EMBC Workshop Proposal

Workshop Type (select one):

- [x] Full Day Workshop
- [ ] Half Day Workshop

Workshop Title:

Modeling complex models of physiology in Modelica and Physiolobrary and creating web-based simulators in Bodylight.js

Workshop Organizer Name & Affiliation:

Tomas Kulhanek, Ph.D., Charles University in Prague

Workshop Organizer/Speaker Name & Affiliation 1:

Tomas Kulhanek, Ph.D., Charles University in Prague

Workshop Organizer/Speaker Name & Affiliation 2:

prof. Jiri Kofranek, M.D. Ph.D., Charles University in Prague

Workshop Organizer/Speaker Name & Affiliation 3:

Workshop Organizer/Speaker Name & Affiliation 4:

Workshop Organizer/Speaker Name & Affiliation 5:

Workshop Organizer/Speaker Name & Affiliation 6:

Theme (Select one):

- ○ 01. Biomedical Signal Processing
- ○ 02. Biomedical Imaging and Image Processing
- ○ 03. Micro/Nano-bioengineering; Cellular/Tissue Engineering & Biomaterials
- ◉ 04. Computational Systems & Synthetic Biology; Multiscale modeling
- ○ 05. Cardiovascular and Respiratory Systems Engineering
- ○ 06. Neural and Rehabilitation Engineering
- ○ 07. Biomedical Sensors and Wearable Systems
- ○ 08. Biorobotics and Biomechanics
- ○ 09. Therapeutic & Diagnostic Systems and Technologies
- ○ 10. Biomedical & Health Informatics
- ○ 11. Biomedical Engineering Education and Society
- ○ 12. Translational Engineering for Healthcare Innovation and Commercialization

Workshop Synopsis— Max 2000 Characters

Physiolibrary is an open-source Modelica library usable for mathematical modeling of cardiovascular circulation, metabolic processes, nutrient distribution, and other system mainly for the lumped-parameter approach.

Bodylight.js is free and open-source set of libraries and tools to produce independent web component embedding model with numerical solver exported from Modelica using FMI standard, graphical objects created in Adobe Animate exported to EaselJS and HTML elements.

First part of the workshop will introduce acausal and object oriented Modelica language using OpenModelica and Dymola tools. Presentation and hands-on sections will demonstrate how to convert existing models from SBML, CellML to Modelica. And Howto build selected models using Modelica and Physiolibrary of 1) cardiovascular system dynamics 2) common biochemical reactions 3) body thermal transfers with blood flow 4) liquid volume penetrating through semipermeable membrane 5) integrative approach to connect all the domain models together.

Second part of the workshop will introduce Bodylight.js libraries and tools. In hands-on section we will create a web-based simulator embeding selected model from first section of the workshop with some scenario and visualisation.

Attendees should bring their own computers to participate in the hands-on part of the workshop and 1) either install OpenModelica (https://www.openmodelica.org) tool in advance 2) or install virtual machine using scripts at https://github.com/creative-connections/Bodylight-VirtualMachine

[1] Mateják, M., et al. (2014). Physiolibrary -Modelica library for Physiology. In Proceedings 10th Modelica Conference, March 10-12, 2014, Lund, Sweden, https://www.physiolibrary.org
[2] Šilar J, et. al: Development of In-Browser Simulators for Medical Education: Introduction of a Novel Software Toolchain, Journal of Medical Internet Research https://www.jmir.org/2019/7/e14160/, https://bodylight.physiome.cz