

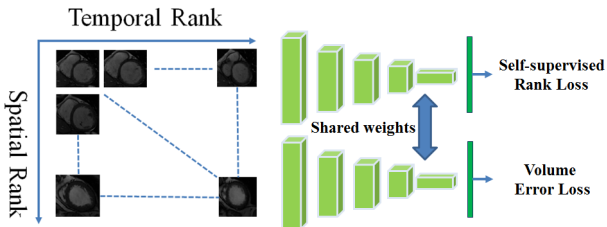
# A Novel Spatio-temporal Self-supervised Framework to Improve the Generalization Ability for Left Ventricle Volume Quantification Based on CMR Data

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**Aims:** The generalization ability of Automated Left Ventricle (LV) Volume Quantification Algorithm (ALVVQA) based on CMR images is crucial to accurate cardiac disease diagnosis, especially for variable CMR imaging conditions. However, improving the generalization ability of the state-of-the-art ALVVQA is still a challenging task, mainly because of different intensity distributions and limited labeled data. Hence, this study aims to propose an innovative method to improve the generalization ability of ALVVQA based on the proposed spatio-temporal self-supervised framework utilizing ranking information from abundant unlabeled CMR image data.

**Methods:** The proposed method is three-fold: (1) for the first time, we proposed a self-supervised framework to model the significant spatio-temporal correlation information of adjacent slices from CMR images. (2) We designed a deep learning network based on spatio-temporal ranking loss to achieve self-supervised training utilizing large-scale unlabeled CMR data. (3) An iterative optimization strategy was developed to achieve efficient model optimization. The proposed framework was trained and validated on multiple CMR image datasets.



**Results:** The proposed method was evaluated by mean absolute error (MAE). The results by comparison with ground truth on End-diastole Volume (EDV), End-systole Volume (ESV), and Ejection Fraction (EF) are shown as: EDV MAE=9.2±3.5ml, ESV MAE=7.2±4.9ml, EF MAE=4.7±2.1% in Kaggle 2016 dataset; EDV MAE=9.7±2.5ml, ESV MAE=7.9±4.5ml, EF MAE=5.5±2.9% in STACOM 2012 LV dataset; EDV MAE=10.2±2.5ml, ESV MAE=8.1±3.2ml, EF MAE=5.2±3.2% in ACDC dataset.

**Conclusion:** The proposed self-supervised framework improves the generalization ability of ALVVQA.