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HEMODYNAMICS SIMULATIONS IN THE CEREBRAL VENOUS NETWORK: TOWARDS THE UNDERSTANDING OF BLOOD FLOW IN A COMPLEX GEOMETRY

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In recent years, significant progress has been performed in blood flow simulations within geometrical models of vessels (see, for instance [2] and references therein for a sound and up-to-date monograph on this topic). However, several open issues still exist, in particular related to an accurate analysis of these complex multi-physics, multi-scale phenomena in complex geometries. Moreover, although there are several publications assessing blood flow in the arterial network, to the best of our knowledge there are little studies exploring the venous part.

In the present work, our aim is to provide a contribution to the modeling and simulation of blood flow in the venous compartment of the cerebral network. Several difficulties have to be taken into account: the asymmetric and considerably more various pattern of the venous network compared to the arterial one, and the highly individual variations of the venous outflow [5].

To accomplish the above objective, we consider the Navier-Stokes system of PDEs, valid in large and medium-sized cerebral veins [3], under the following standard assumptions: (i) the blood density is constant; (ii) the flow is incompressible and isothermal; (iii) the Newtonian model is used for blood flow. Blood flow in rigid veins is then computed, following the methodology presented in [1] and using adequate values of the flow governing parameters and boundary conditions. The computational framework builds upon FEEL++[1] *Finite Element Embedded Language in C++* [4], a flexible generic library which

[1] www.feelpp.org

allows for arbitrary order continuous and discontinuous Galerkin methods in 1D, 2D and 3D, seamlessly in parallel.

We will present several numerical illustrations of large scale simulations of blood flow in complex geometries and give insight into the difficulties related to a deeper understanding of the clinical relevance of the solutions.

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