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AN IMPROVED CONTACT ALGORITHM FOR MULTIMATERIAL CONTINUUM CODES

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ABSTRACT

Realistic and accurate modeling of contact in the presence of large deformations and severe distortions is beset with many computational challenges. Relevant applications where this situation arises include vehicle crash dynamics, ballistic penetration and perforation, structure-blast interaction, warhead fracture and fragmentation, and orbital debris impact. The natural framework for description of surfaces afforded by Lagrangian finite element methods makes it the method of choice for many applications in this class. However, the large distortions often result in elements that develop large aspect ratios, twist, or even invert; making the application of traditional finite element approaches impossible in many cases. Due to this deficiency, Eulerian and arbitrary Lagrangian-Eulerian (ALE) methods have become popular, particularly in the last decade. The tradeoff with Eulerian or ALE approaches is the added complexity associated with permitting multiple materials to occupy a single finite element.

One of the difficulties associated with allowing multiple materials in a single element is satisfying contact constraints at the interface between the materials. Historically this problem has been ignored by replacing the materials present in the element with an *equivalent single* material. The heuristic techniques applied to determine the material properties of this fictitious material usually have little or nothing to do with contact and as a result, often result in unphysical behavior.

A relatively new idea introduced by one of the authors [1,2] is to use distinct velocity fields for each material and satisfy contact inequality constraints approximately. No mixed-element thermodynamic or constitutive models are used in the formulation. Instead, the governing equations are solved for each material, with the appropriate inequality constraints applied at intermediate locations within the elements. What arises from this is a set of coupled equations that are approximated by an uncoupled, reduced form. Using an approximate form of the Lagrange multiplier method, these constraints are applied to the conservation equations. In recent work we have examined the influence of the uncoupling approximation on the fidelity of solutions obtained by this method. This was accomplished by comparing solutions to the fully coupled equations solved using an iterative approach. Results from this development will be presented in

this talk.

REFERENCES

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