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ON STRESS AND STRAIN GRADIENT AND MICROPOLAR THEORIES

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ABSTRACT

Structural continuum theories require a proper treatment of the kinematic, kinetic, and constitutive issues accounting for possible sources of non-local and non-classical continuum mechanics concepts and solving associated boundary value problems. There is a wide range of theories, from higher gradient to truly nonlocal (e.g., strain gradient theories [1,2], couple stress theories, Eringen's stress gradient theories [3], and micropolar theories [4]). In this lecture, an overview of the authors' recent research on couple stress and micropolar theories in developing the governing equations of elasticity, beams, plates, and sandwich structures will be presented. Two different nonlinear gradient elasticity theories that account for geometric nonlinearity and microstructure-dependent size effects are discussed. The first theory is based on modified couple stress theory of Mindlin [1] and the second one is based on Srinivasa and Reddy gradient elasticity theory [3]. The micropolar theory of elasticity includes an independent microrotation. A salient feature of the micropolar models is that, unlike classical or couple-stress models, they allow antisymmetric shear deformation to emerge at locations where detailed 2-D and 3-D deformations cannot be reduced to mid-surface deformations by considering only symmetric shear behavior.

References

1. R.D. Mindlin, Influence of couple-stresses on stress concentrations. *Experimental Mechanics,* **3**(1), 1-7, 1963.
2. A.R. Srinivasa and J.N. Reddy, *Journal of Mech Phys Solids*, **61**(3), 873-885, 2013.