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A NITSCHE STABILIZED FINITE ELEMENT APPROACH FOR MODELING FRICTIONAL CONTACT CONSTRAINTS

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Modeling frictional effects between fractured surfaces has remained a long standing challenge. In a finite element framework, these frictional effects arise as variational inequalities and developing stable and accurate methods that honor these inequalities is a non-trivial challenge. The most convenient numerical schemes result in spuriously oscillating interfacial tractions and make coupled simulations intractable. We propose a stabilized approach inspired by Nitsche's approach for this class of problems, and highlight its accuracy, efficiency, and robustness over conventionally used methods. The proposed method combines the attractive features of two traditionally used approaches *viz.* penalty and augmented Lagrange multiplier methods. Unlike an augmented Lagrange multiplier method, this method is purely displacement-based and does not increase the size of the system-matrix nor does it require an outer-augmentation loop. Furthermore, unlike a penalty method, the method is variationally consistent and therefore results in a much stronger enforcement of the non-interpenetration constraint. For simplex elements, the method is free of user-defined tunable parameters and the method parameter is systematically eliminated through numerical analysis in the proposed stabilized formulation. Finally, we present the results of several benchmark numerical experiments over both aligned and embedded interfaces to validate the proposed approach.

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