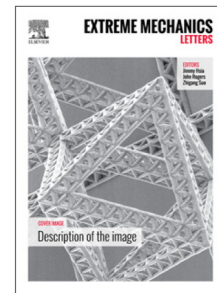


## Accepted Manuscript

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PII: S2352-4316(17)30094-9  
DOI: <https://doi.org/10.1016/j.eml.2017.09.010>  
Reference: EML 313

To appear in: *Extreme Mechanics Letters*

Received date: 17 June 2017  
Revised date: 4 August 2017  
Accepted date: 26 September 2017

Please cite this article as: Y. Chen, X. Liao, Y. Liu, X. Chen, Helical buckling of wires embedded in a soft matrix under axial compression, *Extreme Mechanics Letters* (2017), <https://doi.org/10.1016/j.eml.2017.09.010>

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# Helical buckling of wires embedded in a soft matrix under axial compression

Youlong Chen <sup>a,b</sup>, Xiangbiao Liao <sup>b</sup>, Yilun Liu <sup>c,\*</sup> and Xi Chen <sup>b,d,\*</sup>

<sup>a</sup> *International Center for Applied Mechanics, SV Laboratory, School of Aerospace, Xi'an Jiaotong University, Xi'an 710049, China*

<sup>b</sup> *Columbia Nanomechanics Research Center, Department of Earth and Environmental Engineering, Columbia University, New York, NY 10027, USA*

<sup>c</sup> *State Key Laboratory for Strength and Vibration of Mechanical Structures, School of Aerospace, Xi'an Jiaotong University, Xi'an 710049, China*

<sup>d</sup> *School of Chemical Engineering, Northwest University, Xi'an 710069, China*

**Abstract:** Wires embedded in an infinite soft matrix may buckle into a three-dimensional helical mode upon compression. Based on minimization of potential energy, we present a theoretical analysis of three-dimensional helical buckling of wires embedded in matrix. The buckling spacing and amplitudes are deduced, which are further verified by parallel FEM simulations. It is suggested that, the buckled profile is almost perfectly circular in the axial direction; with increasing compression, the buckling spacing decreases almost linearly, while the amplitude scales with the 1/2 power of the compressive strain. Besides the transition strain from 2D mode to 3D helical mode decreases with the Young's modulus of the wire, and approaches to ~1.25% when the modulus is high enough. This study may shed some lights on the buckling behaviors of wires embedded in matrix and provide some useful instructions of manufacturing complex structures.

**Keyword:** Helical buckling, Wires, Soft matrix, Post-buckling behavior, Theoretical analysis, FEM.

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\* Corresponding authors: [xichen@columbia.edu](mailto:xichen@columbia.edu) (X.C.) and [yilunliu@mail.xjtu.edu.cn](mailto:yilunliu@mail.xjtu.edu.cn) (Y.L.)

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