

Q.H. Ken Zuo, Ph.D.

Associate Professor
Department of Mechanical and Aerospace Engineering
University of Alabama in Huntsville
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PERSONAL

Citizenship: USA

EDUCATION

Ph.D. in Mechanical Engineering, **University of New Mexico**, Albuquerque, New Mexico, USA; 1995

M.S. in Structural Engineering, **Changan University** (formerly Xian Highway University), Xian, China; 1987

B.S. in Civil Engineering, **Southeast University**, Nanjing, China; 1984

PROFESSIONAL EMPLOYMENT

08/2006-Present: **University of Alabama in Huntsville**
Associate Professor, Department of Mechanical and Aerospace Engineering

06/2009-08/2009;

06/2010-08/2010;

06/2015-08/2015: **NASA Marshall Space Flight Center**
NASA Summer Faculty Fellow

11/2000-08/2006: **Los Alamos National Laboratory**
Technical Staff Member, Theoretical Division (T-3)

9/1999-11/2000: **The Procter & Gamble Company**
Engineer, Computer Aided Engineering for BabyCare Products

10/1998-9/1999: **ANSYS Inc.**
Software Developer, Product Development Department

09/1997-10/1998: **Los Alamos National Laboratory**
Post-Doctoral Research Associate, Theoretical Division

10/1995-08/1997: **University of Illinois**
Post-Doctoral Research Associate, Department of Civil Engineering

01/1988-09/1995: University of New Mexico
Graduate Research Assistant, Department of Mechanical Engineering
(01/90-09/95)

Graduate Research Assistant, Department of Civil Engineering
(01/88-12/89)

RESEARCH EXPERTISE/INTEREST

- Modeling Response of Materials under High Rate Conditions
- Physics of Friction Stir Welding and Plug Welding Processes
- Damage and Failure of Brittle Materials and Ductile Materials
- Plasticity and Fracture of Metals

AWARDS & HONORS

MDA Program Director Level Award, Missile Defense Agency, August, 2014.
Associate Fellow Award, American Institute of Aeronautics and Astronautics (AIAA), January 2014.

College of Engineering Outstanding Junior Faculty Member, The University of Alabama in Huntsville, March 2011.

NASA Faculty Fellow, Marshall Space Flight Center, 2009 and 2010.

Award of Excellence, Department of Energy (DOE) Defense Programs, 2005.

1995 Y.C. Hsu Memorial Award from the University of New Mexico for Excellence in Graduate Work in Mechanical Engineering.

TEACHING

Courses taught:

Undergraduate. Statics; Mechanics of Materials; Aerospace Structures.

Graduate. Plasticity; Impact and Penetration Mechanics; Fracture Mechanics; Structural Dynamics; Intermediate Dynamics, Viscoelasticity; Elasticity; Theory of Structural Stability; Continuum Mechanics.

GRADUATE STUDENTS ADVISING

Graduated:

1. Daniel Disilvestro (M.S.), (Date of Graduation: Dec., 2008). Thesis Title: *Incorporating Plastic Deformation into a Micromechanical Damage Model for Brittle Materials.*

2. John Colbaugh (M.S.), (Date of Graduation: August, 2009) Thesis Title: *An Investigation of the Effect of Spring Forces on the Separation of Rocket Motor and Payload.*

3. Luis Deganis (M.S.), (Date of Graduation: May, 2010). Thesis Title: *Incorporating a Nonlinear Equation of State in a Damage Model for High Velocity Impact Analysis of Brittle Materials.*
4. Joel Richter (M.S.), (Date of Graduation: May, 2010). Thesis Title: *Coupling of Plastic Effects with a Rate-Dependent Surface Energy Based Micromechanical Damage Model.*
5. Allen Pike (M.S.), (Date of Graduation: August, 2010). Thesis Title: *Geometric Design Constraints for Controlled Fragmentation of Metallic Cylindrical Shells.*
6. Nathan Mauch, (M.S.), (Date of Graduation: June, 2011). Thesis Title: *Effects of Engine Thrust and Mass, and Material Anisotropy on the Bending-Torsion Flutter of a Composite Wing.*
7. Charles Capps, (M.S.), (Date of Graduation: June, 2011). Thesis Title: *An Analysis and Simulation of Lunch Vehicle Separation Dynamics Including Thrust Transients.*
8. Abraham Kunin, (M.S.), (Date of Graduation: December, 2013). Thesis Title: *Stability and Well-posedness of a Rate-dependent Damage Model for Brittle Materials.*
9. W. Patrick Roush, (M.S.), (Date of Graduation: June, 2014). Thesis Title: *Incorporating Size Effect into a Micromechanical Damage Model for Brittle Materials.*
10. Jeremy Rice, (Ph.D.), (Date of Graduation: June, 2014). Dissertation Title: *A Finite-Deformation Constitutive Model for Solid Propellant Based Upon the Method of Cells.*

PROFESSIONAL AFFILIATIONS & ACTIVITIES

Associate Fellow of *American Institute of Aeronautics and Astronautics (AIAA)*

Member of *American Society of Mechanical Engineers (ASME)*

Member of *Sigma Xi: The Scientific Research Society*

Associate Editor and Member of the Editorial Board of *International Journal of Theoretical and Applied Multiscale Mechanics (IJTAMM)*, published by Inderscience Publishers, UK.

Chair, *Computational Structural Mechanics Session, the Huntsville Simulation Conference*, 2008 and 2009.

- Technical Reviewer for the following research journals:

Mathematical Problems in Engineering

Shock and Vibration

International Journal for Numerical and Analytical Methods in Geomechanics

Modelling and Simulation in Materials Science and Engineering

Finite Elements in Analysis and Design

AIAA Journal (AIAA)

Journal of Propulsion and Power (AIAA)

International Journal of Theoretical and Applied Multiscale Mechanics
International Journal of Plasticity
International Journal of Solids and Structures
Computer Methods in Engineering and Applied Mechanics
Journal of the Acoustical Society of America
ASCE Structures Journal
ASCE Journal of Engineering Mechanics

Technical Reviewer of proposal for US Army Research Office
Reviewer for Proposal for Internal Research Funding for Vanderbilt University
Reviewer for the Army Research Laboratory (ARL) Postdoctoral Fellowship Program
Member of Recommendation Panel for the Computational Technology Area Leader in the Computational Structural Mechanics for the Defense Research and Engineering, US Department of Defense

PUBLICATIONS

A. JOURNAL PUBLICATIONS

[32] Wang, G., Unal A. and **Zuo, Q.H.** (2016), “Modeling and Analysis of Multi-layered Elastic Beam Using Spectral Finite Element Method,” *Journal of Vibration and Acoustics*, Revise Version Under Review.

[31] Kunin, A.B. and **Zuo, Q.H.** (2016), “Stability and Well-posedness of a Rate-dependent Damage Model for Brittle Materials Based on Crack Mechanics”, *Applied Mathematical Modelling*, Vol. 91, 40, pp. 3801-3811.

[30] Pike, A.W. and **Zuo, Q.H.** (2014), “Geometric Design Consideration for Controlled Fragmentation of Metal Shells,” *Finite Elements in Analysis and Design*, Vol. 91, pp. 59-67.

[29] **Zuo, Q.H.**, L.E. Deganis and G. Wang (2012), “Elastic Waves and Damage Quantification in Brittle Material with Evolving Damage”, *Journal of Physics D: Applied Physics*, Vol. 45, No. 14, 145302, pp. 1-8.

[28] **Zuo, Q.H.** (2011), “On the Uniqueness of a Rate-independent Plasticity Model for Single Crystals”, *International Journal of Plasticity*, Vol. 27, pp. 1145-1164.

[27] Deganis, L.E. and **Zuo, Q.H.** (2011), “Crack-mechanics Based Brittle Damage Model Including Nonlinear Equation of State and Porosity Growth”, *AIP Journal of Applied Physics*, Vol. 109, 073504, pp. 1-11.

[26] Zuo, Q.H., D. Disilvestro and J. D. Richter (2010), “A Rate-dependent Model for Damage and Plasticity of Brittle Materials Under Dynamic Loading”, *International Journal of Solids and Structures*, Vol. 47, pp. 2790-2798.

- [25] **Zuo, Q.H.** and D.J. Alldredge (2010), “Stability and Well-posedness of a Rate-Dependent Strain-softening Plasticity Model”, *International Journal of Theoretical and Applied Multiscale Mechanics*, Vol. 1, pp. 195-218.
- [24] **Zuo, Q.H.** and H.L. Schreyer (2010), “Effect of Deviatoric Nonassociativity on the Failure Prediction for Elastic-plastic Materials”, *International Journal of Solids and Structures*, Vol. 47, pp. 1563-1571.
- [23] **Zuo, Q.H.** (2010), “Modified Formulation of a Rate-dependent Damage Model for Ductile Materials”, *AIP Journal of Applied Physics*, Vol. 107, 053513, pp. 1-5.
- [22] **Zuo, Q.H.** (2010), “On the Wave Speeds in Elastic-plastic Materials with Anisotropic Elasticity”, *International Journal of Plasticity*, Vol. 26, pp. 1-24.
- [21] **Zuo, Q.H.** and P.J. Maudlin (2009), “A Sub-grid Model for Localization in Metals under High-rate Loading: Formulations and Preliminary Results”, *International Journal of Theoretical and Applied Multiscale Mechanics*, Vol. 1, pp. 107-117.
- [20] **Zuo, Q.H.** (2009), “Upper Bound on Wave Speeds in Anisotropic Materials Based on Elastic Projection Operators”, *International Journal of Theoretical and Applied Multiscale Mechanics*, Vol. 1, pp. 16-29.
- [19] **Zuo, Q.H.** and J.R. Rice (2008), “An Implicit Algorithm for a Rate-dependent Ductile Failure Model”, *AIP Journal of Applied Physics*, Vol. 104, 083526, pp. 1-9.
- [18] **Zuo, Q.H.**, J.K. Dienes, J. Middleditch and H.W. Meyer Jr. (2008), “Modeling Anisotropic Damage in an Encapsulated Ceramic under Ballistic Impact”, *AIP Journal of Applied Physics*, Vol. 104, 023508, pp. 1-10.
- [17] **Zuo, Q.H.**, E.N. Harstad, F.L. Addessio and C.W. Greeff (2006), “A Model for Plastic Deformation and Phase Transformations of Zirconium under High-rate Loading”, *Modelling and Simulation in Materials Science and Engineering*, Institute of Physics Publishing, Vol. 14, pp. 1465-1484.
- [16E] Dienes, J.K., **Q.H. Zuo** and J.D. Kershner (2006), “Erratum to “Impact Initiation of Explosives and Propellants via Statistical Crack Mechanics”: [Journal of the Physics and Mechanics of Solids 54 (2006) 1237-1275]”, *Journal of the Physics and Mechanics of Solids*, Vol. 54, pp. 2235-2240.
- [16] Dienes, J.K., **Q.H. Zuo** and J.D. Kershner (2006), “Impact Initiation of Explosives and Propellants via Statistical Crack Mechanics”, *Journal of the Physics and Mechanics of Solids*, Vol. 54, pp. 1237-1275.
- [15] **Zuo, Q.H.**, F.L. Addessio, J.K. Dienes and M.W. Lewis (2006), “A Rate-Dependent Damage Model for Brittle Materials Based on the Dominant Crack”, *International Journal of Solids and Structures*, Vol. 43, pp. 3350-3380.

- [14] **Zuo, Q.H.** and J.K. Dienes (2005), “On the Stability of Penny-Shaped Cracks with Friction: The Five Types of Brittle Behavior”, *International Journal of Solids and Structures*, Vol. 42, pp. 1309-1326.
- [13] Gray, G.T., P.J. Maudlin, L.M. Hull, **Q.K. Zuo**, and S.R. Chen (2005), “Predicting Material Strength, Damage, and Fracture: The Synergy between Experiment and Modeling”, *ASM Journal of Failure Analysis and Prevention*, Vol. 5, pp. 7-17. (Feature article for the issue.)
- [12] Addressio, F.L., **Q.H. Zuo**, T.A. Mason and L.C. Brinson (2003), “Model for High-Strain Rate Deformations of Uranium-Niobium Alloys”, *AIP Journal of Applied Physics*, Vol. 93, pp. 9644-9654.
- [11] **Zuo, Q.H.** and K.D. Hjelmstad (1998), “Bounds and Approximations for Elastic Wave Speeds in Tetragonal Media”, *ASA Journal of the Acoustical Society of America*, Vol. 103, pp. 1727-1733.
- [10] **Zuo, Q.H.** and K.D. Hjelmstad (1998), “Piecewise Linear Warping Theory for Multilayered Elastic Beams”, *ASCE Journal of Engineering Mechanics*, Vol. 124, pp. 377-384.
- [9] **Zuo, Q.H.** and K.D. Hjelmstad (1997), “Bounds and Approximations for Elastic Wave Speeds in Cubic Crystals”, *ASA Journal of the Acoustical Society of America*, Vol. 101, pp. 3415-3420.
- [8] **Zuo, Q.H.** and K.D. Hjelmstad (1997), “Conditions for Bifurcation of a Cantilever Beam Subjected to Generalized Follower Loads: Geometrically Exact Approach”, *Journal of Sound and Vibration*, Vol. 203, pp. 899-902.
- [7] Hjelmstad, K.D., **Q.H. Zuo** and J.W. Kim (1997), “Elastic Pavement Analysis Using Infinite Elements”, *Transportation Research Record: Journal of the Transportation Research Board*, No. 1568, pp. 72-76.
- [6] **Zuo, Q.H.** and H.L. Schreyer (1996), “Flutter and Divergence Instability of Non-conservative Beams and Plates”, *International Journal of Solids and Structures*, Vol. 33, pp. 1355-1367.
- [5] **Zuo, Q.H.** and H.L. Schreyer (1995), “A Note on Pure-longitudinal and Pure-shear Waves in Cubic Crystals”, *ASA Journal of the Acoustical Society of America*, Vol. 98, pp. 580-583.
- [4] Schreyer, H.L. and **Q.H. Zuo** (1995), “Anisotropic Yield Surface Based on Elastic Projection Operators”, *ASME Journal of Applied Mechanics*, Vol. 52, pp. 780-785.

[3] Maji, A. K., H.L. Schreyer, S. Donald, **Q.H. Zuo** and D. Satpathi (1995), “Mechanics of Polyurethane Foam Impact Limiters”, *ASCE Journal of Engineering Mechanics*, Vol. 121, pp. 528-540.

[2] Schreyer, H.L., **Q.H. Zuo**, and A.K Maji (1994), “An Anisotropic Plasticity Model for Foams and Honeycombs”, *ASCE Journal of Engineering Mechanics*, Vol. 120, pp. 1913-1930.

[1] Maji, A.K., H.L. Schreyer, D. Satpathi, S. Donald and **Q.H. Zuo** (1993), “Dynamic Modeling for Designing Transportation Packaging Components”, *Journal of Radioactive Waste Management and the Nuclear Fuel Cycle*, Vol. 17, pp. 211-236.

B. PAPERS DELIVERED AT PROFESSIONAL MEETINGS:

[27] Zhou, H., Z. Shen and **Q.H. Zuo** (2014), “Multiscale Investigation and Modeling of a Carbon-fiber Reinforced Epoxy-polurea Hybrid Matrix Composite for Vibration Suppression”, the 2014 Conference of the ASCE Engineering Mechanics Institute, McMaster University, Hamilton, Canada, August 5-8, 2014. (Abstract was refereed and published in the conference proceedings).

[26] Zuo, Q.H. (2013), “Stability Analysis of a Rate-dependent Brittle Damage Model”, the 2013 Conference of the ASCE Engineering Mechanics Institute, Northwestern University, Evanston, IL, August 4 – 7, 2013 (Abstract was refereed and published in the conference proceedings).

[25] **Zuo, Q.H.**, L.E. Deganis and G. Wang, “Wave Propagations in Brittle Materials”, the 13th International Conference on Fracture, Beijing, China, June 16-19, 2013 (Abstract was refereed and published in the conference proceedings). (Deganis is Zuo’s graduate student.)

[24] Sotoudeh, V., R.J. Black, J. Costa, F. Faridian, B. Moslehi, L. Oblea, W.P. Roush, G. Wang and **Q.H. Zuo** (2013), “High-strain measurement using fiber Bragg grating sensors”, *Proceedings of SPIE Vol. 8690, Industrial and Commercial Applications of Smart Structures Technologies 2013* (edited by K.M. Farinholt and S.F. Griffin), paper # 869005, pp. 1-7. (Roush is Zuo’s graduate student.)

[23] Mauch, N.S. and **Q.H. Zuo** (2012), “Effects of Engine Thrust, Mass, and Material Anisotropy on Flutter of a Composite Wing”, *Proceedings of the 53rd AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Material Conference*; April 23-26, 2012, Honolulu, Hawaii; paper ID#: 1209491, pp. 1-9. (Mauch was Zuo’s graduate student.)

[22] **Zuo, Q.H.** and J.D. Richter (2011), “A Rate-Dependent Model for the Damage of Brittle Materials”, *ISCM III – CSE II, Proceedings of the Third International Symposium on Computational Mechanics (ISCM III) in Conjunction with the Second Symposium on Computational Structural Engineering (CSE II)*, 5-7 December, 2011, Taipei, Taiwan

(edited by Y-B Yang, L-J Lew, and C-S-Chen and published by National Taiwan University Press), pp. 92-93 (abstract; invited paper).

[21] Richter, J.D. and **Q.H. Zuo** (2011), “Including Plasticity in a Rate-Dependent Damage Model for Brittle Materials”, 11th US National Congress on Computational Mechanics, Minneapolis, MN, July 24- July 28, 2011 (abstract).

[20] Pike A.W. and **Q.H. Zuo** (2010), “Geometric Design Constraints for the Controlled Fragmentation of Metallic Cylindrical Shells”, Proceedings of the Huntsville Simulation Conference (HSC), (CD by Simulation Councils Inc., Chaired by J. S. Gauthier), pp, 1-1 (abstract).

[19] Deganis, L. E. and **Q.H. Zuo** (2010), “Incorporating Equation of State in a Damage Model for Brittle Materials under Dynamic Loading”, Proceedings of the 8th Biennial International Conference New Models and Hydrocodes for Shock Wave Processes in Condensed Matter, pp. 1-1 (abstract).

[18] **Zuo, Q.H.** (2010) “On the Uniqueness of a Rate-independent Anisotropic Plasticity Model for Single Crystals”, Proceedings of the 16th International Symposium on Plasticity and its Current Applications, (CD, edited by A.S. Khan and B. Farrokh, NEAT, Inc., ISBN: 0-9659463-2-0), pp, 1-1 (abstract).

[17] Colbaugh J. and **Q.H. Zuo** (2009), “The Effect of Spring Forces on the Separation of Rocket Motor and Payload”, Proceedings of the Huntsville Simulation Conference, October 27-29, 2009 (CD by Simulation Councils Inc., Chaired by J. S. Gauthier), pp, 1-1 (abstract).

[16] **Zuo, Q.H.** and D. Disilvestro (2009), “Plastic-DCA: a Crack Mechanics Based Model for Damage and Deformation of Brittle Material”, Proceedings of the 56th JANNAF Propulsion Meeting, Las Vegas, NV, April 14-17, 2009.

[15] **Zuo, Q.H.**, E.N. Harstad, F.L. Addessio and C.W. Greeff (2009), “A Constitutive Model for Zirconium under High-rate Loading”, *Proceedings of the 15th International Symposium on Plasticity and its Current Applications* (CD, edited by A.S. Khan and B. Farrokh, NEAT, Inc., ISBN: 0-9659463-9-8), pp, 1-1 (abstract).

[14] **Zuo, Q.H.** and J.R. Rice (2008), "An Implicit Numerical Algorithm for a Rate-Dependent Model for Ductile Materials", *Proceedings of The Huntsville Simulation Conference, HSC 2008*, (CD by Simulation Councils Inc., Chaired by J. S. Gauthier), pp, 1-1 (abstract).

[13] **Zuo, Q.H.**, P.J. Maudlin (2007), “A Sub-grid Model for Strain Localization in Metals under High-rate Loading”, *Proceedings of the 14th Joint Laboratory Biennial Nuclear Explosive Code Developers’ Conference*.

- [12] **Zuo, Q.H.**, F.L. Addressio, J.K. Dienes and M.W. Lewis (2006), “A Rate-Dependent Model for the Damage of Brittle Materials Under Dynamic Loading”, *Proceedings of the Sixth Biennial International Conference New Models and Hydrocodes for Shock Wave Processes in Condensed Matter*, pp. 28-30.
- [11] Harstad, E.N., F.L. Addressio and **Q.H. Zuo** (2006), “A Strength Model for Materials with Phase Change”, *AIP Conference Proceedings: SHOCK COMPRESSION OF CONDENSED MATTER – 2005*, Vol. 845, pp. 216-219.
- [10] Dienes, J.K., J. Middleditch, **Q.H. Zuo** and J.D. Kershner (2004), “On the Role of Crack Orientation in Brittle Failure”, *AIP Conference Proceedings: SHOCK COMPRESSION OF CONDENSED MATTER – 2003*, Vol. 706, pp. 447-450.
- [9] **Zuo, Q.H.**, J.K. Dienes, J. Middleditch and H.W. Meyer (2003), “Modeling the Damage in Ceramic Armor via Statistical Crack Mechanics”, *Proceedings of the Society for Experimental Mechanics (SEM) 2003 Annual Conference (CD)*, paper # 246, pp. 1-9.
- [8] Dienes, J.K., J. Middleditch, J.D. Kershner, **Q.H. Zuo** and A. Starobin (2002), “Progress in Statistical Crack Mechanics: An Approach to Initiation”, *Proceedings of 12th International Detonation Symposium (edited by J.M. Short)*, pp. 793-799.
- [7] **Zuo, Q.H.**, J.K. Dienes, J. Middleditch and H.W. Meyer (2002), “Modeling the Ballistic Performance of Ceramic Armor via Statistical Crack Mechanics”, *Proceedings of 5th Joint Classified Symposium (U) on Bomb & Warhead and Ballistics (CD)*, pp. 1-12.
- [6] Hjelmstad, K.D., J. Kim, and **Q.H. Zuo** (1997), “Finite Element Procedures for Three-Dimensional Pavement Analysis”, *Aircraft/Pavement Technology: In the Midst of Change*, edited by F.V. Hermann, pp. 125-137.
- [5] Kim, J., K.D. Hjelmstad, and **Q.H. Zuo** (1997), “Three-Dimensional Finite Element Study of Wheel Load Interaction”, presented at *1997 Aircraft/Pavement Technology: In the Midst of Change*, edited by F.V. Hermann, pp. 138-150.
- [4] **Zuo, Q.H.** and H.L. Schreyer (1995), “Flutter and Divergence Instability of Non-conservative Plates”, *Proceedings of the ASCE 10th Engineering Mechanics Conference* edited by S. Sture, pp. 187-190.
- [3] **Zuo, Q.H.** and H.L. Schreyer (1994), “Flutter and Divergence Instability of the Cantilevered Beam”, *Recent Advances in Structural Mechanics*, ASME PVP-Vol. 295, edited by Y.W. Kwon and H.H. Chung, pp. 211-214.
- [2] Schreyer, H.L. and **Q.H. Zuo** (1994), “Anisotropic Yield Surface Based on Elastic Projection Operators”, *Material Instabilities: Theory and Application*, ASME AMD-Vol. 183, edited by R.C. Batra and H.M. Zbib, pp. 95-109.

[1] **Zuo, Q.H.**, Maji, A. K., M.K. Neilsen and H.L. Schreyer (1992), “Rate-Dependent Plasticity Representation for Energy Absorbing Materials”, *Proceedings of the ASCE 9th Engineering Mechanics Conference*, edited by L.D. Lutes and J.M. Niedzwecki, pp. 151-154.