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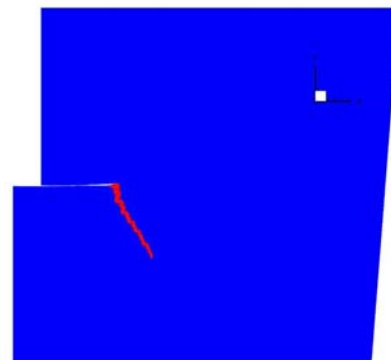
Short Bio

Fernando Fraternali is an associate professor in the Department of Civil Engineering of the University of Salerno, Italy. He received a M.S/B.S. in Civil Engineering from the University of Salerno in 1986 and the Research Abilitation in Mechanics of Solids and Structures from the same University in 1993. He is author of approximately 80 journal articles, conference papers and scientific reports. He has participated as a PI or co-PI in various research projects funded by the Italian Italian National Research Council, the Italian Ministry of Education, and the Regione Campania (Italy). Most of his current and past research work has dealt with multiscale approaches to the mechanics of materials and structures, strongly nonlinear phononic crystals, mechanics of impulse loading and damage of materials, biomechanics of soft biological materials, traumatic brain injuries, unilateral structures and integrated shape optimization, and composite materials and structures. F. Fraternali has been granted of a Fulbright Research Scholarship for the Academic Year 2005/2006 and has been Visiting Associate in Aeronautics at the Graduate Aerospace Laboratories of the California Institute of Technology, from September 2005 to February 2009. In 1991 he has also visited the Department of Engineering Science and Mechanics of the Virginia Polytechnic Institute and State University. He is in the Board of Editors of the International Journal of "Mechanics Research Communications" and is member of the International Association for Computational Mechanics (IACM), the International Society of Mesomechanics (ISM), the European Mechanics Society (EUROMECH), the European Research Center "Laboratoire Lagrange", the Italian Association of Theoretical and Applied Mechanics (AIMETA), the Italian Association for Stress Analysis (AIAS), and the United States Association for Computational Mechanics (USACM).

Research Summary

- Multiscale approaches to the mechanics of materials and structures

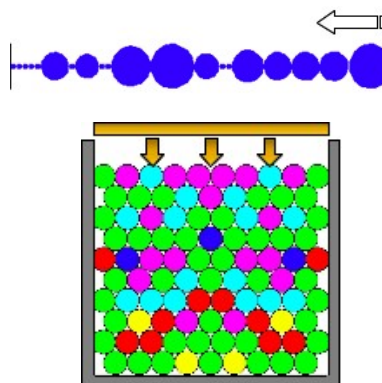
Limit behavior of families of variational problems depending on geometric, constitutive, and discretization scale parameters. Scale-dependent free discontinuity models and eigendeformation approaches in fracture mechanics. From discrete to continuum variational methods for materials and structures. Gamma-convergence properties of energy functionals and minimizing sequences. Dimension reduction problems in fracture mechanics and structural mechanics. Through the scales modeling of wave propagation in granular materials. Scale-dependent nonlinear and dissipative Hamiltonian systems. Multiscale models of nanomaterials and biomolecules, coupling atomistic and continuum mechanics.



Eigendeformation approach to brittle fracture

- Strongly nonlinear phononic crystals

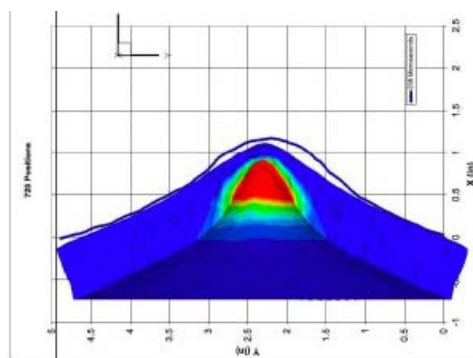
Wave propagation in phononic crystals. Energy transport through solitary waves, impulse and shock disintegration, anomalous wave reflections, thermalization, tunability of wave properties through precompression, granular protectors, acoustic bandgap systems. Discrete particle methods for the dynamics of granular systems accounting for path-dependent interaction potentials. Optimal design of shock protection devices, optical lenses and band gaps systems through evolutionary strategies. Matching of multiple band gaps through optimization. Innovative methods for nondestructive testing.



Optimized granular protectors

- Mechanics of impulse loading and damage of materials

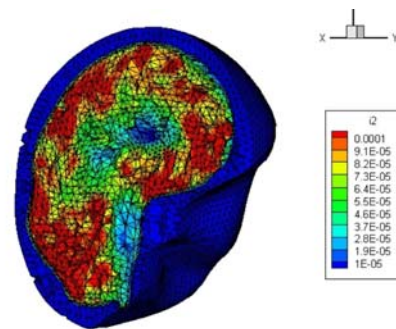
Development of a continuum framework including visco-elastic, elastic-plastic and cohesive models in finite strain kinematics for use in stress analysis, damage prediction and fracture/ fragmentation simulation under dynamic loading. Constitutive models for metals, polymers and biomaterials and their validation against experimental data. Simulation of the dynamic response of structures under dynamic loadings, including loadings produced by blast and ballistic events. Design and virtual testing of damage mitigation technologies. Virtual impact testing of structures and materials. Seismic response of structures. Optimization of crash and impact performance of materials and structures.



Ballistic impact simulation on a steel/polyurea composite plate

- Biomechanics of traumatic brain injuries

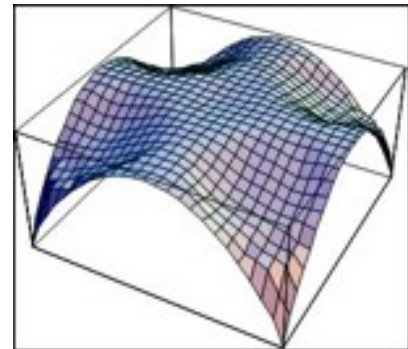
Experimental behavior of brain tissue. Constitutive models of brain tissue accounting for cavitation damage and diffuse axonal injury. Finite element models of the human head. Biomechanical modeling of traumatic brain injuries. Finite element simulations of head impacts against external obstacles and prediction of brain tissue damage. Correlation between mechanical damage and physiological brain dysfunction. Biomechanical-clinical brain injury scales. Head injury criteria for governmental and industrial regulations. Design of head protection devices including energy dissipation mechanisms.



Prediction of cavitation damage to brain tissue

- Unilateral structures and integrated shape optimization

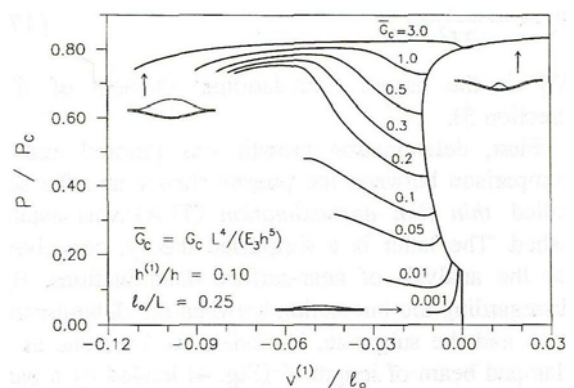
Lumped Stress Method for bodies with internal unilateral constraints (no-tension/no-compression solids and structures). Representation of a continuous medium as a network of material points interacting through mutual forces. Form-finding of unilateral plates and shells and prediction of wrinkling and crack patterns. Optimal shape of masonry domes. Stress skeleton of masonry walls. Structural shape optimization through variational methods and evolutionary strategies. Multifunctional optimization of structures, integrating architectural, structural and mechanical performance criteria. Design of multistable structural elements and smart structures.



Optimal shape of a no-tension membrane

- Composite materials and structures

Mechanical theories for laminated composite structures and FRP-reinforced structures, addressing stress prediction, stability analysis, thermal effects, delamination, and bimodular material behavior. Experimental testing of laminated structures. Dynamic response, fracture and damage of fiber-reinforced composites. Application of recycled materials, biodegradable polymers, nanotube foams, natural fibers, and sustainable concrete in civil engineering. Thermo-mechanical properties of recycled plastic fiber reinforced concrete. Aggregate or dispersed fiber/tube structures.



Load-deflection curves of delaminated beams

Composites reinforced with fiber-optic sensors and shape memory alloys for use in smart structures. Design and testing of junction systems.

Selected Publications

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