Modelling Multi-phase Cardiac Anatomy with Generative Deep Learning

Thalia Seale, Blanca Rodriguez, Vicente Grau and Abhirup Banerjee

Abstract:
The motion of the cardiac anatomy has a considerable influence on cardiac function and disease development. Previous contributions to the analysis of cardiac anatomy have mostly focussed on one or two phases from the cardiac cycle. However, a more complete understanding of cardiovascular disease could be achieved through the analysis and quantification of motion abnormalities in the anatomy over the full cardiac cycle. In this work, we propose a deep learning pipeline capable of reconstructing and generating continuous-time representations of the biventricular anatomy from a finite number of time points in the cardiac cycle. We demonstrate the proposed model provides interpretable quantification of geometric and motion characteristics of the anatomies. Our analysis of a dataset of 190 subjects shows that the reconstructions from the proposed model are accurate to sub-pixel resolution, with an average Chamfer distance of 1.71 (± 1.13) mm.