A domain decomposition solution of soil-structure interaction problems in porous media considering uncertainties

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ABSTRACT

Damage sustained in recent earthquakes, such as the 1995 Kobe Earthquake, indicate that the seismic behavior of a structure is highly influenced by the response of the superstructure, the response of the foundation and the response of the underlying soil. This interrelation becomes even more significant when considering the effect of water pore pressure and the uncertainties involved in the estimation of both the soil skeleton parameters and the pore properties.

While the solution of models involving porous media is considered an open problem, it has been shown that the most reliable approach for solving such problems is the monolithic approach [1,2] where all field equations are solved simultaneously. However, this approach is computationally expensive and requires the solution of large scale algebraic systems. On the other hand, stochastic methodologies such as the spectral stochastic finite element method (SSFEM) have been shown to outperform the standard Monte Carlo methods when combined with an efficient solution strategy [3].

In order to solve the large algebraic systems occurring from problems involving both porous media and uncertainties, a family of state-of-the-art parallel domain decomposition methods are used that combine the advantages of both direct and iterative solvers [4]. In this work, these solvers are presented along with numerical examples that showcase their parallel performance.

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