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Composition du Jury

Civilité	Nom	Prénom	Grade / Qualité	Rôle
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Résumé

Cardiovascular diseases remain one of the most serious health problems, motivating research to deepen our understanding of the myocardial function. To succeed, there is a need to get detailed information about the spatial arrangement of the cardiac tissue components. Currently, our understanding of the cardiac microarchitecture is limited by the lack of 3D descriptions of the cardiac tissue at the microscopic scale. This thesis investigates the 3D cardiac tissue microstructure using X-Ray µ-CT phase contrast imaging available at the ESRF. For the first time, 9 human cardiac left ventricle (LV) wall samples are imaged at an isotropic resolution (3.5 µm) and analysed. We focus on the description of the cardiac extracellular matrix (CEM) that is one of the main components of the tissue. The CEM includes: the endomysium that surrounds and separates individual myocytes and capillaries, the perimysium that surrounds groups of myocytes and the epimysium that surrounds the entire heart muscle. Each reconstructed sample is about 30 Gb which represents a large amount of data to process and display. To succeed, we developed an automatic image processing algorithm to binarise each sample by selecting the CEM. We extract statistical features of the ECM, mainly the thickness of the cleavage planes (CP) and the inter-CP distances. The results show that the local 3D arrangement of the CP differs according to their location in the LV (posterior, anterior, septal) and their distance from the apex (more complex). The thickness of the CP extracted from all the samples roughly ranges from 24 µm to 59 µm and the inter-CP distances from 70 µm to 280 µm with significant local variations of the standard deviation. Those new quantitative markers of the ECM of the human cardiac are of main interest for a better understanding of the heart function.