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Assessment of numerical frameworks for turbulence transition modelling in pulsatory flows

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Pulsatory flows have been the subject of investigation for several decades [1], [2], with research being mainly focused on high Reynolds number flows, either in, or near, the fully turbulent regime, while research into low Reynolds number flows, like the ones encountered in arterial flows, has been fairly limited. Consequently, the modelling of transition to turbulence is still an open issue in hemodynamics.

As a result, the application of numerical techniques in hemodynamics research has only had a limited effect in advancing understanding of arterial flows, primarily due to the use of oversimplifications and ambiguity in the modelling of turbulence and transition to turbulence.

It is therefore the aim of this research to assess the viability of current turbulence modelling approaches, primarily various Reynolds averaged Navier-Stokes (RANS) models and Large Eddy Simulation (LES), for the modelling of arterial flows. Several commonly used RANS and LES approaches are used to simulate pulsatory flows and the results are compared with available experimental and direct numerical simulation data. This is done by employing the cell-centred finite volume method implemented within the open-source code OpenFOAM [3]. An assessment of the frameworks considered, and proposals for future research directions are given based on the presented results.

References

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