Smart Materials in Fast Varying Dynamic Problems

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Abstract: Mechanical problems involving contact between an object and an obstacle, particularly dynamic problems describing the impact of deformable bodies, are generally difficult to solve both analytically and numerically. Meanwhile, the demand from engineers forces the design of materials with non-classical properties. Such materials may have unusual geometric microstructures or contain filler materials with properties strongly dependent on the speed of deformation. This affects the atypical response of the structure in rapid processes.

We will present analytical solution and derive characteristic matrices for numerical solutions to problems in which material properties change momentarily and locally due to the movement of a wavefront. While we can obtain analytical solutions in a narrow time interval, numerical solutions allow us to track the process of wavefront reflections from edges. The work contains analytical results, numerical formulations, and simple experimental examples demonstrating the effectiveness of modifying the rheological properties of the material upon contact with a rigid obstacle.