Departamento de Matemática

Centro de Matemática e Aplicações

Seminário

Three-dimensional velocity field for blood flow using the power-law viscosity function

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Resumo

The three-dimensional model associated with blood flow where viscosity depends on shear-rate, such power-law type dependence, is a complex model to study in terms of computational optimization, which in many relevant situations becomes infeasible. In order to simplify the three-dimensional model and as an alternative to classic one-dimensional models, we will use the Cosserat theory related with fluid dynamics to approximate the velocity field and thus obtain a one-dimensional system consisting of an ordinary differential equation depending only on time and on a single spatial variable, the flow axis. From this reduce system, we obtain the unsteady equation for the mean pressure gradient depending on the volume flow rate, Womersley number and the flow index over a finite section of the tube geometry. Attention is focused on some numerical simulations for constant and non-constant mean pressure gradient using a Runge-Kutta method and on the analysis of perturbed flows. In particular, given a specific data we can get information about the volume flow rate and consequently we can illustrate the three-dimensional velocity field on the constant circular cross-section of the tube. Moreover, we compare the three-dimensional exact solution for steady volume flow rate with the corresponding one-dimensional solution obtained by the Cosserat theory.

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Palavras chave:

Cosserat theory; blood flow; shear-thinning fluid; one-dimensional model; power-law model; volume flow rate; mean pressure gradient.

Referências:

[1] D.A. Caulk and P.M. Naghdi, Axisymmetric motion of a viscous fluid inside a slender surface of revolution, Journal of Applied Mechanics 54, 1987, pp. 190--196.

[2] F. Carapau and A. Sequeira, 1D Models for Blood Flow in Small Vessels Using the Cosserat Theory, WSEAS Transactions on Mathematics 5(1), 2006, pp. 54--62.

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