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# Numerical analysis of crack problem in compressible hyperelastic materials, with Xfem Cut-off method

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## ABSTRACT

One of the most used methods to study cracked domains, is the classical finite elements. Nevertheless, the polynomial functions employed in this method are incapable to detect singularities present due to the localization of highly stresses around the crack tip, especially under ultimate states of load. Then, a local mesh refinement becomes necessary in order to obtain satisfactory results, which, consequently, increases computation time and costs. To prevent this new problem, we propose through this work, the use of the eXtended Finite Elements, thanks to its ability to easily detect singularities by enriching the classical fem basis by the analytical form of the solution. The Xfem variant used here is the Xfem cut-off, which makes a smooth transition between enriched and non-enriched areas, and enables finding satisfactory results, without increasing outstandingly the number of freedom degrees or deteriorating the associated linear system conditioning (see [3]).

This study is devoted to compressible hyperelastic materials at large strain, and two constitutive laws was taken into account, the Generalized Blatz-Ko law and the Ciarlet-Geymonat law. The asymptotic crack tip displacement solutions for this two potentials are given by [1] and [2], and serve to enrich the Xfem basis. Numerical simulations show that Xfem cut-off leads to optimal rate of convergence, and decreases considerably estimation errors, when compared to the classical fem. Besides, the order of singularity was determined numerically by minimizing energy, and confirms prediction given by asymptotic analysis in [1] and [2].

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