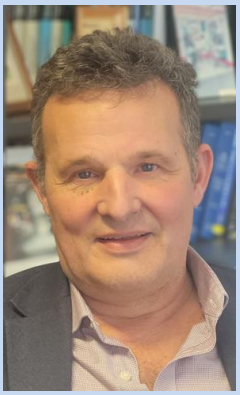
KTH SOLID MECHANICS KEYNOTE SEMINAR; Thursday, June 26th, 16.15; https://kth-se.zoom.us/j/66846580810

Javier Bonet

"First order conservation law formulations in solid dynamics: applications and stable SPH discretization"

The presentation will describe the latest advances in the novel conservation based formulation of solid and structural dynamics developed by the author. The formulation differs from standard displacement based approaches in using linear momentum and strain like variables as problem unknowns. The resulting mixed equations are written in the form of a system of first order conservation laws in a manner similar to Computational Fluid Dynamics (CFD). This formulation has been exploited by the authors to improve the discretization techniques of solid dynamics resolving issues such as incompressible locking and poor stress convergence. A variety of common CFD discretization techniques have been exploited for this purpose, from upwind finite volume to Petrov-Galerkin finite elements. Recent work has applied these concepts to problems such as crack propagation and contact mechanics as well to the stabilisation of Smooth Particle Hydrodyamics (SPH) models using the concept of ballistic energy as a convex entropy like variable. Extensions to Arbitrary Eulerian Lagrangian mechanics within the framework of first order conservative formulations will also be presented. The lecture will provide examples based on elasticity and thermoelasticity using the Mie-Gruneisen equation of state. A number of benchmark test will be provided that demonstrate that all variables conserved, and their conjugates (that is stresses and temperature) converge at the same rate as the velocities and displacements. This is in contrast to standard displacement based formulations where strains and stresses converge at one order below the rate of displacements. The application of the technology to dynamic crack propagation in linear elasticity will show that analytical models predicting intersonic and supersonic crack propagation with Mach like shock waves can be developed, which closely resemble experimental results observed and reported in the literature.



Professor Javier Bonet is the General Director of CIMNE. He was previously Deputy Vice Chancellor, Research & Enterprise, at the University of Greenwich in London and Professor of Computational Engineering and Head of the College of Engineering at Swansea University. He graduated from the Polytechnic University of Catalonia in Barcelona, Spain as a Ingeniero de Caminos Canales y Puertos and holds a PhD from Swansea University under the supervision of Prof. O.C. Zienkiewicz. Javier Bonet is a Fellow of the Learned Society of Wales and has received prestigious awards such as the SEMNI prize in recognition of his scientific and academic trajectory and the Zienkiewicz award of the International association of Comp. Mechanics. He was a panel member of the 2021 Research Excellence Framework Exercise in the UK and a member of Editorial Boards of prestigious journals, such as Archives in Comp. Methods in Engineering, Comp. Mechanics and Particle Mechanics. Javier Bonet research interest covers computational and numerical methods applied to nonlinear solid mechanics, such as Smooth Particle Hydrodynamics, stabilised Finite Element and Finite Volume techniques. He has over 120 publications listed in Scopus attracting over 7000 citations, resulting in a Scopus H-index of 43.