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Treating volumetric inequality constraint in a continuum media with a coupled X-FEM/Level-Set strategy

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Some mechanical problems involve inequality kinematic constraint. This study deals with an original approach to handle those difficult problems. The main issue is the treatment of the variational inequalities due to the fact that the constrained area is a priori unknown. After a brief statement of the constraint minimization problem studied here, we will describe an augmented lagrangian method classically used for contact problems, that we applied to our problem, using an Active Set algorithm [1]. However, we will show that in our particular case, this method offers a poor rate of convergence and the stability rely on hard to set parameters. Next, we will present our new approach. The strategy consists in turning the minimization problem under inequality constraint into a shape equilibrium one. The strategy proposed here is to replace the inequality constraint by an equality constraint over an unknown domain. Hence, we assimilate the media to a two elastic phases media. On one phase, no constraints are imposed and on the second one an equality constraint is imposed. Each phase has a mechanical behaviour that depends on the state of the constraint (active or inactive). With the help of the configurational mechanic and the notion of configurational force, the shape of the boundary between each phase is found iteratively. Numerically, the constraint zone is represented by a level-set [2] and the X-FEM [3] is used to properly enrich the displacement field on the interface. Several numerical tests will be shown to compare the two methods (figure 1). Finally some first results toward the extension of the method to contact problems will be described.

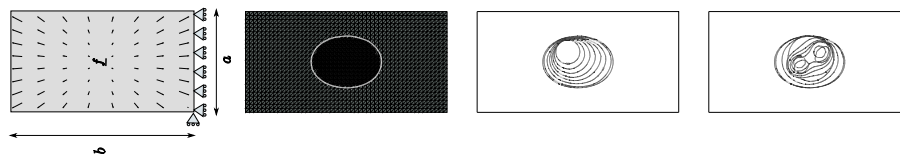


Figure 1: Application of the method on a simple case. From left to right, mechanical setting, mesh and constrained zone for both methods, evolution of the constrained zone during the iteration for two different starting configuration using the new method.

References

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