Similarity Prediction of Intracardiac Electrograms Images Using Regression Model Based on Siamese Network Architecture

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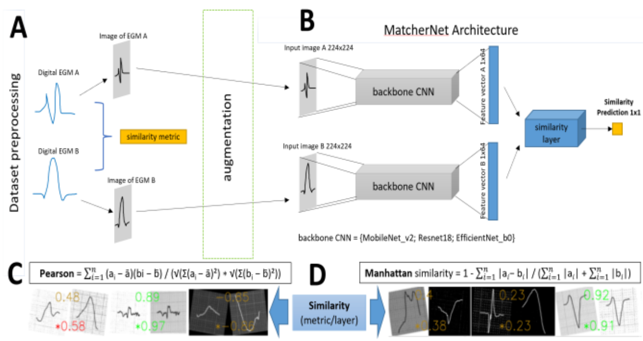
Background: Accurately localizing the source of cardiac arrhythmia is crucial for patient outcomes, and pace mapping is the only technique that allows this when the arrhythmia is non-inducible during the electrophysiological study. However, when presented as images by programmer devices, intracardiac electrograms (EGMs) from implantable cardiac devices can only be assessed for similarity by subjective eyeballing, highlighting the need for objective measures.

Aim: This study aimed to develop regression models for objective measuring similarities between images of two distinct signals to improve the precision of arrhythmia mapping.

Methods: We developed six regression models based on Siamese neural network architecture, using *Resnet18*, *Efficientnet_b0*, and *MobileNet_V2* as backbones and two types of custom similarity layers. We created a comprehensive library of augmented images from 17,421 digital intracardiac EGMs and generated datasets for both similarity metrics (Pearson correlation coefficient and Manhattan similarity), comprising 40,000 pairs of images with labels calculated using corresponding digital signals (Figure 1 A and B).



Results: The best performance showed the model with Efficientnet_b0 as the backbone for Manhattan similarity (MSE = 0,002, R^2 = 0.98) and Resnet18 as the backbone for Pearson correlation (MSE = 0,009, R^2 = 0.973). All models showed better prediction accuracy for Manhattan similarity (MSE_{mean}=0.002) as compared to Pearson correlation (MSE_{mean}=0.011).

Conclusion: Regression models based on the Siamese network architecture with custom similarity layers provide a promising tool for objectively measuring the similarity of EGM images acquired from implanted devices.