Synthetic Seismocardiography Signal Generation by a Generative Adversarial Network

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Aims: Seismocardiography (SCG) is a non-invasive technique that measures the vibrations of the chest wall generated by the heart's mechanical activity. SCG signals provide valuable information about the heart's performance and have been used to derive many key cardiovascular indicators. The technique subsists in a very noisy environment where deep learning is often needed to extract important information, requiring large amounts of training data. Unfortunately, obtaining relevant SCG data can be challenging, time-consuming, and expensive, limiting its use in research and clinical potential. In this work, we aim to create synthetic SCG heartbeats that are realistic and diverse to affordably augment current SCG datasets.

Methods: SCG signals were recorded on the xiphoid process of 62 healthy subjects. We trained a Generative Adversarial Network (GAN) on real SCG heartbeats to produce synthetic SCG data. The architecture consisted of a deep convolutional GAN that was conditioned on an embedded identifier label for each subject to enable the generation of subject-specific heartbeats. The GAN was fine-tuned to optimize the quality and diversity of the generated SCG heartbeats.

Results: Our results demonstrated that the GAN could generate SCG heartbeats that closely resembled real SCG morphology with diverse physiological features similar to the natural variability observed in real SCG signals. This suggests that the artificial SCG heartbeats generated by the GAN could be used as a valuable tool for training and testing SCG analysis algorithms, without relying solely on real patient data.

Conclusion: The study presented a novel approach of using GANs to generate artificial SCG heartbeats. The use of GAN-generated SCG heartbeats has the potential to overcome the limitations of real SCG data availability, allowing for enhanced research and clinical applications of this valuable cardiac diagnostic technique.