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Two-level approach for modeling blood flow in liver / liver lobule

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In this work a two-level approach of blood flow in the liver lobule is introduced. Authors consider two levels of problem: the first level is connected with liver (part of liver for simplicity) and the second level describes blood flow process in liver lobule. Structurally, the liver is made up of smaller blocks, which can be described in a different ways. One of the most commonly used description is "classic lobule". Each lobule has approximately hexagonal shape, with central vein in the center, surrounded by a sinusoidal space. Portal tracts are located on the angles of the hexagon, each consisting of a branch of the hepatic portal vein, a branch of the hepatic artery and the bile duct. Blood from the portal tracts flows through the sinusoidal space and empties into the central vein of each lobule. Therefore it is necessary to consider two minimum net of veins on liver lever, one for portal tracts and second for central veins. On lobule level we already have possibility to consider interaction between this two nets. The proposed model is built on the basis of a double porosity model for lobule. The computational algorithm is based on finite-element approximation in space and explicit-implicit approximation in time. Authors also consider possibilities of using neural networks for one of levels for reduce computational cost. Results of numerical experiments for FEM approach and neural network approach are demonstrated.