Comparative Analysis of 1-D and 2-D Deep Convolutional Neural Networks in Magnetocardiogram Classification for Coronary Artery Disease

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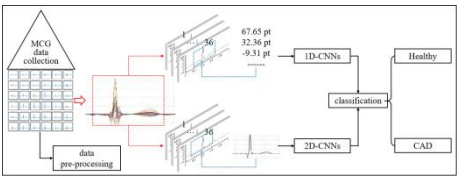
Coronary artery disease (CAD) imposes a substantial burden on healthcare systems, necessitating accurate diagnosis and effective treatment. Magnetocardiography (MCG) emerges as a promising non-invasive diagnostic tool for CAD. Nevertheless, the conventional approach to CAD diagnosis via one-dimensional (1-D) MCG is subjective and susceptible to inaccuracies. In response, a novel image-based MCG classification method has been introduced, leveraging a two-dimensional convolutional neural network (2-D-CNN) to distinguish MCG signals indicative of healthy cardiovascular function from those associated with CAD pathology. To further enhance the accuracy and robustness of CAD classification via MCG, we compared the classification performance of AlexNet, ResNet, and VGGNet networks using 1-D MCG and 2-D MCG images as inputs, respectively. Subsequently, to mitigate overfitting in 2-D networks, we initialized AlexNet-like, ResNet-like, and VGGNet-like architectures with weights pretrained on ImageNet. Our evaluation on the collected CAD dataset demonstrates that the proposed method achieves an accuracy of 95.2% and the 2-D-CNN outperforms the 1-D MCG, particularly in scenarios with limited data availability. Among the architectures under consideration, ResNet exhibited the most promising performance.



Overview of the proposed structure for 1D-CNNs and 2D-CNNs

Results of different types of deep learning models

Model	AlexNet		VGGNet		ResNet	
Metrics	F1	AUC	F1	AUC	F1	AUC
Tanh-1D	0.802	0.895	0.812	0.900	0.804	0.896
ELU-1D	0.794	0.891	0.794	0.891	0.749	0.871
Swish-1D	0.827	0.895	0.804	0.901	0.852	0.917
SeLU-1D	0.756	0.832	0.868	0.914	0.859	0.930
ReLU-1D	0.787	0.853	0.766	0.858	0.811	0.873
Random-2D	0.843	0.908	0.854	0.928	0.843	0.941
ImageNet-2D	0.868	0.940	0.845	0.946	0.894	**0.952**