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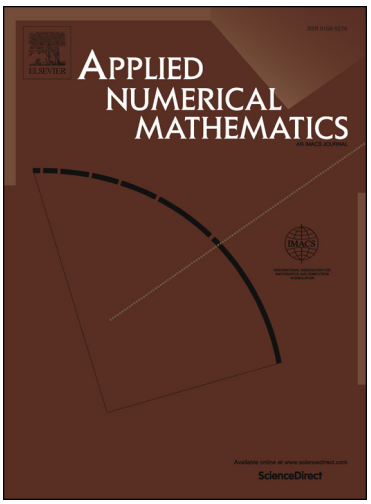

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A reduced proper orthogonal decomposition (POD) element free Galerkin (POD-EFG) method to simulate two-dimensional solute transport problems

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Abstract

One meshless method based on the variational weak form is the element free Galerkin method. The element free Galerkin (EFG) method is similar to the finite element method but the test and trial functions for the EFG method are chosen from moving least squares (MLS) approximations. The shape functions of MLS approximation don't have the δ-Kronecker property thus the essential boundary conditions (Dirichlet boundary conditions) can not be applied, directly. On the other hand, there are some shape functions that have the mentioned property. One of these functions is the radial point interpolation method (RPIM). In the current paper, we employ the shape functions of RPIM as the test and trial functions. We apply the EFG method based on the RPIM (EFG-RPIM) for solving two-dimensional solute transport problems. To reduce the used CPU time, the proper orthogonal decomposition (POD) approach has been combined with the EFG-RPIM technique. Also, the unconditional stability and convergence of POD-EFG-RPIM method are proved by the energy method. Finally, some numerical results have been reported to show the efficiency and computational order of the new method.

Keywords: Element free Galerkin, Solute transport problems, Error estimate, Stability, Convergence, Proper orthogonal decomposition, Radial point interpolation method.

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