Journal of Applied Mechanics

Preface

Special Issue on Advances in Impact Engineering

It is now established that computational tools are indispensable to augment experimental techniques for the analysis of complex structures under dynamic loading. Many new computational techniques are currently being developed and new applications in the fields of impact and shock loadings are emerging. In this special issue of *Journal of Applied Mechanics*, we have assembled a number of recent studies in the field of impact engineering. The present issue attempts to provide a glimpse into the wide range of engineering problems in the field of *Impact Engineering* that mainly can be dealt with by employing computational techniques. A brief overview of each article published in this special issue is provided here.

In "Dynamic Fracture of Shells Subjected to Impulsive Loads," Song and Belytschko present a novel numerical model based on the extended finite element method for the simulation of dynamic cracks in thin shells. The capability of the proposed model is demonstrated by comparing the numerical results with the elasto-plastic crack propagation experiments involving quasi-brittle fracture.

In "Fluid-Structure and Shock-Bubble Interaction Effects During Underwater Explosions Near Composite Structures," Young et al. investigate the role of fluid-structure interaction and shock-bubble interaction in the response of composite structures during underwater explosions using a 2D Eulerian–Lagrangian numerical method. A systematic study is carried out to highlight the effect of Taylor's FSI, the bending/stretching deformation, the core compression, and the boundary condition, on the response of composite structures.

In "Finite Element Analysis of Plugging in Steel Plates Struck by Blunt Projectiles," Kane et al. investigate the fracture of various steel structures impacted by blunt projectiles using the explicit solver of a non-linear finite element code, which incorporates a thermoelastic-thermoviscoplastic constitutive model with coupled or uncoupled ductile damage.

In "The Crushing Characteristics of Square Tubes With Blast-Induced Imperfections: Part 1—Experiments" and "The Crushing Characteristics of Square Tubes With Blast-Induced Imperfections: Part II—Numerical Simulations," Yuen and Nurick study the crushing characteristics of square tubes, with blast-induced imperfections, subjected to axial load. In the experimental part of the study, different imperfection types are created on opposite sides at mid-length of a square tube by means of localized blast loads. In the numerical part, the response of tubes with imperfection is modeled under dynamic axial loading using the finite element method. The work provides insight into the role of imperfection on energy absorption characteristics and deformation mechanisms of the tube.

In "Computational Modelling of Damage Development in Composite Laminates Subjected to Transverse Dynamic Loading," Forghani and Vaziri present a robust computational model for the response of composite laminates to high intensity transverse dynamic loading using a cohesive type tie-break interface for modeling delamination. The proposed model also simulates intra-laminar damage mechanisms within the sub-laminates in a smeared manner using a strain-softening plastic-damage model. The validity of the developed model is assessed by comparing the results with experiments and its capabilities are highlighted by providing several numerical examples.

In "The Influence of Material Properties and Confinement on the Dynamic Penetration of Alumina by Hard Spheres," Wei et al. study the roles of plasticity and micro-cracking on penetration resistance of alumina using the computational protocol devised by Deshpande and Evans. The results provide significant insight into the behavior of alumina and new avenues for building structures and materials for applications that require high penetration resistance.

In "Integrated Experimental, Atomistic, and Microstructurally-Based Finite-Element Investigation of the Dynamic Compressive Behavior of 2139 Aluminum," Elkhodary et al. study the microstructural mechanisms related to the high strength and ductile behavior of 2139-Al using three interrelated approaches. In the computational part, a specialized microstructurally-based finite-element analysis and a dislocation-density based multiple-slip formulation are conducted. The numerical simulations and experimental observations provide fundamental insight into the microstructural mechanisms of shear strain localization in 2139-Al behavior due to dynamic compressive loads.

In "Energy and Momentum Transfer in Air Shocks," Hutchinson presents a series of one-dimensional studies to reveal basic aspects of momentum and energy transfer to plates in air blasts. A simple conjecture, backed by numerical simulations, is put forward related to the momentum transmitted to massive plates and dimensionless parameters are selected to highlight the most important groups of parameters that govern the energy and momentum transfer in air shocks.

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