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Modeling of flows in a network of thin tubes

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Navier-Stokes equations in thin tube structures may be applied to model blood flow in the arterial system. An asymptotic analysis of the time dependent three dimensional Navier-Stokes equation in a thin tube structure [1,2] leads to two types of equations for the pressure on the graph of the structure: one of them is a well-known Reynolds equation on the graph with Kirchhoff junction conditions at the nodes (it appears at the slow time scale) ; another equation is a new one proposed by G.Panasenko and K.Pileckas in [1,2]. It couples a one-dimensional, nonlocal in time problem on the graph with a heat equation in the cross-section of the tubes. We investigate numerical schemes for this problem. We also compare numerically this asymptotic model with the full 3D Navier-Stokes equations.This research might be useful to reduce the computational complexity in certain hemodynamical problems.

1. Panasenko G., Pileckas K., Asymptotic analysis of the non-steady Navier-Stokes equations in a tube structure.I. The case without boundary layer-in-time. *Nonlinear Analysis, Series A, Theory, Methods and Applications*, **122**, 2015, 125-168, http://dx.doi.org/10.1016/j.na.2015.03.008

2. Panasenko G., Pileckas K., Asymptotic analysis of the non-steady Navier-Stokes equations in a tube structure. II. General case. *Nonlinear Analysis, Series A, Theory, Methods and Applications*, **125**, 2015, 582-607, http://dx.doi.org/10.1016/j.na.2015.05.018