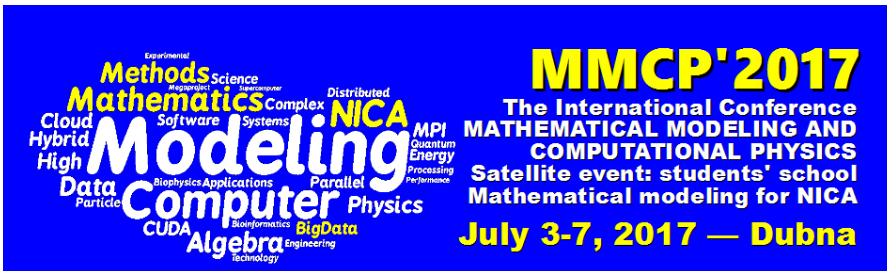

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Methods of investigation of equations that describe waves in tubes with elastic walls and application of the theory of reversible and weak dissipative shocks

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Different models of tube with hyper elastic walls are investigated. They are tube with controlled pressure, tube filled by incompressible fluid, tube filled by compressible gas. Complete membrane model and non-linear hyper elastic model are used for walls of tube. Linear model of plate is used in order to take bending resistance of walls into account. Equations are solved numerically. Walls of the tube are treated as incompressible. Compressibility of material of walls and viscosity of material and gas of fluid may be taken into account. Simplified hyperbolic equations and Boussinesq-type equations are derived. Stability of solitary waves for the case of controlled pressure is investigated. Analysis of solutions of Riemann problem is made for all models. It is opened that in all cases typical non-dissipative shock structures are predicted by the theory of reversible and weak dissipative shocks. Three-layer centered time and space reversible numerical scheme and similar two-layer space reversible numerical scheme with approximation of time derivatives by Runge-Kutta method are used. It is opened that in the case controlled pressure both methods gives good results. But in the case of fluid-filled and gas-filled tube numerical edge instability appears. Numerical scheme based on Runge-Kutta method was used in these cases. It was opened that this scheme possesses non-correct scheme dissipation. Increase of disturbances is observed for long-time calculations. It was opened that there are no such increase if predictor-corrector method with predictor for complete time step is used. In the case of Runge-Kutta method predictor is calculated for half of time step. Hence the same program may be used. But this method is method of first order approximation. It possesses essential numerical viscosity. Non-dissipative shocks become weak dissipative shocks if this method is used. Method of correction of numerical schemes by inclusion of terms with high-order derivatives was developed. Order of approximation of numerical scheme is not changed. Good results for tubes filled by inviscid fluid and gas were obtained. It seems that such approach may be used in all cases of models with evolutional equations. Result of the investigation is a step to development of general approach of calculations of equations with dispersion. This work is supported by Russian Fund for Basic Research, grant 15-01-04357a.

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