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Numerical modeling of transient poroelastic waves in the low frequency range

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A numerical method is proposed to simulate the propagation of transient poroelastic waves across heterogeneous media, in the low frequency range. A velocity-stress formulation of Biot's equations is followed, leading to a first-order differential system. The latter is splitted in two parts: a propagative one discretized by a fourth-order ADER scheme, and a diffusive one solved analytically. Near sources and interfaces, a space-time mesh refinement is implemented to capture the small scales of evolution of the diffusive slow compressional wave. Lastly, an immersed interface method is implemented to accurately model the jump conditions at interfaces between the different media. Numerical experiments in one and two dimensions are shown, with porous/porous or fluid/porous interfaces. Comparisons with analytical solutions confirm the efficiency of the approach.
[1] G. Chiavassa, B. Lombard, J. Piraux, Numerical modeling of 1-D transient poroelastic waves in the low-frequency range, soumis au J. Comput. Appl. Math., (2007), disponible sur http://hal.archives-ouvertes.fr/hal-00193103/fr/