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Convolution Quadrature Based Boundary Element Method for Quasi-Static Poroelasticity

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The reasons to use a CQM-based BEM instead of usual time-stepping procedures are either to include inelastic material behavior or to improve the stability of the time-stepping procedure. The main difference to usual time-stepping BE formulations is the way to solve the convolution integral appearing in most time-dependent integral equations. In the CQM formulation, this convolution integral is approximated by a quadrature rule whose weights are determined by the Laplace transformed fundamental solutions and a multi-step method. For quasi-static problems in poroelasticity there is no need to apply the CQM because time-dependent fundamental solutions are available. However, these fundamental solutions are highly complicated yielding to very sensitive algorithms. Therefore, it is promising to apply the CQM also on the quasi-static integral equations in poroelasticity. Applying the usual spatial discretization on the poroelastic integral equations and using the CQM for the temporal discretization yields a time-stepping algorithm. The algorithm shows no stability problems and behaves well over a broad range of time step sizes.

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