J-BHI Special Issue on "Revolutionizing Intelligent Disease Diagnosis: Generative Medical Image Processing, Evaluation, and Application"

Recent advances in generative artificial intelligence (AI) are transforming the landscape of biomedical imaging, particularly in the context of intelligent disease diagnosis. With the rise of models such as Generative Adversarial Networks (GANs), Variational Autoencoders (VAEs), and diffusion-based models, it has become increasingly feasible to synthesize medical images that exhibit visual and structural fidelity to real patient data. These generative technologies offer an innovative solution to long-standing challenges in intelligent disease diagnosis, most notably the scarcity of annotated data, data imbalance across disease types, and the need for privacy-preserving data sharing.

However, the integration of synthetic medical images into clinical workflows and diagnostic systems raises critical questions about quality, reliability, and clinical utility. Unlike conventional imaging data, AI-generated images require rigorous validation to ensure their authenticity and diagnostic relevance. Poorly generated or unverified images may introduce noise, bias, or misleading patterns into diagnostic models, potentially undermining patient safety. Therefore, the development of robust quality assessment frameworks for AI-generated medical images has emerged as a crucial step before such data can be used for training disease diagnosis models.

Moreover, the medical imaging community currently lacks standardized protocols for evaluating the realism and diagnostic informativeness of synthetic images. There is also a limited understanding of how to effectively integrate generative data with real-world clinical datasets to improve diagnostic performance, generalizability, and fairness. This presents an urgent research opportunity to design new evaluation metrics, domain-specific benchmarks, and hybrid modelling frameworks that make optimal use of both real and synthetic data sources.

This Special Issue aims to bring together researchers, clinicians, data scientists, and ethicists to explore this frontier at the intersection of medical image generation, quality evaluation, and diagnostic application.

Topics of interest include, but are not limited to, the following:
- Development and application of GANs, VAEs, and other models for synthesizing high-fidelity medical images.
- Establishing metrics and frameworks to evaluate the authenticity and clinical applicability of AI-generated images.
- Techniques for combining synthetic data with real patient data to enhance diagnostic algorithms.
- Using generative models to augment datasets, particularly for rare diseases, to improve diagnostic performance.
- Real-world implementations of AI-generated images in disease diagnosis, treatment planning, and patient monitoring.
- Exploring models capable of synthesizing data across multiple imaging modalities for comprehensive analysis.
- Developing methods to elucidate decision-making processes of generative models to foster clinician trust.

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