Semi-Automated Extraction of Canine Left Ventricular Purkinje Fiber Network

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The purkinje fiber network (PFN) is a very important conduction system in the endocardial surface of the ventricle, which is crucial in modeling ventricular tachycardia and fibrillation. Traditional medical imaging methods such as magnetic resonance imaging (MRI) or computed tomography (CT) fail to reveal the PFN information well especially when individual fibers are in dense fibrous regions or under noisy conditions. Another kind of method is to construct the PFN by the modeling method. i.e. modeling using the fractal structure of the endocardial surface photographs. However, among steps of the construction, PFN is extracted by the threshold value of the gray scale before the visualization, which needs the gray scale modification at some points to differentiate them from background points. In this work, we will introduce a semi-automated method for extracting PFN in the left ventricle, which is increasingly concerned in the pattern recognition and is proved to be feasible and efficient in the visualization and simulation of the heart. In the proposed method, a bank of filters with different orientations and scales is first used to lift the 2D image in a 4D orientation space, which is effective in disambiguating the crossing configuration problem of other lifting method. Then we use a geodesic based method to compute optimal paths in this 4D space, leading to a robust global segmentation of fibers. Our method can directly and naturally compute both centerlines and radii of fibers. With this method, a semi-automated scheme can be used to extract PFN conveniently by only manually providing the starting and ending points of purkinje fibers.