15th INTERNATIONAL CONFERENCE
Dynamical Systems — Theory and Applications
December 2-5, 2019. Lodz, POLAND.

DSTA 2019

paper id: VIB217 (keynote speech)

Continuum & statistical aspects of gradient theory

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Abstract: Gradient theory for elasticity, plasticity and diffusion processes has been advanced by the author and co-workers over the last two decades. The key ingredient was the enhancement of classical theories with internal lengths and internal times. This enhancement enabled the capturing of shear band width and thickness, as well as the interpretation of deterministic size effects. However, intermittent plasticity and stochastic effects cannot be modeled. This is done by further enhancement of gradient theory with statistical aspects. An effective way to achieve this is by resorting to Tsallis q-statistics and non-extensive entropy thermodynamics. Typical examples from micropillar experiments are considered. Acknowledgements: The support of Hellenic Foundation for Research and Innovation (HFRI) MIS 5005134: "Nano-chemomechanics in Deformation and Fracture: Theory and Applications in LiBs and SGS" and MIS 5045454: "Material Instabilities, Size Effects, and Morphogenesis: Nanomaterials and Brain" is acknowledged. The participation of I. Tsagrakis, I. Konstantopoulos, A. Sidiropoulos, G. Petsos, O. Kapetanou and A. Tsolakis in these projects is also acknowledged. Reference: E.C. Aifantis, Internal length gradient (ILG) material mechanics across scales & disciplines, Adv. Appl. Mech. 49, pp. 1-110, 2016.

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