

عنوان مقاله:

Investigation of Fluid-structure Interaction by Explicit Central Finite Difference Methods

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خلاصه مقاله:

Fluid-structure interaction (FSI) occurs when the dynamic water hammer forces cause vibrations in the pipe wall. FSI in pipe systems due to Poisson and junction coupling has been the center of attention in recent years. It causes fluctuations in pressure heads and vibrations in the pipe wall. The governing equations of this phenomenon include a system of first order hyperbolic partial differential equations (PDEs) in terms of hydraulic and structural quantities. In the present paper, a two-step variant of the Lax-Friedrichs (LxF) method, and a method based on the Nessyahu-Tadmor (NT) are used to simulate FSI in a reservoir-pipe-valve system. The computational results are compared with those of the Method of Characteristics (MOC), Godunov's scheme and also the exact solution of linear hyperbolic four-equation system to verify the proposed numerical solution. The results reveal that the proposed LxF and NT schemes can predict discontinuity in fluid pressure with an acceptable order of accuracy. The independency of time and space steps allows for setting different spatial grid sizes with a unique time step, thus increasing the accuracy with respect to the conventional MOC. In these schemes, no Riemann problems were solved and hence field-by-field decompositions were avoided which led to reduced run times compared with Godunov scheme.

کلمات کلیدی:

Fluid-structure Interaction Lax-Friedrichs Method Nessyahu-Tadmor Method Water Hammer

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