Professor Quan (Abraham) Wang

P. Eng., B.Sc (Zhejiang), M.Sc., Ph.D. (Peking)

Canada Research Chair in Solid Mechanics
Natural Sciences and Engineering
Department of Mechanical and Manufacturing Engineering
University of Manitoba, Canada

See:
home.cc.umanitoba.ca/~wang37
home.cc.umanitoba.ca/~wang37/CV%20WANG%20Jan%202009.doc
http://sydney.edu.au/engineering/civil/seminars/seminars_2007_wang.shtml
http://www.chairs-chaires.gc.ca/chairholders-titulaires/profile-eng.aspx?profileID=2006

Biography:

Dr. Wang received his Ph.D. in 1994 from Peking University. He has conducted research in Hong Kong University, Nanyang Tech. University, University of South Carolina, Purdue University, National University of Singapore, and the University of Central Florida. He is currently a Canada Research Chair and an associate professor in the University of Manitoba. His research topics include: health monitoring of structures with wavelet technique and smart materials, wave excitation and propagation in piezoelectric coupled structures, vibration and control of structures by piezoelectric materials, stability analysis and control of structures by use of piezoelectric materials and shape memory alloy (SMA), repair of cracked and delaminated structures with piezoelectric materials, and nano-mechanics. His research papers have been published in leading refereed international journals, such as Applied Physics Letters, Physical Review B, International Journal of Solids and Structures, ASME Journal of Applied Mechanics, ASCE Journal of Engineering Mechanics, Smart Materials and Structures, Physics Letters A and etc. His research findings has received more than 330 SCI citations. Dr. Wang is the recipient of many rewards such as Intellectual Property Award and Technology Transfer Award sponsored by University of South Carolina. He is an editorial board member of 3 international journals.

Education:
B.Sc., Jul 6, 1988, Zhejiang University, China
M.Sc., Jul 9, 1991, Peking University, China
PhD., Jul 9, 1994, Peking University, China

Research Interests:
Nano-mechanics, Structural Health Monitoring
Smart Materials and Structures
Engineering Mechanics

Current Research Work:
Nano-mechanics, Structural health monitoring
Smart Materials and Structures, Repair of structures with smart materials
Wavelet transform in damage detection of structures, Mechanics of materials

Teaching:
MECH 3420 Vibrations and Acoustics
MECH 4650 Machine Design 4M

Professional Activities:
Editor

- Smart Materials and Structures (Associate Editor, Institute of Physics Publishing, 2008-)
- ASME Journal of nanotechnology in Engineering and Medicine (Associate Editor, ASME, 2011-)

Editorial board member

- Carbon (editorial advisory board, Elsevier, 2011-)
- Journal of Sound and Vibration (editorial advisory board, Elsevier, 2009-)

Work Experience:

April 2008-	University of Manitoba, Professor and Canada Research Chair
May 2006-March 2008	University of Manitoba, Mechanical and Manufacturing Engineering Department Associate professor and Canada Research Chair
June 2003-May 2006	University of Central Florida, Mechanical, Materials and Aerospace Engineering Department Associate Professor
January 2002-June 2003	The National University of Singapore, Civil Engineering Department Associate Professor
April 1999-Dec. 2001	The National University of Singapore, Civil Engineering Department Assistant Professor
Aug. 1998 – April 1999	Purdue University, Aeronautics and Astronautics School Research Assistant
Jan. 97- Aug. 1998	University of South Carolina, Mechanical Engineering Department Research Assistant, Teaching Assistant
June 95- Jan. 97	Nanyang Technological University, Mechanical and Production Engineering School

	Research fellow
Sept. 1994- June 1995	University of Hong Kong, Hong Kong Research Fellow

List of publications:
home.cc.umanitoba.ca/~wang37/CV%20WANG%20Jan%202009.doc

Selected Publications:

Q Wang (1) and V K Varadan (2)
(1) Department of Mechanical, Materials and Aerospace Engineering, University of Central Florida, Orlando, FL 32816-2450, USA
(2) Department of Engineering Science and Mechanics, The Pennsylvania State University, University Park, PA 16802-1400, USA
"Stability analysis of carbon nanotubes via continuum models", Smart Mater. Struct., Vol. 14, 2005, 281
doi: 10.1088/0964-1726/14/1/029
ABSTRACT: This paper presents the research on the stability analysis of carbon nanotubes (CNTs) via elastic continuum beam and shell models. The estimation of the flexural stiffness of a single-walled nanotube (SWNT) via the elastic beam model is proposed based on the postulate analyzed and provided in the paper. The validation of the stiffness is conducted with the ab initio calculations of the vibration of a SWNT. Based on the stiffness proposed, the stability analysis of CNTs is further conducted and validated with the well-cited research results by Yakobson and his collaborators. In addition, more predictions of various buckling phenomena of carbon nanotubes by beam and shell models are provided and studied. Finally, the kink phenomenon in a SWNT under pure bending is discussed via the continuum model. It is hoped that this paper will pave the way toward a better understanding of the application of continuum models in the stability and dynamics analysis of carbon nanotubes.

Q. Wang (1), V.K. Varadan (2) and S.T. Quek (3)
(1) Department of Mechanical and Manufacturing Engineering, University of Manitoba, Winnipeg, MB R3T 5V6, Canada
(2) Department of Electrical Engineering, University of Arkansas, Fayetteville, AR 72701-1201, USA
(3) Department of Civil Engineering, National University of Singapore, 117576, Singapore
"Small scale effect on elastic buckling of carbon nanotubes with nonlocal continuum models", Physics Letters A, Vol. 357, No. 2, September 2006, pp. 130-135, doi:10.1016/j.physleta.2006.04.026
ABSTRACT: Nonlocal elastic beam and shell models are developed and applied to investigate the small scale effect on buckling analysis of carbon nanotubes (CNTs) under compression. General and explicit solutions are derived and expressed in terms of the solutions via local or classical elastic models, in which the scale effect is not accounted, to reveal the small scale effect on CNTs buckling results. The dependence of the scale effect with respect to the length, radius, and buckling modes of CNTs is clearly established and observed from the universal solutions derived in the manuscript. It is clearly seen from the results that the buckling solutions for CNTs via local continuum mechanics are overestimated and hence the scale effect is indispensable in providing more accurate results for mechanical behaviors of CNTs via continuum mechanics.

Q. Wang (1), S.T. Quek (2) and V.K. Varadan (3)
(1) Department of Mechanical and Manufacturing Engineering, University of Manitoba, Winnipeg, Manitoba, Canada R3T 5V6
(2) Department of Civil Engineering, National University of Singapore, Singapore 117576, Singapore
(3) Department of Electrical Engineering, University of Arkansas, Fayetteville, AR 72701-1201, USA
"Torsional buckling of carbon nanotubes", Physics Letters A, Vol. 367, Nos. 1-2, July 2007, pp.135-139, doi:10.1016/j.physleta.2007.02.099
ABSTRACT: Continuum mechanics models for the torsional buckling of carbon nanotubes (CNTs) are developed in the Letter. The applicability of these models is investigated for CNTs with different aspect ratios. In particular, molecular dynamics simulations are conducted to verify the feasibility of the models for

moderately long CNTs.

Q. Wang (Department of Mechanical and Manufacturing Engineering, University of Manitoba, Winnipeg, Manitoba R3T 5V6, Canada), “Instability analysis of double-walled carbon nanotubes subjected to axial compression”, Journal of Applied Physics, Vol. 104, No. 3, 2008, pp. 036102-036102-3, doi: 10.1063/1.2955740
ABSTRACT: The buckling of short double-walled carbon nanotubes subjected to compression is investigated through molecular dynamics in the paper. The inner wall is discovered to have helically aligned buckling mode while the outer wall is reported to have shell buckling mode with kinks. Such buckling modes are attributed to the interaction of the two walls via the van der Waals effect. In addition, a buckling strain higher than the buckling strains of two constituent inner and outer walls is found in the double-walled tube within a certain size range. The causes for such a phenomenon are analyzed and discussed.

Yan-Gao Hu (1), K.M. Liew(1), Q. Wang (2), X.Q. He (1) and B.I. Yakobson (3)
(1) Department of Building and Construction, City University of Hong Kong, Hong Kong
(2) Department of Mechanical and Manufacturing Engineering, University of Manitoba, Winnipeg, Manitoba, Canada R3T 5V6
(3) ME&MS Department, Rice University, MS 321, Houston, TX 77005-1892, USA
“Nonlocal shell model for elastic wave propagation in single- and double-walled carbon nanotubes”, Journal of the Mechanics and Physics of Solids, Vol. 56, No. 12, December 2008, pp. 3475-3485, doi:10.1016/j.jmps.2008.08.010
ABSTRACT: This paper investigates the transverse and torsional wave in single- and double-walled carbon nanotubes (SWCNTs and DWCNTs), focusing on the effect of carbon nanotube microstructure on wave dispersion. The SWCNTs and DWCNTs are modeled as nonlocal single and double elastic cylindrical shells. Molecular dynamics (MD) simulations indicate that the wave dispersion predicted by the nonlocal elastic cylindrical shell theory shows good agreement with that of the MD simulations in a wide frequency range up to the terahertz region. The nonlocal elastic shell theory provides a better prediction of the dispersion relationships than the classical shell theory when the wavenumber is large enough for the carbon nanotube microstructure to have a significant influence on the wave dispersion. The nonlocal shell models are required when the wavelengths are approximately less than 2.36x10^-9 and 0.95x10^-9 m for transverse wave in armchair (15,15) SWCNT and torsional wave in armchair (10,10) SWCNT, respectively. Moreover, an MD-based estimation of the scale coefficient e0 for the nonlocal elastic cylindrical shell model is suggested. Due to the small-scale effects of SWCNTs and the interlayer van der Waals interaction of DWCNTs, the phase difference of the transverse wave in the inner and outer tube can be observed in MD simulations in wave propagation at high frequency. However, the van der Waals interaction has little effect on the phase difference of transverse wave.

Q. Wang (Department of Mechanical and Manufacturing Engineering, University of Manitoba, Winnipeg, Manitoba, Canada R3T 5V6), “Compressive buckling of carbon nanotubes containing polyethylene molecules”, Carbon, Vol. 49, No. 2, February 2011, pp. 729-732, doi:10.1016/j.carbon.2010.10.023
ABSTRACT: The instability of a carbon nanotube containing a polyethylene molecule subjected to compression is investigated using molecular dynamics. A decrease up to 35% in the buckling strain of the (6,6) and (10,10) carbon nanotube/polymer structures due to the attractive van der Waals interaction between the tube wall and the polymer molecule is reported. In particular, the decrease in the buckling strain of the (6,6) carbon nanotube/polymer structure is attributed to the initiation of two flattenings on the tube wall. Simulations show that the buckling strain of the structure is insensitive to the number of units of the polymer molecule.

Q. Wang (Department of Mechanical and Manufacturing Engineering, University of Manitoba, Winnipeg, Manitoba, Canada R3T 5V6), “Buckling of carbon nanotubes wrapped by polyethylene molecules”, Physics Letters A, Vol. 375, No. 3, January 2011, pp. 624-627, doi:10.1016/j.physleta.2010.12.005
ABSTRACT: The discovery of a buckling instability of a single-walled carbon nanotube wrapped by a polyethylene molecule subjected to compression is reported through molecular mechanics simulations. A decrease up to 44% in the buckling strain of the nano-structure owing to the van der Waals interaction between the two molecules is uncovered. A continuum model is developed to calculate both the interaction between the tube and the polymer and the decreased buckling strain of the structure by fitting the molecular mechanics

results.

Q. Wang (1), K.M. Liew (2) and W.H. Duan (1)
(1) Department of Mechanical and Manufacturing Engineering, University of Manitoba, Winnipeg, Manitoba, Canada R3T 5V6
(2) Department of Building and Construction, City University of Hong Kong, Hong Kong, China
“Modeling of the mechanical instability of carbon nanotubes”, Carbon, Vol. 46, No. 2, February 2008, pp. 285-290, doi:10.1016/j.carbon.2007.11.022
ABSTRACT: A hybrid continuum mechanics and molecular mechanics model is developed to predict the compressive buckling strain and load for the inelastic buckling of armchair and zigzag carbon nanotubes. The effectiveness of the hybrid model is demonstrated by comparisons of buckling results from the model, molecular dynamics simulations, and continuum models by other work.