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J-BHI Special Issue on "Efficient Deep Learning Frontiers for Next-Generation Biomedical Sensing Intelligence"

The rapid advancement of sensing technologies has transformed healthcare by enabling the continuous collection of diverse physiological parameters, from in-hospital monitoring systems to wearable devices and ambient sensors. While these technologies have become indispensable in modern healthcare, their effectiveness hinges on large, well-annotated datasets with sufficient examples across all classes. However, annotating streaming data is prohibitively expensive, requiring significant expertise, time, and financial resources. Moreover, the inherent class imbalance in biomedical data poses persistent challenges for traditional machine learning models.

To address these issues, there is an urgent need for data- and label-efficient learning methods tailored to sensing informatics—paving the way for next-generation biomedical sensing intelligence. Emerging paradigms such as self-supervised learning, semi-supervised learning, few-shot learning, transfer learning, and prompt tuning minimize the need for extensive supervision and have already demonstrated remarkable success in computer vision and natural language processing. In parallel, the rise of foundation models—trained on large and diverse datasets and adapted with minimal fine-tuning—promises to significantly advance data- and label-efficient learning in healthcare sensing, leading to more accurate and efficient applications.

This special issue targets cutting-edge research at the intersection of computational methods and biomedical applications. By concentrating on data and label-efficient learning methods for sensing intelligence, this special issue addresses a critical and timely gap in the current literature. The target audience includes researchers and practitioners in biomedical engineering, healthcare informatics, machine learning, and related fields who are interested in developing and applying novel computational methods to healthcare sensing technologies.

Topics of interest include, but are not limited to, the following:

- Efficient foundation model development and deployment for biomedical sensing informatics
- Population-level studies leveraging data and label-efficient learning for biomedical sensing
- Novel self-/semi-/weakly supervised learning approaches for biomedical sensing informatics
- Advanced methods for addressing class imbalance and long-tailed distributions in biomedical sensing data
- Transfer learning, domain adaptation, and domain generalization methods for robust and scalable model adaptation
- Novel generative AI frameworks that enable efficient model training and inference in biomedical sensing
- Applications of efficient learning methods in specific domains, such as cardiac monitoring, sleep monitoring, human motion analysis, and neurological disorders

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