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Analysis of perfusion, microcirculation and drug transport in tumors. A computational study. PAOLO ZUNINO, Department of Mechanical Engineering and Materials Science, University of Pittsburgh, LAURA CATTANEO, MOX, Department of Mathematics, Politecnico di Milano — We address blood flow through a network of capillaries surrounded by a porous interstitium. We develop a computational model based on the Immersed Boundary method [C. S. Peskin. Acta Numer. 2002.]. The advantage of such an approach relies in its efficiency, because it does not need a full description of the real geometry allowing for a large economy of memory and CPU time and it facilitates handling fully realistic vascular networks [L. Cattaneo and P. Zunino. Technical report, MOX, Department of Mathematics, Politecnico di Milano, 2013.]. The analysis of perfusion and drug release in vascularized tumors is a relevant application of such techniques. Blood vessels in tumors are substantially leakier than in healthy tissue and they are tortuous. These vascular abnormalities lead to an impaired blood supply and abnormal tumor microenvironment characterized by hypoxia and elevated interstitial fluid pressure that reduces the distribution of drugs through advection [L.T. Baxter and R.K. Jain. Microvascular Research, 1989]. Finally, we discuss the application of the model to deliver nanoparticles. In particular, transport of nanoparticles in the vessels network, their adhesion to the vessel wall and the drug release in the surrounding tissue will be addressed.

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