

## Accepted Manuscript

A unified nonlocal nonlinear higher-order shear deformable plate model for postbuckling analysis of piezoelectric-piezomagnetic rectangular nanoplates with various edge supports

Raheb Gholami, Reza Ansari

PII: S0263-8223(16)32051-7

DOI: <http://dx.doi.org/10.1016/j.compstruct.2017.01.045>

Reference: COST 8179

To appear in: *Composite Structures*

Received Date: 4 October 2016

Revised Date: 19 December 2016

Accepted Date: 13 January 2017



Please cite this article as: Gholami, R., Ansari, R., A unified nonlocal nonlinear higher-order shear deformable plate model for postbuckling analysis of piezoelectric-piezomagnetic rectangular nanoplates with various edge supports, *Composite Structures* (2017), doi: <http://dx.doi.org/10.1016/j.compstruct.2017.01.045>

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

# A unified nonlocal nonlinear higher-order shear deformable plate model for postbuckling analysis of piezoelectric-piezomagnetic rectangular nanoplates with various edge supports

Raheb Gholami<sup>\*,a</sup>, Reza Ansari<sup>\*,b</sup>

<sup>a</sup> *Department of Mechanical Engineering, Lahijan Branch, Islamic Azad University, P.O. Box 1616, Lahijan, Iran*

<sup>b</sup> *Department of Mechanical Engineering, University of Guilan, P.O. Box 3756, Rasht, Iran*

## Abstract

By considering the small-scale effect based on the nonlocal elasticity theory, the nonlinear postbuckling of thick and moderately thick rectangular piezoelectric-piezomagnetic nanoplates with various edge supports subjected to the magneto-electro-thermo-mechanical loading is investigated. For this objective, a unified nonlinear higher-order shear deformable plate model is proposed. By adopting the nonlocal theory to capture the small-scale effect and utilizing a generalized displacement field to consider the influence of transverse shear deformation, unified size-dependent nonlinear governing equations and related boundary conditions are derived based on the virtual work principle in conjunction with von Kármán geometric nonlinearity. By choosing appropriate shape functions, the developed plate model can be reduced to the size-dependent Kirchhoff, Mindlin, Reddy, parabolic, trigonometric, hyperbolic and exponential shear deformable plate models. The nonlinear governing equations and boundary conditions are discretized using the generalized differential quadrature method first. Then, the pseudo arc-length continuation technique is used to solve the discretized equations and obtain the secondary equilibrium path of nanoplate in the postbuckling regime. In addition to providing significant guidelines for accurate prediction of the stability conditions nanoplates, extracting various plate models on the basis of any existing shear deformable plate theory becomes readily attainable by utilizing the proposed unified plate model.

**Keywords:** Piezoelectric-piezomagnetic rectangular nanoplate; Magneto-electro-thermo-mechanical loading; Nonlocal nonlinear postbuckling; Unified nonlocal higher-order shear deformable plate model.

## 1. Introduction

Significant advancements in material science and manufacturing technologies have provided a new class of composite materials known as intelligent and smart materials with excellent thermal, electrical, magnetic and mechanical properties that might be suitable in the development of advanced precise systems including the active vibration control [1, 2], sensors and actuators [3, 4] and medical and aerospace devices [5]. For instance, structures made up of piezoelectric and piezomagnetic constituents, as intelligent and smart composites, have attracted a wide research attention in recent years. Moreover,

---

\*Corresponding Authors. [gholami\\_r@liau.ac.ir](mailto:gholami_r@liau.ac.ir) (R. Gholami), [r\\_ansari@guilan.ac.ir](mailto:r_ansari@guilan.ac.ir) (R. Ansari).

Download English Version:

<https://daneshyari.com/en/article/4912306>

Download Persian Version:

<https://daneshyari.com/article/4912306>

[Daneshyari.com](https://daneshyari.com)