Professor Xiao-Qiao He

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Biography:
Dr. Xiaoqiao He received his B.S. in Solid Mechanics from Wuhan University of Technology, M.S. in Computational Mechanics from Huazhong University of Science and Technology and PhD in Dynamics from National University of Singapore in 1982, 1988 and 1998, respectively. After his graduation from National University of Singapore, he worked as a R&D Engineer in MAINTAINER (S) PTE LTD in Singapore for one year. Prior to joining the City University of Hong Kong as a lecturer in September 2005, Dr He had four years of working experience as a Research Fellow in the joint Research Center of Institute of High Performance

Computing and Nanyang Technological University in Singapore. Also, he worked as a Research Fellow in City University of Hong Kong for two years. His main research areas include nanomechanics of carbon nanotubes, smart structures, computational mechanics, parallel computing on PC environment and multiscale modeling of CNT-reinforced composite. Over the past fifteen years, Dr He's research in these fields has resulted in over 80 SCI journal papers in various top international journals and received a total of morn than 1500 citations (excluding self-cited ones) with h-index 24 from ISI index. Dr He has co-authored four papers with more than 100 citations each according to ISI index. The paper, "Buckling analysis of multi-walled carbon nanotubes: a continuum model accounting for van der Waals interaction" by He, X.Q., Kitipornchai, S., Liew, K.M., Journal of the Mechanics and Physics of Solids 53, 303-326, 2005, was evaluated as the top 1% highly influential paper by Essential Science Indicators (THOMSON ISI). This paper ranked No. 3 in Top 10 Cited articles published in Journal of the Mechanics and Physics of Solids in 2009 and 2010. The proposed explicit formulas in this paper have been applied by many researchers from USA, Japan, Iran and China in their researches. Since Dr He became a lecturer in City U in 2005, he has been a principal investigator for fourteen research grants (including five GRF grants and a NSFC grant) with a total funding over HK$4.5 millions. The success rate of applying GRF is 5/6.

Research Interests:
Structural Engineering, Nanomechanics of Carbon nanotubes, Smart Structures, Computational Mechanics, Parallel Computing.

Selected Publications with Abstracts:

X.Q. He (1), S. Kitipornchai (1) and K.M. Liew (2 and 3)
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"Buckling analysis of multi-walled carbon nanotubes: a continuum model accounting for van der Waals interaction", Journal of the Mechanics and Physics of Solids, Vol. 53, No. 2, February 2005, pp. 303-326, doi:10.1016/j.jmps.2004.08.003
ABSTRACT: Explicit formulas are derived for the van der Waals (vdW) interaction between any two layers of a multi-walled carbon nanotube (CNT). Based on the derived formulas, an efficient algorithm is established for the buckling analysis of multi-walled CNTs, in which individual tubes are modeled as a continuum cylindrical shell. The explicit expressions are also derived for the buckling of double-walled CNTs. In previous studies by Ru (J. Appl. Phys. 87 (2000b) 7227) and Wang et al. (Int. J. Solids Struct. 40 (2003) 3893), only the vdW interaction between adjacent two layers was considered and the vdW interaction between the other two layers was neglected. The vdW interaction coefficient was treated as a constant that was not dependent on the radii of the tubes. However, the formulas derived herein reveal that the vdW interaction coefficients are dependent on the change of interlayer spacing and the radii of the tubes. With the increase of radii, the coefficients approach constants, and the constants between two adjacent layers are about 10% higher than those reported by Wang et al. (Int. J. Solids. Struct. 40 (2003) 3893). In addition, the numerical results show that the vdW interaction will lead to a higher critical buckling load in multi-walled CNTs. The effect of the tube radius on the critical buckling load of a multi-walled CNT is also examined.

X. Q. He (1), C. Qu (2), Q. H. Qin (3) and C. M. Wang (4)
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(4) Engineering Science Programme and Department of Civil Engineering National University of Singapore, Kent Ridge, Singapore 119260
"Buckling and Postbuckling Analysis of Multi-Walled Carbon Nanotubes Based on the Continuum Shell Model", International Journal of Structural Stability and Dynamics Vol. 7, No. 4 (2007) pp. 629–645
ABSTRACT: Buckling and postbuckling behaviors of multi-walled carbon nanotubes (MWCNTs) under a compressive force are studied. MWCNTs are modeled by Donnell's shallow shell nonlinear theory with the allowance of van der Waals (vdW) interaction between the walls. It is shown herein that the buckling load decreases while the buckling strain increases as the innermost radius of MWCNT increases. For the postbuckling behavior, the shortening-load curves show an initial steep gradient that gradually level up when the radius of the innermost tube changes from a small value to a large value. However, the deflection-load curves are almost level for various radii of MWCNTs. In addition, the analytical results showed that the shortening-load curves are almost linear but the deflection-load curves are nonlinear and the stability of MWCNTs can be enhanced by adding tubes.

Liew, K. M., Wang, J. B., He, X. Q. and Zhang, H. W. (Department of Building and Construction, City University of Hong Kong, Kowloon, Hong Kong), "Buckling analysis of abnormal multiwalled carbon nanotubes", Journal of Applied Physics, Vol. 102, No. 10, September 2007, pp. 053511-053511-6, doi: 10.1063/1.2777893
ABSTRACT: Abnormal multiwalled carbon nanotubes (MWNTs) with an interlayer distance of less than 0.34 nm are proposed and optimized based on molecular dynamics simulation, in which the second-generation Tersoff-Brenner potential and Lennard-Jones (12-6) potential are used to characterize the intratube interatomic interaction and the intertube van der Waals (vdW) interaction, respectively. Then, a multishell continuum model that is combined with a refined vdW force model is used to carry out the buckling analysis of abnormal MWNTs (including two-, four-, and six-walled MWNTs) and to investigate the effect of the vdW interaction of abnormal MWNTs. The numerical results show that the effect of the vdW interaction is more significant for abnormal MWNTs than for normal MWNTs and that the vdW interaction of abnormal MWNTs cannot be neglected. The critical buckling strains of abnormal MWNTs are greatly enhanced compared with those of normal MWNTs, which suggests that abnormal MWNTs may be excellent candidates as enforced fibers of nanocomposites.

K. M. Liew (1 and 2), C. H. Wong (1 and 2), X. Q. He (1), M. J. Tan (2), and S. A. Meguid (3)
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(3) Engineering Mechanics and Design Laboratory, Department of Mechanical and Industrial Engineering, University of Toronto, 5 King's College Road, Toronto, Ontario, Canada M5S 3G8
"Nanomechanics of single and multiwalled carbon nanotubes", Phys. Rev. B 69, 115429 (2004) [8 pages], doi: 10.1103/PhysRevB.69.115429
ABSTRACT: Buckling behavior of single-walled and multiwalled carbon nanotubes is studied under axial compression in this work. Brenner's "second generation" empirical potential is used to describe the many-body

short-range interatomic interactions for single-walled carbon nanotubes, while the Lennard Jones model for the van der Waals potential is added for multiwalled carbon nanotubes. Single-, two-, three-, and four-walled nanotubes are considered in the simulations in order to examine the effects of the number of layers on the structural properties of the multiwalled nanotubes. Results indicate that there exists an optimum diameter for single-walled nanotubes at which the buckling load reaches its maximum value. The buckling load increases rapidly with the increase of the diameter up to the optimum diameter. A further increment beyond this diameter results in a slow decline in buckling load until a steady value is reached. The effects of layers on the buckling load of multiwalled nanotubes are also examined.

More Selected Publications:

HE XQ, Kuang YD, Chen CY and Li GQ (2009), Enhanced mechanical properties of single-walled carbon nanotubes due to chemical functionalization, J. Phys.: Condens. Matter, 21: 215301

HE XQ and Huang XH (2009), On the use of cellular automata algorithm for the atomic-based simulation of carbon nanotubes, Proceedings Of The Royal Society A-Mathematical Physical And Engineering Sciences, 465(2101): 193-206.

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Kuang YD, HE XQ, Chen CY and Li GQ (2009), Buckling of functionalized single-walled nanotubes under axial compression, Carbon, 47(1): 279-285.

Yan Y, HE XQ, Zhang LX and Wang CM (2009), Dynamic behavior of triple-walled carbon nanotubes conveying fluid, Journal of Sound and Vibration, 319(3-5): 1003-1018.

HE XQ, Qu C and Qin QH (2008), A Theoretical Model for Surface Bone Remodeling under Electromagnetic Loads, Archive of Applied Mechanics, 78(3): 163-175.

HE XQ, Wang CM, Yan Y, Zhang LX and Nie GH (2008), Pressure dependence of instability of multi-walled carbon nanotubes conveying fluid, Archive Of Applied Mechanics, 78(8): 637-648.

HE XQ, Qu C and Qin QH (2007), Buckling and Post-buckling analysis of multi-walled carbon nanotubes based on the continuum shell model, International Journal of Structural Stability and Dynamics, 7(4): 629-645.

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HE XQ, Eisenberger M and Liew KM (2006), The effect of Van der Waals interaction modeling on the vibration characteristics of multi-walled carbon nanotubes, Journal of Applied Physics, DEC 15 , 100(12): 124317

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KITIPORNCHAI S, HE XQ and LIEW KM (2005), Buckling analysis of triple-walled carbon nanotubes embedded in an elastic matrix, Journal of Applied Physics, 97: 114318

HE XQ, KITIPORNCHAI S and LIEW KM (2005), Buckling analysis of multi-walled carbon nanotubes: a continuum model accounting for van der Waals interaction, Journal of the Mechanics and Physics of Solids, 53(2): 303-326.

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LIEW KM, HE XQ and WONG CH (2004), On the study of elastic and plastic properties of multi-walled carbon nanotubes under axial tension using molecular dynamics simulation, Acta Materialia, 52: 2521-2527.

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Qin QH and HE XQ (1995), Variational principles, FE and MPT for analysis of non-linear impact-contact problems, Comput. Methods Appl. Mech. Engrg., 122: 205-222.

HE XQ and Qin QH (1993), Nonlinear analysis of Reissnear's plate by the variational approaches and boundary element methods, Appl. Math. Modelling, 17: 149-155.