A Method for Early Screening of Potential Coronary Artery Disease Based on Magnetocardiography

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Abstract

Magnetocardiography (MCG) offers a high-sensitivity, radiation-free, and noninvasive approach for assessing coronary artery disease (CAD), enabling detection of subclinical ischemia. However, its diagnostic accuracy is significantly limited by interindividual variations in cardiac electromechanical properties. To overcome these limitations, we introduce MagnetoCardioGraphy U-shaped Transformer Network (MCGUT-NET), a novel pixel-wise deep learning framework for initial CAD screening using MCG current density vector maps (CDVM). MCGUT-NET integrates a multi-resolution U-shaped architecture with a state-of-the-art Transformer encoder to enable comprehensive feature extraction from MCG CDVM while efficiently aggregating contextual information for global spatiotemporal feature integration. Evaluated via three-fold cross-validation on a prospective cohort of 150 patients with angiographically confirmed coronary artery occlusion and 150 matched controls, MCGUT-NET demonstrated robust performance: recall 97.08%, precision 95.07%, F1-score 96.06%, specificity 95.65%, and overall accuracy 96.33%. This diagnostic precision, particularly in subclinical stages, holds significant promise for improving early CAD detection. These advancements may reduce unnecessary invasive procedures and facilitate timely intervention in asymptomatic subclinical CAD patients.

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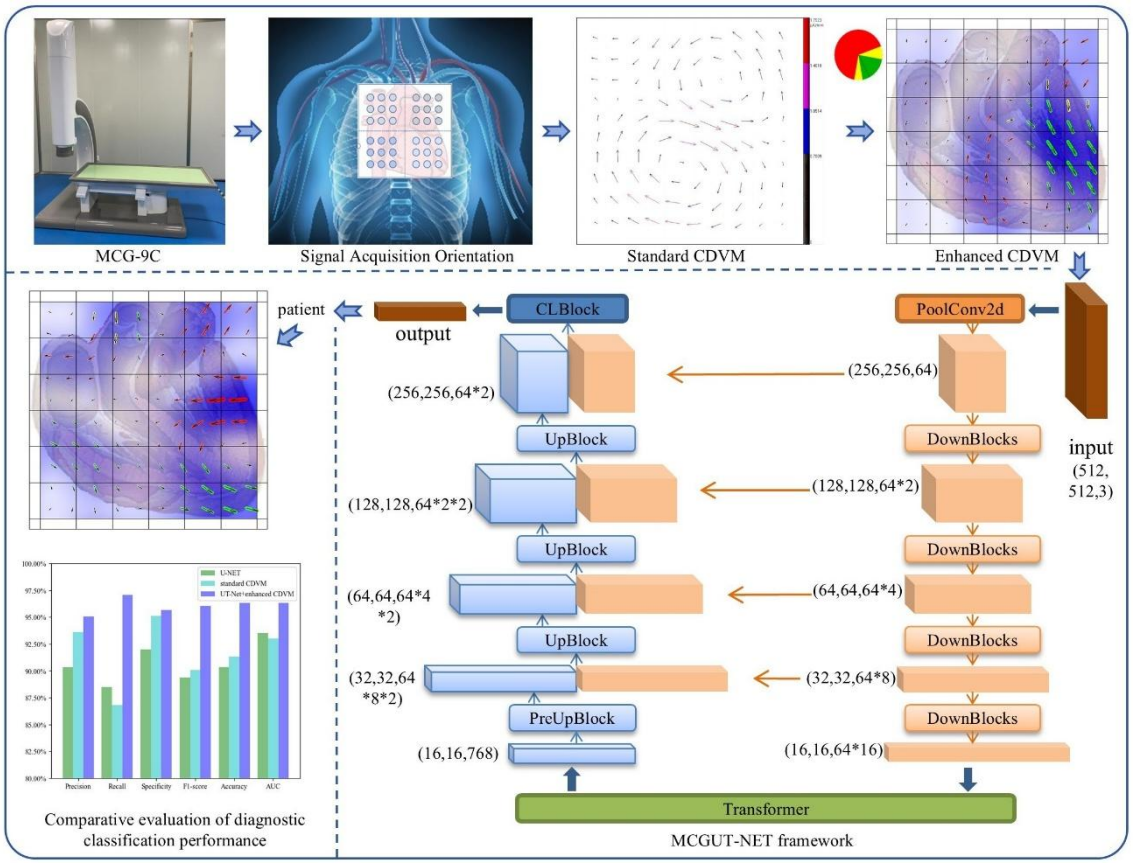

Innovative Description: Specially designed Magnetocardiography U-shaped transformer network (pixel-level) for enhanced current density vector maps analysis achieves 97.08% coronary artery disease recall.