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Applications to biological networks of adaptive Hagen-Poiseuille flow on graphs

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Transport networks are some of the many dynamical systems that can be described using networks and graphs, and key aspects of these networks can be described using hydrodynamical equations. Specifically, some can be described using the Hagen-Poiseuille law, like blood network models or network models that describe Physarum polycephalum, an acellular protist that grows in a network-like pattern, and whose networks are efficient, robust and cheap.
This work intends to analyse the dynamics of such network models, based on the Hagen-Poiseuille adaptive formalism for viscous incompressible flows proposed by R. Almeida & R. Dilão in Phys. D: Nonlinear Phenom. 436 (2022), p. 133322. More explicitly, the goals of the project are to analyse: phase transitions on graph structures, the effect of saturation on the elasticity functions characterising veins, the topological changes of vein networks to time-dependent sources, the dynamic characterisation of Murray's law and models of Physarum's periodic processes (peristalsis and shuttle streaming) in vein networks.

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