals with personalized guidance to restore balance to their normal physiological state. This advancement exemplifies the significance of physiological signal processing—a field where wellness solutions are no longer reactive but are shifting towards intelligent and personalized strategies that are adapted to individual needs."

However, the field of physiological signal processing involves a wide range of applications, not just stress management. Researchers discover new ways to improve cognitive abilities, improve learning results, and recognize potential neurological disorders at an early stage through the examination of complex brain signal patterns and other physical indicators. Consider a scenario where athletes optimize their performance by utilizing real-time brain activity data, enabling customized training programs based on neural feedback. This has a practical impact for professional athletes and fitness enthusiasts alike, or where students receive customized learning approaches that align with their individual cognitive abilities, thereby improving their educational outcomes.

While the innovation and progression in the domain of physiological signal processing is exciting, it is important to acknowledge and address the ethical, privacy, and fairness concerns that arise from using these technologies. This includes considerations like the potential misuse of sensitive health data, algorithmic biases, and the need for robust data governance frameworks. It is also essential to ensure transparency and accountability in artificial intelligence-driven health technologies. Protecting personal information and data is critical to guarantee that the valuable perceptiveness obtained from physical signals are kept protected and used fairly. Additionally, it is important to take steps to guarantee that transformative technologies are available and fair, narrowing the gap between those who have access to them and those who do not, and enabling people from diverse backgrounds to gain the advantages of advancements in personalized wellbeing solutions.

This collection of research articles showcases innovative approaches aimed to improve the efficiency of physiological signal processing. These contributions explore new possibilities for analyzing both simulated and real signals obtained from various modalities.

Song and Lee conducted a comparative analysis of time-frequency transformation techniques for classifying ECG signals. The study examines various time-frequency transformation methods for electrocardiogram (ECG) signal classification, aiming to address the growing need for automated classification techniques in ECG interpretation. Using CNNs and the Ricker Wavelet function for image transformation, this study achieved a notable 96.17% accuracy in detecting premature ventricular contractions. This high level of precision points out the potential of advanced machine learning models to improve real-time ECG analysis and arrhythmia detection, particularly in critical care scenarios. The fine-tuning and hyperparameter selection indicate the importance of optimizing CNNs for ECG analysis in order to improve arrhythmia detection and diagnosis. Moreover, the research provides support for practitioners and researchers, highlighting the potential of CNNs in enhancing ECG interpretation accuracy and efficiency, particularly in emergency care settings. Further exploration of image-transformation methods and their application to wearable ECG monitors represent promising avenues for future research in this field.

Tiwari and Falk conducted a study on innovative metrics of heart rate variability, utilizing sub-band tachogram complexity and spectral characteristics, aimed at enhancing stress and anxiety monitoring in environmentally diverse settings. The authors propose novel methods for computing proxies of heart rate variability (HRV) to predict mental states like stress and anxiety in uncontrolled environments. They address challenges such as noise, artifacts, and confounding effects from other psychological and physical variables. Their proposed features, measuring spectral and complex properties of the autonomic nervous system, outperform benchmark HRV metrics and provide complementary information. These features, particularly those derived from the high-frequency band, are necessary for mental state assessment in real-world settings, as demonstrated across two separate datasets. Furthermore, the analysis of feature ranking indicates the significance of their novel metrics, particularly those derived from the high-frequency range, which demonstrated essentiality even in the presence of variables such as fatigue and physical exertion. This research brings out the promise of employing advanced HRV analysis techniques for accurate evaluation of mental states in practical settings, laying the groundwork for better monitoring of wellbeing and interventions in vital sectors such as healthcare and emergency services.

Varshney and Khan utilized a set of six phonetically distinct words with different phonetic characteristics to do an interesting study on the categorization of imagined speech. The study investigates the newly emerging topic of imagined speech, providing a pathway for command without auditory or tactile inputs. Acknowledging the shortage of publicly accessible datasets, the study presents an EEG dataset with six phonetically different and emotionally neutral imagined words. The study, which involved 15 participants, used a 64-channel EEG collection system to record EEG signals and analyze them for imagined speech classification. The results showed accuracy levels higher than chance. The significance of phonetic variation in capturing imagined speech nuances is highlighted by comparison with current datasets, which accelerates improvements in EEG-based recognition systems that have potential applications in other fields. For use in applications such as brain-computer interfaces and assistive technologies, this work increases imagined speech understanding and EEG-based recognition systems.

Sharan conducted a concise review on the automated discrimination of cough in audio recordings, offering detailed investigation into the subject matter. The COVID-19 virus has drastically changed the world, leading to lockdowns in many countries due to its high infectivity and long incubation period, prompting research on using artificial intelligence to differentiate between different types of coughs for early detection and diagnosis. This paper reviews different approaches to discriminate between types of coughs using smartphone microphones and discusses medical issues related to coughs worldwide. Researchers have explored deep learning techniques, including convolutional neural networks (CNNs) and neural architectures incorporating symptom and cough embeddings. It also covers various cough detection techniques, machine learning algorithms deep learning techniques, including convolutional neural networks (CNNs) and neural architectures, and the use of artificial intelligence to discriminate between types of coughs, including those related to COVID-19. The paper highlights the importance of using machine learning for timely and accurate testing of COVID-19 through cough audio. The researchers evaluated 204 papers. The team propose that more public data is needed to bring neural networks into medical practice, which can help in diagnosing COVID-19 through cough discrimination. This will reduce screening costs, increase accessibility, and improve testing to control the spread of the virus. While progress has been made in AI-driven cough discrimination, further advancements are needed to integrate these technologies effectively into medical practice, aiding in faster and more accessible COVID-19 screening.

Collectively, these studies illustrate the transformative role of advanced signal processing technologies in revolutionizing healthcare and wellness. They provide a foundation for developing more accurate, efficient, and personalized health monitoring systems. From predicting mental states in real-world settings to decoding silent thoughts and detecting heartbeat irregularities using deep learning, these advancements enrich our understanding of physiological signals. They also hold the potential to revolutionize healthcare delivery and patient care. By integrating AI-powered algorithms, wearable sensors, and novel datasets, these findings contribute to the evolution of healthcare systems. They promise improved diagnostics, early disease detection, and tailored interventions for individuals, ultimately leading to better health outcomes and better quality of life.

Author contributions

The guest editors collectively collaborated to decide the acceptance or rejection of papers, with each manuscript undergoing evaluation by different peer reviewers. Each editorial team member offered their comprehensions and revisions to refine the published paper."

The authors apologize for this error and state that this does not change the scientific conclusions of the article in any way. The original article has been updated.

Publisher's note