Improving Myocardial Scar Segmentation with End-to-End and Cascaded CNN using Hybrid Loss and Multi-Modality CMR Imaging

Farheen Ramzan[1,2], Chen (Cherise) Chen[1,2], Richard H. Clayton[1,2]

[1]Insigneo Institute for *in-silico*, Medicine, University of Sheffield, Sheffield, UK
[2]Department of Computer Science, University of Sheffield, Sheffield, UK

Abstract
Late gadolinium enhancement (LGE) CMR imaging is commonly used to locate and quantify ventricular scars for treatment planning after myocardial infarction. Effective treatment such as ablation can mitigate ventricular tachycardia risk. A deep learning based segmentation approach can provide an automated and efficient way to segment and assess the severity of ventricular scars. In this paper, we investigate various end-to-end and cascaded deep learning pipelines based on a self-configuring convolutional neural network for myocardial scar segmentation. We build a standardized framework to systematically a) study whether the cascaded pipeline (which first learns to capture cardiac anatomical structural information and then uses this as shape prior knowledge to refine the segmentation of abnormal scar and edema regions) works better than the end-to-end one-stage approach; b) analyze whether adding complementary CMR sequences including T2 and bSSFP can improve the segmentation accuracy; c) search for the best combination of existing loss functions to tackle class imbalance, the problem behind the task. Our results suggest that the end-to-end model works better than the cascaded one, which can achieve an average Dice score of 0.7257 when trained with a hybrid loss (based on the standard Dice and focalTvesky loss functions) for the scar segmentation task on the public MyOPS 2020 test dataset, outperforming the winner algorithm of the MyOPS challenge.