Peridynamic modelling of metal materials under high-speed velocity impact

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Abstract

High-speed velocity and hypervelocity impact have drawn so much attentions of the researchers in the past decades. The problem often emerges from fields of industry and aerospace, such as impact molding and the defense of space debris. It is cumbersome to repeat the phenomena in the lab and capture the dynamic progress during the impact using the experiment manner. Thus it is quite practical for numerical methods to make prediction and representations for understanding the fundamentals of the mechanical behaviors of the materials, which then serves as a guidance for structure and material design. In this work, the non-ordinary state-based Peridynamic framework is adopted to model the metal material with rate-dependent effect under high strain-rate. Classic constitutive relationship is incorporated to model the metal and alloy materials under finite deformation. The objectivity of the constitutive update with Lagrangian description are discussed, as well as the material failure criterion. Benchmark tests are carried out to validate the validity of our model. Demonstrations and discussions are made against the experimental results to show the ability of the proposed approach.

Keywords: Computational, Peridynamics, fracture, metal, material failure, high-speed impact