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MINIMALLY INVASIVE ENDOVASCULAR PROCEDURES SIMULATIONS USING 1D HAEMODYNAMICS

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Network blood flow simulation in terms of 1D models [1, 2] requires a correct structural scheme of the 3D individual vascular network. Such network can be produced from 3D vascular domain extracted from MRI data. Two state-of-the-art software libraries provide tools for such functionality, commercial code Amira and open source code VMTK. We use VMTK for 3D volume extraction from individual MRI data for the vascular centerlines reconstruction. For patient-specific vascular network reconstruction we adopt the open source library VMTK to produce vascular centerlines on the basis of MRI data followed by the developed automated skeletonisation algorithm. The produced vascular graph possesses all necessary individual geometric data for 1D hemodynamic simulations. It's properties were made accessible by user-friendly interface based on the multi-touch sensor panel hardware.

The anatomical model and it's functional properties (elasticity and hydraulic resistance) were validated and fitted basing on the patient-specific MRI and ultrasound data provided by I.M. Sechenovs First Moscow State Medical University and N.V. Sklifosovsky Scientific Research Institute of First Aid.

As a practical example of the personalized hemodynamic model we present simulations of real revascularization procedure for the case of thigh artery stenting caused by atherosclerotic occlusion. We also demonstrate our approach to hemodynamical impact analysis by examples of minimally invasive procedures, such as cava-filter placement, artificial embolisation of arterio-venous malformations, blood gases monitoring during laparoscopy procedures and enhanced external counterpulsation procedure.

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