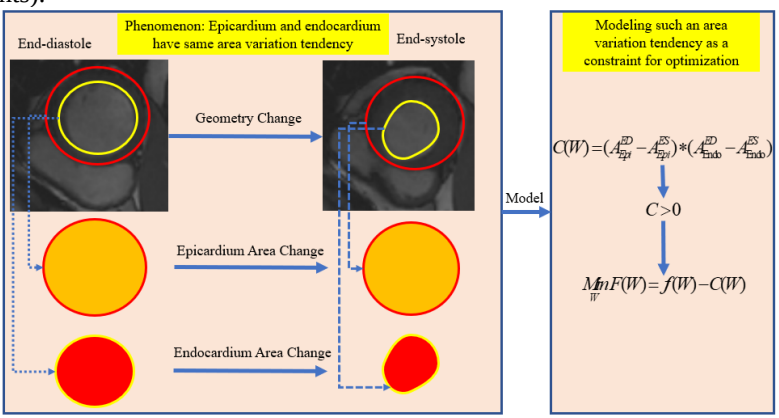
A Temporal Area Variation Regularized Deep Learning Network for Left Ventricle Segmentation on CMR

Gongning Luo, Shaodong Cao, Kuanquan Wang*, Henggui Zhang

Harbin Institute of Technology
Harbin, China

Aims: The automated segmentation of the left ventricular (LV) on MRI is a crucial step for the evaluation of LV structure and function. However, LV segmentation is still a challenging task, mainly because of inherent difficulties from the variable imaging conditions. Hence this study aims to propose an innovative approach to segment LV endocardium and epicardium based on the phenomena of temporal area variation correlation.

Methods: The proposed method is three-fold: (1) For the first time, we formulated a significant phenomenon that epicardium and endocardium have same area variation tendency into a temporal area variation constraint. (2) We designed a deep leaning network based on LSTM to model such a temporal area variation constraint. (3) An efficient optimization framework was developed to achieve end-to-end optimization. The deep learning network was trained and validated on cardiac MRI datasets from MICCAI 2012 LV segmentation challenge including 100 patients (50 train patients and 50 test patients).



Results: The proposed method was evaluated by the widely used criterions, including average Dice metric (ADM), average Hausdorff distance (AHD). The results by comparison with ground truth are as following: Endocardium: ADM=0.97±0.09, AHD=3.9±0.9mm; Epicardium: ADM=0.92±0.05, AHD=5.9±1.4mm;

Conclusion: The proposed LV segmentation method is novel, effective and accurate.