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PROCEEDINGS

A Modified Rate-Dependent Peridynamic Model with Rotation Effect for Dynamic Mechanical Behavior of Ceramic Materials

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ABSTRACT

As a mathematical expression of the dynamic mechanical behavior, the constitutive model plays an indispensable role in numerical simulations of ceramic materials. The current bond-based peridynamic constitutive models can accurately describe the dynamic mechanical behavior of partial ceramic materials under impact loading, however, the predicted value of the Poisson's ratio is 0.25, which is not true for most of the known ceramic materials. Herein, based on the existing bond-based peridynamic constitutive model, the current study utilizes the description of tangential bond force and considers the influence of bond force on rotation to accurately predict the Poisson's ratio of different types of ceramic materials, e.g., SiC and B4C. Moreover, a novel and comprehensive damage assessment criterion during tensile-shear and compressive-shear is established, and the rate-dependent bond-based peridynamic constitutive model is improved, which realized the optimization of the original model. Then, the improved rate-dependent bond-based peridynamic constitutive model is employed to conduct several numerical experiments, including frontal impact, edge-on impact and uniaxial compression experiments. The simulation results are compared with the classical finite element model and experimental results, demonstrating the superiority of the optimized model in terms of accuracy and versatility. The optimized model describes the damage behavior of different ceramic materials and provides theoretical bases for future work in penetration behavior of ceramics.

KEYWORDS

Peridynamics; ceramic penetration behavior; poisson ratio; crack growth; failure criteria

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