Second-Order Finite-Volume Numerical Scheme for Blood Flow PDEs With Stenosis At The Boundary

Overview: In this MATLAB code we implement second-order finite-volume numerical scheme for blood flow in an artery of length L, where the blood enters the artery at the left end ($x=0$) and exists the artery at the right end ($x=L$). The blood flow Q is restricted by stenosis phenomenon on the right boundary ($x=L$).

Description of the MATLAB File: BloodFlow_SecondOrder_FiniteVolumeScheme_HLL.m

Step 1. First define the number of finite volume elements (or intervals) given with notation n.

Step 2. Next define the time steps and the total time.

Step 3. Next initialise all the vectors for all time and space.

Step 4. Define inflow $Q_{\rm in}(t)$ at $x=0$.

Step 5. Use For-Loop to compute values at each time instance and at each spatial element.

Step 6. Calculate the boundary values using inflow and characteristics of the hyperbolic PDE (corresponding to equations (4) and (5) of the article).

Step 7. Calculate the fluxes using the HLL flux scheme as in [1, Section 3] at the finite volume.cell interfaces (corresponding to flux term $F(A,Q)$ in equation (17)).

Step 8. Next update the values for the j time instance based on the values at j-1 time instance.

Step 9. Using the semi-implicit method update the flow variable (corresponding to source term $S(A,Q)$ in equation (17)).

Step 10. Plot flow and cross-sectional area.

PS: The folder also contain Flux function file needed to calculate fluxes at each cell interface.