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Uncertainty Quantification methodology for blood flow in elastic vessels.

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We develop a Stochastic Finite Volume [1] - Arbitrary DERivative [2] (SFV-ADER) methodology for computational Uncertainty Quantification (UQ) in the context of high-order finite volume schemes on Cartesian grids in its general framework for systems of balance laws. An illustration of its second order version for the viscous Burgers' Equation with uncertain viscosity coefficient is given in detail with examples of different deterministic initial conditions. Results and features of the resulting scheme are discussed, as well as attainment of theoretically expected convergence rate is demonstrated. We then extend the SFV-ADER method to a non-linear hyperbolic system that constitutes a one-dimensional (1D) mathematical model of blood flow in elastic vessels [3], assuming uncertainties in parameters. Results are then compared with measurements in a well-defined 1:1 replica of the largest arteries in the human systemic circulation. By a 99-confidence level, a severe influence in parameters fluctuations is appreciable in pressure rates, while its secondary effect in shaping flow rates becomes visible expecially in terminal branches. This suggests the primary influence of terminal resistances over the accuracy of model predictions, leading to future developments.

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