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A Finite Element/Finite Volume Method for Dam-Break Flows over Deformable Beds

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Abstract : A coupled two-layer finite volume/finite element method was proposed for solving dam-break flow problem over deformable beds. The governing equations consist of the well-balanced two-layer shallow water equations for the water flow and a linear elastic model for the bed deformations. Deformations in the topography can be caused by a brutal localized force or simply by a class of sliding displacements on the bathymetry. This deformation in the bed is a source of perturbations, on the water surface generating water waves which propagate with different amplitudes and frequencies. Coupling conditions at the interface are also investigated in the current study and two mesh procedure is proposed for the transfer of information through the interface. In the present work a new procedure is implemented at the soil-water interface using the finite element and two-layer finite volume meshes with a conservative distribution of the forces at their intersections. The finite element method employs quadratic elements in an unstructured triangular mesh and the finite volume method uses the Rusanove to reconstruct the numerical fluxes. The numerical coupled method is highly efficient, accurate, well balanced, and it can handle complex geometries as well as rapidly varying flows. Numerical results are presented for several test examples of dam-break flows over deformable beds. Mesh convergence study is performed for both methods, the overall model provides new insight into the problems at minimal computational cost.

Keywords : dam-break flows, deformable beds, finite element method, finite volume method, hybrid techniques, linear elasticity, shallow water equations
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