IX International Conference on Computational Bioengineering
ICCB 2022
P. R. Fernandes and J. Folgado (Editors)

Abstract ID 70

SIMULATION OF THE FULL CARDIAC CYCLE USING PARAMETRIC LEFT VENTRICLE MODEL

Bogdan Milićević[1], Miljan Milošević[2], Vladimir Simić[3], Miloš Kojić[4], Nenad Filipović[1]
[1]Faculty of Engineering, University of Kragujevac,
Bioengineering Research and Development Center, Kragujevac, Serbia
[2]Bioengineering Research and Development Center, Kragujevac, Serbia, Institute for Information Technologies, University of Kragujevac, Belgrade Metropolitan University
[3]Bioengineering Research and Development Center, Kragujevac, Serbia Institute for Information Technologies, University of Kragujevac, Kragujevac, Serbia
[4]Bioengineering Research and Development Center, Kragujevac, Serbia, Serbian Academy of Sciences and Arts, Belgrade, Serbia Houston Methodist Research Institute, Houston, USA
bogdan.milicevic@uni.kg.ac.rs, miljan.m@kg.ac.rs, vsimic@kg.ac.rs, mkojic42@gmail.com, fica@kg.ac.rs

Keywords: Cardiac cycle, Holzapfel experimental model, Hunter muscle model, 3D parametric model

Summary: The study of processes in the LV is of primary interest. Heart dysfunction, diseases, and heart failure are often related to the tissue of the left ventricle. Numerical methods can give an insight into the mechanical response of the left ventricle under different conditions, before the execution of clinical trials and experiments. In our work, we generated a parametric model of the left ventricle with an aortic and mitral valve. During diastole, we prescribed inlet velocities to the mitral valve of the left ventricle, while velocity at the aortic valve is zero. During the isovolumetric contraction, both valves are closed, inlet and outlet velocities are zero, and muscles are activated by the prescribed calcium concentration function. To acquire passive stresses we used Holzapfel experimental material model and to acquire active stresses, produced in the muscle fibers, we used the Hunter material model. After the isovolumetric contraction, the aortic valve opens and the blood is ejected from the left ventricle through the aortic valve. Our numerical model can be used to simulate a full cardiac cycle with patient-specific data such as dimensions of the left ventricle and different velocities and calcium concentration functions, which can potentially help evaluate drug effects and clinical scenarios.