Seminar of the University of Wuppertal

Parallelization of the asymptotic partial domain decomposition in thin tube structures: numerical experiments

by

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The method of asymptotic partial domain decomposition for thin tube structures (finite unions of thin cylinders) is revisited. Its application to the newtonian and non-newtonian flows in great systems of vessels is considered. The possibility of a parallelization of its algorithm is discussed for linear and nonlinear models. An asymptotic analysis of the Stokes equations and the Navier-Stokes equations set in thin tube structures (some finite unions of thin cylinders with ratio $\varepsilon \ll 1$ of the diameter to the length) has been developed in [1]-[2]-[3]-[4]. It shows that for small Reynolds numbers the flow is approximately a Poiseuille function at some distance of the ends of the cylinders. These Poiseuille functions are glued by some boundary layer type junction functions in the neighborhoods of the ends of the cylinders. This structure of the solution allows to justify for these flows the method of asymptotic partial decomposition of domain (MAPDD) replacing the unknown velocity by the poiseuille functions at the distance δ from the "nodes" (ends points of cylinders). This δ is estimated as $O(\varepsilon|ln\varepsilon|)$ and so this method reduces considerably the computational cost of the problem. This approach may be applied for such tremendous systems as the blood circulation system. Here we discuss the possibility to parallelise the computations in MAPDD approach. Although the MAPDD is justified rigorously only for the newtonian fluids; we study its applicability to the non-newtonian fluids developping some numerical experiments.

keyword: Navier-Stokes equations, thin structures, method of asymptotic partial domain decomposition, multi-scale models, models of hybrid dimension, parallelization.

Bibliography

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