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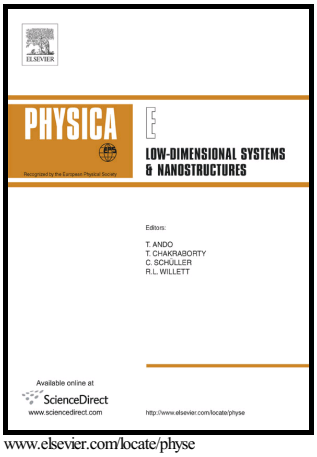

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Size-dependent dynamic pull-in analysis of geometric non-linear micro-plates based on the modified couple stress theory

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ABSTRACT

This paper focuses on the size-dependent dynamic pull-in instability in rectangular micro-plates actuated by step-input DC voltage. The present model accounts for the effects of in-plane displacements and their non-classical higher-order boundary conditions, von Kármán geometric non-linearity, non-classical couple stress components and the inherent non-linearity of distributed electrostatic pressure on the micro-plate motion. The governing equations of motion, which are clearly derived using Hamilton's principle, are solved through a novel computationally very efficient Galerkin-based reduced order model (ROM) in which all higher-order non-classical boundary conditions are completely satisfied. The present findings are compared and successfully validated by available results in the literature as well as those obtained by three-dimensional finite element simulations carried out using COMSOL Multyphysics. A detailed parametric study is also conducted to illustrate the effects of in-plane displacements, plate aspect ratio, couple stress components and geometric non-linearity on the dynamic instability threshold of the system.