Hybrid Multiscale Method for Coupled Geomechanics and Reservoir Simulation

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Abstract

Detailed descriptions of mechanical response are important for reservoir management. Such high resolution characteristics impose severe computational challenges to computer resources. Therefore, the demand for accurate and efficient coupled geomechanics and reservoir simulation technique is widely increasing in the real-field applications. In this paper, we develop a hybrid multiscale algorithm for flow simulation of poroelasticity problems. Two sets of multiscale basis functions for the coupled problems are constructed using the hybrid finite element method-mimetic finite difference method. The displacement basis functions are constructed over coarse cells for solid skeleton using multiscale finite element method (MsFEM). The conservative pressure and velocity basis functions are then constructed for flow field using the multiscale mimetic finite difference method, which will couple with the MsFEM. Though multiscale basis functions, the hybrid multiscale methods can not only reach a high efficiency, but also finally generate a high-resolution and detailed solution on the full fine-scale grid. Numerical results are presented to demonstrate the accuracy and efficiency of the proposed hybrid multiscale method.

Keywords

Multiscale finite element method; Multiscale mimetic finite difference method; Coupled geomechanics and reservoir simulation;