Elementary waves, Riemann invariants, new conservation laws and numerical method for the blood flow through artery

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Abstract

In this paper we consider the quasi linear hyperbolic system of two coupled nonlinear equations that arises in blood flow through arteries. This model has already been reflected the human circulatory system. We first study the parametrization of elementary waves. We formulate the Riemann invariants corresponding to the blood flow model. Furthermore we present an interesting and important motivation of the Riemann invariants. We represent the diagonal form corresponding to the blood flow model, which admits the existence of global smooth solution for this system. We introduce further application, namely a new conservation laws for the blood flow model. Finally, we propose a simple and accurate class of finite volume scheme for numerical simulation of blood flow in arteries. This scheme consists of predictor and corrector steps, the predictor step contains a parameter of control of the numerical diffusion of the scheme, which modulate by using limiter theory and Riemann invariant, the corrector step recovers the balance conservation equation. The numerical results demonstrate high resolution of the proposed finite volume scheme (Modified Rusanov) and confirm its capability to provide accurate simulations for blood flow under flow regimes with strong shocks.

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