



## Human circulatory system in terms of a closed-loop hydraulic structure

**Wiktor Parandyk, Donat Lewandowski, Jan Awrejcewicz**

*Abstract:* The primary objective of this study is to examine a human/mammal circulatory system. Considering structures and operating rules of a natural, biological circulatory system it can be easily stated that it is possible to create an analogous hydromechanical dynamic system. Noting the similarities and taking into account blood and vessels features there is mathematical model given that include differential equations of the fluid mechanics. Additionally a stand/analog consisted of hydraulic and electronics elements is presented. A prototype of the circulatory system is proposed with a construction of the heart as a bicapsular pumping unit powered by external pneumatic system. Apart from the mechanical system construction and mathematical model, an attempt was made to suggest a continuous distribution of the vascular system geometry to recreate it in order to calculate properly a modeled blood vessels variable parameters. Solving the equations describing biological system, gives opportunities to examine some external and internal risk factors, model input signals and activity under different conditions.

---

<sup>1)</sup> Wiktor Parandyk, M.Sc. (Ph.D. student): Lodz University of Technology, Department of Automation and Biomechanics, 1/15 Stefanowski St., 90-924 Łódź, POLAND (parandyk.wiktor@gmail.com), the author presented this work at the conference.

<sup>2)</sup> Donat Lewandowski, Professor: Lodz University of Technology, Department of Automation and Biomechanics, 1/15 Stefanowski St., 90-924 Łódź, POLAND (donat.lewandowski@neostrada.pl).

<sup>3)</sup> Jan Awrejcewicz, Professor: Lodz University of Technology, Department of Automation and Biomechanics, 1/15 Stefanowski St., 90-924 Łódź, POLAND (jan.awrejcewicz@p.lodz.pl).