Strain gradient elasticity: a theory suitable for materials with microstructural effects

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Summary

When linear elastic solids and structures have extremely small dimensions (e.g., microelectronic mechanical systems – MEMS or nanoelectronic mechanical systems – NEMS), which are comparable to their microstructural lengths, their response to static or dynamic loading is significantly influenced by the microstructure of their material. Microstructural effects are also important in problems of localization of deformation, such as stress concentration or crack problems, where the stress field is nonlocal in character and in problems dealing with dispersion of propagating waves in non-homogeneous materials. These microstructural effects appear in the form of increased stiffness, size effects, elimination of singularities, increase of natural frequencies and buckling loads and wave dispersion.

Classical linear elasticity cannot take these effects into account and one needs higher order or generalized theories of elasticity with internal length scale parameters, which introduce microstructural effects in a macroscopic manner. Among these theories, non-local, micropolar and strain gradient elasticity are the most widely used enhanced theories that were able to explain microstructural effects in many applied mechanics problems. This presentation addresses a strain gradient elastic theory, first proposed by Mindlin, suitable for capturing microstructural effects in granular materials, concrete and bones.

CV of Prof. Polyzos

Professor Demosthenes Polyzos received his Diploma degree in mechanical engineering from the University of Patras, Greece, and the Ph.D. degree in mechanical engineering from the Department of Mechanical Engineering of the University of Patras. Since 1982, he has been with the Department of Mechanical Engineering & Aeronautics, University of Patras, Greece, where he currently is a Professor of Applied Mechanics. He has published more than 90 papers in scientific journals and books and more than 130 papers in international conferences. He is Associate Editor of the International Journal CMES: Computer Modelling in Engineering and Sciences and his scientific interests include Numerical analysis with the Boundary Element Method (BEM), meshless methods and hybrid Meshless/BEM numerical methods in direct and inverse wave scattering and radiation problems, Non-destructive Testing, Fracture mechanics, Mechanical vibrations and vibration isolation, bioengineering and materials and structures with microstructural effects.