MATERIALS SCIENCE & ENGINEERING
TEXAS A&M UNIVERSITY

MSEN 681 SEMINAR SERIES

4:10 PM • APRIL 29 • RDMC 202

Dr. José A. Rodríguez-Martínez

Associate Professor

The Department of Continuum Mechanics and Structural Analysis

The University Carlos III of Madrid

A comparative study of the dynamic fragmentation of non-linear elastic and elasto-plastic rings

In this seminar we will present a comparative analysis of the processes of dynamic necking and fragmentation in elasto-plastic and hyperelastic ductile rings subjected to rapid radial expansion. For that purpose, we have carried out finite element simulations using the commercial code ABAQUS/Explicit. Expanding velocities which range between 25 and 600 m/s have been investigated. The elasto-plastic material and the hyperelastic material are modelled with constitutive equations which provide nearly the same stress-strain response during monotonic uniaxial tensile loading, and fracture is assumed to occur at the same level of deformation energy. The computations have revealed that, while the number of necks nucleated in the elasto-plastic and hyperelastic rings is similar, the mechanisms which control their development are significantly different. In the elasto-plastic rings several necks are arrested due to the stress waves which travel the specimen after the localization process has started, and thus the number of fractures in the ring is significantly lower than the number of incepted necks. On the contrary, these stress waves do not stop the development of any neck in the hyperelastic rings. The elastic energy released from the sections of the ring which are unloading during the localization process fuels the development of the necks. Hence, for the whole range of investigated velocities, the proportion of necks that develop into fracture sites is much greater for the hyperelastic rings than for the elasto-plastic ones. The comparison between the numerical results obtained for both materials brings to light the roles of elastic unloading and plastic dissipation in multiple necking and fragmentation processes.

Dr. Rodríguez-Martínez holds a position of Associate Professor at the Department of Continuum Mechanics and Structural Analysis of the University Carlos III of Madrid, where he is the head of the Nonlinear Solid Mechanics group (https://www.nonsolmecgroup.com/). He has co-authored more than 50 per-reviewed papers that have been published in renowned journals of Solid Mechanics: JMPS, IJP, IJSS, MOM, IJES, PRSA… and participated in numerous international conferences and workshops where he has delivered various invited lectures. Dr. Rodríguez-Martínez has been chairman of 3 international symposiums devoted to the dynamic behaviour of solids and structures, and has organized thematic sessions in several international conferences. He was awarded in 2017 with an ERC Starting Grant which aims at unravelling the mechanisms which govern the fragmentation of metallic materials at high strain rates. Moreover, he is currently the coordinator of two other European Grants (consortiums), within the framework of the H2020-MSCA actions, to study, in collaboration with researchers of different European and American institutions, the flow behavior and fracture of engineering materials subjected to extreme loading conditions. The main topics of research Dr. Rodríguez-Martínez are the constitutive modelling of metallic materials at high strain rates, the analysis of plastic instabilities and fracture in ductile solids subjected to dynamic loading, and the large amplitude vibrations of nonlinear elastic structures.