COLLABORATIVE RESEARCH CENTER 837

INTERACTION MODELING IN MECHANIZED TUNNELING

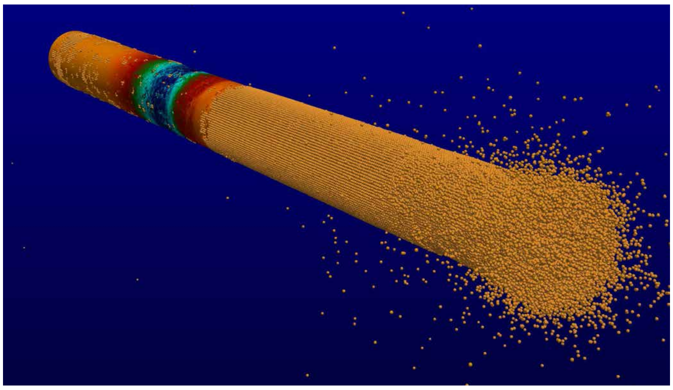
RUB

MULTISCALE MODELING AND SIMULATION OF FRACTURE AND FRAGMENTATION – APPLICATION TO FUSED SILICA GLASS

Prof. Michael Ortiz

(California Institute of Technology, USA; Hausdorff Center for Mathematics, Germany)

29.11.2017 – 13:30 - 16:00
IC 03 / 606



The anomalous shear modulus behavior of fused silica glass has been a long-standing topic of investigation. Likewise, the anomalous pressure dependence of the strength of amorphous silica has also received considerable attention. In order to formulate a model of material behavior, we perform molecular dynamics (MD) calculations designed to data-mine information regarding the permanent deformation, both volumetric and in shear, of amorphous silica. Based on these observations, we formulate a critical-state constitutive model for fused silica and fit material parameters to the MD data. Remarkably, the MD data reveals that the limit yield surface is nonconvex. The treatment of this non-convexity necessitates a fundamental extension of classical plasticity. We consider the implications of this extension and utilize tools from the Direct Methods in the Calculus of Variation to characterize explicitly the effective behavior at the macroscale. The resulting effective model of plasticity, together with consideration of brittle fracture of fragmentation, provide the basis for the simulation of failure waves in glass rods impacting a rigid target. The calculations are carried out using the Optimal-Transportation Meshfree (OTM) method combined with the eigenerosion approach to fracture. This computational approach proves effective at predicting the experimentally observed failure wave speeds and complex fracture and fragmentation patterns, while simultaneously allowing for complex material behavior.

The Guest Lecture by Prof. Ortiz is followed by four presentations by Ph.D. and PostDoc researchers:

COUPLED TWO-SCALE SIMULATION OF MULTIPHASE STEEL	A. Gandhi and D. Balzani
VARIATIONAL INTERFACE MODEL IN SOLID AND HYDRAULIC FRACTURING PROBLEMS	I. Khisamitov and G. Meschke
A RELAXATION-BASED APPROACH TO DAMAGE MODELING	P. Junker and K. Hackl
MULTISCALE MODELING OF TRANSPORT AND DETERIORATION IN POROUS MATERIALS	J.J. Timothy and G. Meschke

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