National Institute of Technology Rourkela

Progress Seminar

Seminar Title	: A Framework for Out-of-Clinic Heart Sound Analysis Using Attention Mechanisms and Adversarial Learning
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Venue	: Convention Hall (CS)
Date and Time	: 23 Jun 2025 (05.30 PM)
Abstract	: Accurate heart sound analysis is crucial for cardiovascular monitoring however, it is frequently affected by internal and external noise. To address this, we propose AUGAN-Net, a novel denoising model that enhances heart sound signals by using attention mechanisms within a U-Net architecture. The model is trained as part of a Generative Adversarial Network (GAN), where the attention-based U-Net acts as the generator, and a CNN discriminator distinguishes between clean and denoised signals. By processing noisy spectrograms, AUGAN-Net effectively suppresses noise. Experiments on public datasets show it outperforms recent denoising methods and improves classification accuracy by 16.40\% in practical settings. Although AUGAN-Net effectively reduces noise, it sometimes introduces additional noise in real-world conditions and tends to suppress low-amplitude signals. To overcome these challenges, we enhanced the model by replacing the additive attention block with a frequency-based attention mechanism. This modification enables the model to selectively focus on important frequency components, preserving frequency-specific heart components. Removing the additive attention also overcomes the issue of over-smoothing of the denoised signal. As a result, the model achieves more precise noise removal and better retention of critical signal features. Consequently, the improved model achieves notable gains in performance, with increases of 1.59 dB SNR, 1.37 dB SI-SDR, and a reduction of 0.064 in RMSE in real-world noisy conditions. This improvement enhances the robustness of the method for automatic heart disease detection in out-of-clinic settings.