Bin Wu

Marie Curie Individual Fellow

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Education, Employment and Research Highlights

2020–Present **Marie Curie Individual Fellow**, *Applied Mechanics*, NUI Galway, Ireland.
Host: Professor Michel Destrade
Topic: *Manipulating and tuning dynamic characteristics of soft electro-active materials: Modelling, simulations and experiments*

2019–2020 **IRC Postdoctoral Fellow**, *Applied Mechanics*, NUI Galway, Ireland.
Supervisor: Professor Michel Destrade
Topic: *Dynamic characteristics of soft electro-active materials*

2018–2019 **Postdoctoral Fellow**, *Composite Mechanics*, Politecnico di Torino, Italy.
Supervisor: Professor Erasmo Carrera
Topic: *Nonlinear vibrations and control of advanced materials and structures*

2012–2018 **PhD (Hons.)**, *Solid Mechanics*, Zhejiang University, China.
Supervisor: Professor Weiqiu Chen
Thesis: *Guided waves in soft electroelastic circular cylinders under biasing fields*

2014-2016 **Joint Training PhD**, *Structural Mechanics*, University of Siegen, Germany.
Supervisor: Professor Chuanzeng Zhang & Professor Weiqiu Chen
Topic: *Size effects on dynamic behaviors of multi-functional nanomaterials*

2008-2012 **BSc (Hons.)**, *Engineering Mechanics*, Chongqing University, China.
Supervisor: Professor Xianghe Peng & Professor Weiqiu Chen
Thesis: *Wave propagation in piezoelectric plates with surface effects*

Research Interests

- **Wave Propagation & Free Vibration Analysis**;
- **Mechanics of Smart Materials and Structures** (including piezoelectric, multiferroic, functionally graded and soft smart materials);
- **Tunable Waveguides** (especially phononic crystals & metamaterials);
- **Geometrical Nonlinearity and Post-buckling** (via refined Finite Element Method);
- **Fluid-structure Interaction** (especially Non-Newtonian fluids);
- **Micro/nano Mechanics** (especially surface and interface effects).

Funded Research Projects

[7] Manipulating and tuning dynamic characteristics of soft electro-active materials: Modelling, simulations and experiments,
European Union, €197,000; 09/2020-08/2022.
[**Role: Principal Investigator**]

[6] Irish Research Council Postdoctoral Fellowship,

Irish Research Council, €97,500; 10/2019-08/2020.

[**Role: Principal Investigator**]

[5] Non-linear vibrations and control of advanced materials and structures,

Postdoctoral Scheme, €27,500; 07/2018-09/2019.

[**Role: co-Investigator** with E. Carrera and A. Pagani]

[4] Performance optimization and manipulation of elastic waves in periodic soft materials and structures,

National Natural Science Foundation of China, €562,500; 01/2016-12/2020.

[**Role**: Participated]

[3] Surface and interface effects on dynamic behaviors in multi-functional nanomaterials under biasing fields,

China Scholarship Council, €28,800; 10/2014-10/2016.

[**Role: Principal Investigator**]

[2] Linear and nonlinear waves in soft electro-elastic solids and structures,

National Natural Science Foundation of China, €110,000; 01/2013-12/2016.

[**Role**: Participated]

[1] Dynamic characteristics and control mechanisms of layered electro-magnetic composite materials and structures,

National Natural Science Foundation of China, €250,000; 01/2011-12/2014.

[**Role**: Participated]

Scientific Skills

Advanced Theoretical Knowledge:

• Nonlinear Electroelasticity, Small-on-Large (Incremental) Theory, State Space Method, Surface Impedance Matrix Method, Arc-Length Method;

• Muller (Parabolic) Search Method for complex roots;

• Transfer Matrix Method and Plane Wave Expansion Method for calculating band structures.

Numerical Skills:

• Calculations of band structures and transmission characteristics of phononic crystals with commercial finite element packages ABAQUS and COMSOL;

• Simulations of geometric nonlinearity (including large-deflection and post-buckling) and its relevant linearized vibrations of composites, as well as nonlinear response of soft materials via refined Finite Element codes (i.e. CUF FEM codes).

Experimental Skills:

• Uni-axial tensile platform to measure the nonlinear response of soft materials;

• Data receiver and electrodynamic shaker to excite, receive and measure transmission of elastic waves in phononic crystals.

Programming Language and Software Competency:

• Fortran, Mathematica, Python, Matlab, Abaqus, Comsol;

• LaTeX, Origin, Adobe Illustrator, Mathtype, Endnote, Microsoft Office.

Selected Honors and Awards

2019 Nomination Award of Excellent PhD Thesis, *Chinese Society of Theoretical and Applied Mechanics (most prestigious honor for Chinese PhD graduates in 'Mechanics')*

2018 Excellent PhD Student, *Zhejiang University*

2017-2018 Dabeinong Scholarship, *Zhejiang University*

2014-2016 Joint Training PhD Scholarship, *Chinese Science Council (CSC)*

2012-2013 Nandu Scholarship Band Three, *Zhejiang University*

2013 Best Student Talk (Second Class Award), *Proceedings of SPAWDA*

2012 Excellent Undergraduate & Graduation Thesis, *Chongqing University*

2008-2010 National & National Endeavor Scholarships, *Chinese Ministry of Education (the two highest honors for Chinese undergraduates)*

Other Scientific Activities

Editorial Board:

2021 **Contributing Editor** of Mechanics of Advanced Materials and Structures

Organisation of International Conferences:

2021 Co-organizer of the Topic Session on '*Nonlinear Problems in Aerospace Structures*', ASME IMECE2021 Virtual Conference;

2019 Co-organizer of the Mini-symposium on '*Computational Acoustics and Elastodynamics in Solids and Structures*', 10th ICCM2019, Singapore;

2019 Member of the Local Organizing Committee, 2nd ICMAMS, Nanjing, China;

2019 Co-organizer of the Parallel Session on '*Fluid Solid Interaction*', 2nd ICMAMS, Nanjing, China.

Reviewer for Journals:

2015-Present International Journal of Mechanical Sciences; Mechanics of Advanced Materials and Structures; Mathematics and Mechanics of Solids; Philosophical Transactions of the Royal Society A; International Journal of Non-Linear Mechanics; European Journal of Mechanics-A/Solids; Applied Mathematics and Mechanics (English Edition); International Journal of Mechanics & Materials in Design; Meccanica; Engineering Computations.

Teaching and Supervision Activities:

2016 Winter Teaching Assistant, ***Elastodynamics*** (graduate course), Zhejiang University;

2014 Spring Teaching Assistant, ***Theory of Elasticity*** (undergraduate course), Zhejiang University;

2013 Winter Teaching Assistant, ***Continuum Mechanics*** (graduate course), Zhejiang University;

2019 Co-supervisor (with Prof. Erasmo Carrera) of **1 PhD student** (Politecnico di Torino);

2018-Present Co-supervisor (with Prof. Weiqiu Chen) of **3 PhD students** (Zhejiang University);

2017/**2019** Co-supervisor (with Prof. Weiqiu Chen) of **2 undergraduate students** (now PhD candidates at Zhejiang University) on their final-year projects.

Advanced Training Courses:

2019 May. 27-31 Spring school on '*Virtual Manufacturing and Testing of Composites*', organized by MUL2 Group of Politecnico di Torino, Italy;

2019 Feb. 5-7 Doctoral course on '*Aeroelastic Tailoring – Modelling, Design, Manufacturability and Experiments*', organized by Politecnico di Torino, Italy;

2018 Jun. 5-9 IUTAM Symposium on '*Acoustic/Elastic Metamaterials: Their Design and Applications*', organized by Beijing Institute of Technology, China;

2012 Aug. 6-9 Advanced summer workshop on '*Piezoelectric Device Analysis: Theory and Methods*', organized by Ningbo University, China.

Publications

Submitted or In Preparation:

[1] A. Pagani, R. Azzara, **B. Wu**, E. Carrera. Effect of different geometrically nonlinear strain measures on the static nonlinear response of isotropic and composite shells. Submitted to *Int. J. Mech. Sci.*

Book Chapter:

[1] **B. Wu**, W.Q. Chen. (2019) Continuum theory for deformable interfaces/surfaces with multi-field coupling. In: *Handbook of Mechanics of Materials*, Springer, Singapore, pp. 795-821. [ISBN: 978-981-10-6884-3]

Topic Reviews:

[2] Y.F. Wang, Y.Z. Wang, **B. Wu**, et al. (2019) Tunable and active phononic crystals and metamaterials. *Appl. Mech. Rev.*, 72(4): 040801.

[1] **B. Wu**, et al. (2016) Theory of electroelasticity accounting for biasing fields: Retrospect, comparison and perspective. *Adv. Mech.*, 46: 201601.

*Peer-Reviewed Articles (*Corresponding Author)*:

2021 [30] E. Carrera, R. Azzara, E. Daneshkhah, A. Pagani, **B. Wu**. (2021) Buckling and post-buckling of anisotropic flat panels subjected to axial and shear in-plane loadings accounting for classical and refined structural and nonlinear theories. *Int. J. Non-Lin. Mech.*, 133: 103716 (2021).

[29] Y.Z. Cao, J. Zhu, **B. Wu**, et al. (2021) Axisymmetric free vibration of soft electro-active circular plates under biasing fields. *Acta Mech. Solida Sin.*, 34(3): 326-345.

[28] **B. Wu***, M. Destrade. (2021) Wrinkling of soft magneto-active plates. *Int. J. Solids Struct.*, 208-209: 13-30 (2021).

[27] Y.J. Chen, **B. Wu***, et al. (2021) Low-frequency tunable topological interface states in soft phononic crystal cylinders. *Int. J. Mech. Sci.*, 191: 106098.

[26] **B. Wu***, et al. (2021) Geometrically nonlinear refined shell theories by Carrera Unified Formulation. *Mech. Adv. Mater. Struct.*, 28(16): 1721-1741.

[25] W.J. Zhou, **B. Wu**, et al. (2021) Tunable flexural wave band gaps in a prestressed elastic beam with periodic smart resonators. *Mech. Adv. Mater. Struct.*, 28(3): 221-228.

2020 [24] **B. Wu**, et al. (2020) Nonlinear response and axisymmetric wave propagation in functionally graded soft electro-active tubes. *Int. J. Mech. Sci.*, 187: 106006.

[23] A. Pagani, R. Azzara, R. Augello, E. Carrera, **B. Wu**. (2020) Accurate through-the-thickness stress distributions in thin-walled metallic structures subjected to large displacements and large rotations. *Vietnam J. Mech.*, 42(3): 239-254 (2020). [Special Issue dedicated to Professor J.N. Reddy's 75th birthday (**Invited contribution**)]

[22] F.Z. Zhu, **B. Wu***, et al. (2020) Electrostatically tunable axisymmetric vibrations of soft electroactive tubes. *J. Sound Vib.*, 483: 115467.

[21] Y.J. Chen, **B. Wu***, et al. (2020) Effects of strain stiffening and electrostriction on tunable elastic waves in compressible dielectric elastomer laminates. *Int. J. Mech. Sci.*, 176: 105572.

[20] E. Carrera, A. Pagani, R. Augello, **B. Wu**. (2020) Popular benchmarks of nonlinear shell analysis solved by 1D and 2D CUF-based finite elements. *Mech. Adv. Mater. Struct.*, 27(13): 1098-1109. [Special Issue honouring Dr. J.N. Reddy for receiving the 2019 ASME Timoshenko Medal (**Invited contribution**)]

[19] W.J. Zhou, **B. Wu**, et al. (2020) Actively controllable topological phase transition in homogeneous piezoelectric rod system. *J. Mech. Phys. Solids*, 137: 103824.

[18] Y.P. Su, **B. Wu**, et al. (2020) Pattern evolution in bending dielectric-elastomeric bilayers. *J. Mech. Phys. Solids*, 136: 103670. [Special Issue in Honour of Davide Bigoni (**Invited contribution**)]

2019 [17] **B. Wu**, et al. (2019) Three-dimensional vibrations of multilayered hollow spheres submerged in a complex fluid. *J. Fluid Mech.*, 879: 682-715.

[16] R.W. Mao, **B. Wu***, et al. (2019) Electrostatically tunable small-amplitude free vibrations of pressurized electro-active spherical balloons. *Int. J. Non-Lin. Mech.*, 117: 103237. [Special Issue on 'Nonlinear Theory of Electro- and Magneto-Elasticity' (**Invited contribution**)]

[15] **B. Wu***, et al. (2019) Large-deflection and post-buckling analyses of isotropic rectangular plates by Carrera Unified Formulation. *Int. J. Non-Lin. Mech.*, 116: 18-31.

[14] **B. Wu**, et al. (2019) Accurate stress fields of post-buckled laminated composite beams accounting for various kinematics. *Int. J. Non-Lin. Mech.*, 111: 60-71.

[13] Y.P. Su, **B. Wu**, et al. (2019) Finite bending and pattern evolution of the associated instability for a dielectric elastomer slab. *Int. J. Solids Struct.*, 158: 191-209.

[12] Y.J. Chen, **B. Wu**, et al. (2019) Tunable two-way unidirectional acoustic diodes: Design and simulation. *ASME J. Appl. Mech.*, 86(3): 031010.

2018 [11] **B. Wu**, et al. (2018) On propagation of axisymmetric wave in pressurized functionally graded elastomeric hollow cylinders. *J. Sound Vib.*, 421: 17-47.

[10] **B. Wu**, et al. (2018) Tuning elastic waves in soft phononic crystal cylinders via large deformation and electromechanical coupling. *ASME J. Appl. Mech.*, 85: 031004.

[9] W.J. Zhou, **B. Wu**, et al. (2018) Actively tunable transverse waves in soft membranetype acoustic metamaterials. *J. Appl. Phys.*, 123: 165304.

[8] **B. Wu**, et al. (2018) On free vibration of piezoelectric nanospheres with surface effect. *Mech. Adv. Mater. Struct.*, 25(13): 1101-1114.

[7] Y.P. Su, **B. Wu**, et al. (2018) Optimizing parameters to achieve giant deformation of an incompressible dielectric elastomeric plate. *Extreme Mech. Lett.*, 22: 60-68.

[6] J. Zhu, H. Chen, **B. Wu**, et al. (2018) Tunable band gaps and transmission behavior of SH waves with oblique incident angle in periodic dielectric elastomer laminates. *Int. J. Mech. Sci.*, 146-147: 81-90.

2017 [5] **B. Wu**, et al. (2017) On guided circumferential waves in soft electroactive tubes under radially inhomogeneous biasing fields. *J. Mech. Phys. Solids*, 99: 116-145.

2015 [4] **B. Wu**, et al. (2015) Surface effects on anti-plane shear waves propagating in magnetoelectro-elastic nano-plates. *Smart Mater. Struct.*, 24(9): 095017.

2014 [3] **B. Wu**, et al. (2014) One-dimensional equations for coupled extensional, radial, and axial-shear motions of circular piezoelectric ceramic rods with axial poling. *Arch. Appl. Mech.*, 84: 1677-1689. [Special Issue on 'Gérard A. Maugin: Engineering Scientist. Celebrating his 70th Anniversary' (**Invited contribution**)]

[2] W.Q. Chen, **B. Wu**, et al. (2014) On wave propagation in anisotropic elastic cylinders at nanoscale: surface elasticity and its effect. *Acta Mech.*, 225(10): 2743-2760.

[1] **B. Wu**, et al. (2014) Two-dimensional equations for high-frequency extensional vibrations of piezoelectric ceramic plates with thickness poling. *Arch. Appl. Mech.*, 84: 1917-1935.

Conference Proceedings

[4] E. Carrera, A. Pagani, **B. Wu**, M. Filippi. (2020) Large-deformation analysis of elastomeric structures by Carrera Unified Formulation. *Proceedings of IMECE2019*, 11364, Salt Lake City, Utah, USA.

[3] **B. Wu**, W.Q. Chen. (2013) Wave propagation in piezoelectric cylinders with surface effects. *Proceedings of the 2013 Symposium on Piezoelectricity, Acoustic Waves and Device Applications*, edited by X. Han et al., pp. 239-243, Changsha, Hunan, China.

[2] **B. Wu**, W.Q. Chen (2013) Elasticity theory of anisotropic spherical surfaces. In: *Developments in Solid Mechanics and its Applications*, edited by W.Q. Chen, R.Q. Xu and H.M. Wang, pp. 181-189, Zhejiang University Press, Hangzhou. (in Chinese)

[1] W.Q. Chen, **B. Wu** (2012) Wave propagation in elastic cylinders with surface effect. In: *Mechanics of Functional Materials and Structures (Proceedings of ACMFMS 2012)*, edited by Kapuria, S. and Pradyumna, S., pp. 275-278, Narosa Publising House, New Delhi.

Invited Presentations

2021 Feb. 22 Tuneable dynamic characteristics of soft electro-active materials. Virtual Conference of *AIDAA Educational Series and Academy – Challenges and Opportunities for the Aerospace Frontier Research*.

2019 Oct. 19-22 Geometrical nonlinear analysis of shells by Carrera Unified Formulation. *2nd ICMAMS*, Nanjing, China.

2019 Jun. 7 Large-deflection and post-buckling of flexible composite structures by Carrera Unified Formulation. *A One-Day Workshop on Virtual Manufacturing and Testing of Composites*, Turin, Italy.

2017 May 29-31 Tunable Bragg band gaps in a compressible dielectric elastomer cylinder. *Workshop on Phononic Crystals and Acoustic Metamaterials*, Beijing, China.

Conference Oral Presentations

2019 Oct. 19-22 Large-deformation analysis of elastomeric structures by Carrera Unified Formulation. *2nd ICMAMS*, Nanjing, China.

2019 Feb. 17-20 Effect of mechanical loading on free vibrations of plates with large-deflection and post-buckling. *The First International Nonlinear Dynamics Conference*, Rome, Italy.

2017 Aug. 13-16 On guided circumferential waves in soft electroactive tubes under inhomogeneous biasing fields. *The Chinese Congress of Theoretical and Applied Mechanics*, Beijing, China.

2016 Aug. 24-25 Electrostatically tunable band structures of elastic waves in compressible periodic dielectric elastomer laminates. *A Two-Days Workshop on Structural Mechanics*, University of Siegen, Germany.

2015 May 27-28 Effects of biasing fields on elastic wave propagation. *A Two-Days Workshop at the Chair of Structural Mechanics*, University of Siegen, Germany.

2013 Oct. 25-27 Wave propagation in piezoelectric cylinders with surface effects. *Proceedings of the 2013 Symposium on Piezoelectricity, Acoustic Waves and Device Applications*, Changsha, Hunan, China.

2013 Aug. 1-2 Elasticity theory of anisotropic spherical surfaces. *Proceedings of the 2013 Symposium on Solid Mechanics and its Applications*, Hangzhou, Zhejiang, China.