A local projection stabilized extended finite element approximation of cracked bodies submitted to contact with Tresca friction

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Key Words: *Local projection stabilization method, extended finite element method, Tresca problem.*

ABSTRACT

Only a few works have been devoted to contact and XFEM, and they mainly use two methods to formulate contact problems: penalty method and Lagrange multiplier method. A uniform discrete inf-sup condition is theoretically required between the finite-element space for the displacement and the one for the multiplier in order to obtain a good approximation of the solution. To overcome these difficulties many method are used. we can cite the Barbosa Hughes stabilization where the stability is assured by adding supplementary term involving an approximation of the normal derivative of the primal variable on the crack (see [4] and [1]). The local projection stabilization technique introduced in [2] where the difference of the multiplier with its projection on some pre-defined patches is penalized to ensure the stability of the problem. This stabilized technique is fully consistent and affect only the multiplier equations in a manner that is independent of the problem to be solve. The purpose of this contribution is to applied the local projection stabilization technique to the enriched finite-element approximation of Tresca contact problems of cracked elastic bodies. we introduce the formulation of the unilateral contact problem with Tresca friction on a crack of an elastic structure. Then we present the elasticity problem approximated by both the enrichment strategy introduced in [3] and the local projection stabilized Lagrange multiplier method. we study the existence and uniqueness of the solution of the stabilized formulation. Also we show a priori error estimates for three different discrete contact conditions (the study is restricted to piecewise affine and constant finite element methods). Finally, we present some numerical experiments on a very simple situation. We compare the stabilized and the non-stabilized cases for different finite-element approximations. The influence of the stabilization parameters is also investigated.

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