School for Engineering of Matter, Transport & Energy
Arizona State University

Yongming Liu, Ph.D.

EDUCATION

Ph.D. in Civil Engineering
Vanderbilt University, Nashville, TN May 2006
Dissertation: Stochastic multiaxial fatigue and fracture modeling

M.S. in Structural Engineering
Tongji University, Shanghai, China May 2002
Thesis: Fracture behavior of steel beam-column joints under earthquake loading

B.S. in Structural Engineering
Tongji University, Shanghai, China July 1999
Thesis: Nonlinear dynamic response of steel frame structures

PROFESSIONAL EXPERIENCE

Professor, School for Engineering of Matter, Transport & Energy, Arizona State University, 2017 – present

Associate professor, School for Engineering of Matter, Transport & Energy, Arizona State University, 2012 – 2017

Associate professor, Department of Civil and Environmental Engineering, Clarkson University, 2012

Assistant Professor, Department of Civil and Environmental Engineering, Clarkson University, 2007 - 2012

SYNERGISTIC ACTIVITIES

- Associated Editor, ASCE Journal of Bridge Engineering, 2010 – present; responsible for the submission on fatigue, fracture, and structural reliability
- Editorial board of ASCE/ASME Journal of Risk and Uncertainty Analysis, 2013~
- Guest Editor for the Special Issue on "Physics-of-Failure based reliability and life prediction for critical components", to be published in Advances in Mechanical Engineering, Springer, 2016.
- Editorial board of Journal of Chongqing University (English Edition); 2008~.
- Associate Fellow of AIAA, member of ASCE
- Student paper Chair of AIAA SciTech – NDA conference, 2015 (Elected)
- Deputy Technical Chair of AIAA SciTech – NDA conference, 2017 (Elected)
- Technical Chair of AIAA SciTech – NDA conference, 2018 (Elected)
- Scientific committee, 2016/2018 ASCE EMI & PMC

- Member of Nondeterministic Approach Technical Committee, AIAA
- Member of Probabilistic Methods committee, ASCE
- Member of advanced materials and structures committee, ASCE
- Member of SEI-ASCE Technical Council on Life-Cycle Performance, Safety, Reliability and Risk of Structural Systems.
- Conference session Chair and co-Chair: MS&T 2010, 49th ~ 51th Structures, Dynamics, and Materials Conference; 10th AIAA Non-Deterministic Approaches Conference; ASCE Engineering Mechanics 2008, ASCE.
- Proposal review for DOE, NSF, UTRC, Houston University
- Technical reviewer of many prestigious journals in engineering mechanics, including International Journal of Fatigue, Engineering Fracture Mechanics, ASCE – Journal of Structural Engineering, ASCE – Journal of Bridge Engineering, Reliability Engineering and System Safety, etc.
- University senator , ASU 2014-2018
- ASU task force group for improving the university facility services, 2015

HONORS AND AWARDS

- SwRI Best Student Paper Award, at 2019 AIAA SciTech, PhD advisor
- Best Paper (Theory) Award, PHM Society Annual Conference, 2018
- Exemplar faculty, School of Engineering, Arizona State University, 2018
- Harry H. and Lois G. Hilton Student Paper Award at 2016 AIAA SciTech, PhD advisor
- Best paper award, ASCE Journal of Aerospace Engineering, 2011
- AFOSR Young Investigator Award, 2011
- Million Dollar Club – research grant, Clarkson University, 2011
- Albert Merrill Award 2010-2011, Clarkson University CEE
- Excellent Reviewer Award, ASCE Journal of Bridge Engineering, 2010
- Teaching Excellence Award – Clarkson CSoE, 2008, 2011
- Best student paper award, 1st prize, School of Engineering, Vanderbilt University, 2006
- Harold Stirling Vanderbilt Graduate Scholarship, Vanderbilt University, 2002-2005
- Jinmen Scholarship, Tongji University, 2002

BOOK CHAPTERS

(highlighted **Liu, Y/Yongming Liu** indicating the corresponding author; * indicating my current/former students; ** indicating my current/former postdoc; *** indicating my current/former visiting scholars)

1. **Liu, Y** and Mahadevan, S. Probabilistic fatigue damage modeling of composite laminates, Fatigue of Composite Materials, edited by Ronald F. Gibson, 2013, ISBN: 978-1-60595-085-3
2. Xuefei Guan*, Jingjing He*, Ratneshwar Jha, **Yongming Liu** "Structure Reliability and Response Prognostics under Uncertainty Using Bayesian Analysis and Analytical Approximations", (pages 358-375), Diagnostics and Prognostics of

Engineering Systems, Editor: Seifedine Kadry, IGI Global, 2012. ISBN: 978-1-4666-2095-7

3. Jingjing He*, Xuefei Guan*, **Yongming Liu**, "Fatigue Damage Prognostics and Life Prediction with Dynamic Response Reconstruction Using Indirect Sensor Measurements" (pages 376-390), Diagnostics and Prognostics of Engineering Systems, Editor: Seifedine Kadry, IGI Global, 2012. ISBN: 978-1-4666-2095-7
4. Guan, X* and **Liu, Y**. Bayesian Analysis for Fatigue Damage Prognostics and Remaining Life Prediction (Chp 7). In Machine Learning and Knowledge Discovery for Engineering Systems Health Management. Edited by Ashok Srivastava and Jiawei Han, Chapman and Hall/CRC Press, 2011, ISBN-13: 978-1439841785.
5. **Liu, Y.** and Mahadevan, S. Fatigue life prediction of composites and composite structures. Edited by A.P. Vassilopoulos, Woodhead Publishing, July 2010. ISBN 1 84569 525 9; ISBN-13: 978 1 84569 525 5.

EDITED VOLUME

(highlighted **Liu, Y/Yongming Liu** indicating the corresponding author; * indicating my current/former students; ** indicating my current/former postdoc; *** indicating my current/former visiting scholars)

1. Walbridge, Scott, and Yongming Liu, 'Fatigue Design, Assessment, and Retrofit of Bridges' (American Society of Civil Engineers, 2018)
2. Zhu, Shun-Peng, Xiancheng Zhang, Chao Jiang, Yongming Liu, and Zhiyong Huang, 'Physics-of-Failure-Based Reliability and Life Prediction for Critical Components' (SAGE Publications Sage UK: London, England, 2017)

JOURNAL PUBLICATIONS

(highlighted **Liu, Y/Yongming Liu** indicating the corresponding author; * indicating my current/former students; ** indicating my current/former postdoc; *** indicating my current/former visiting scholars)

1. Chang, Qinan*, Tishun Peng*, and **Yongming Liu,** 'Tomographic Damage Imaging Based on Inverse Acoustic Wave Propagation Using K-Space Method with Adjoint Method', Mechanical Systems and Signal Processing, 109 (2018), 379–98
2. Chang, Qinan*, Tishun Peng*, and **Yongming Liu,** 'Wave Propagation Simulation in Damaged Isotropic and Anisotropic Solids Using K-Space Method', Journal of Theoretical and Computational Acoustics, 26 (2018), 1850023
3. Dahire, Sonam*, Fraaz Tahir*, Yang Jiao, and **Yongming Liu,** 'Bayesian Network Inference for Probabilistic Strength Estimation of Aging Pipeline Systems', International Journal of Pressure Vessels and Piping, 162 (2018), 30–39
4. **Liu, Yongming,** and Chao Zhang**, 'A Critical Plane-Based Model for Mixed-Mode Delamination Growth Rate Prediction under Fatigue Cyclic Loadings', Composites Part B: Engineering, 139 (2018), 185–94
5. Luo, Guangen***, and Yongming Liu, 'Two Simplified Methods for Fatigue Crack Growth Prediction under Compression-Compression Cyclic Loading', Marine Structures, 58 (2018), 367–81
6. Sun, Zhe, Cheng Zhang, Pingbo Tang, Yuhao Wang*, and Yongming Liu, 'Bayesian Network Modeling of Airport Runway Incursion Occurring Processes for Predictive Accident Control', in Advances in Informatics and Computing in Civil and Construction Engineering (Springer, 2019), pp. 669–76

7. Venkatesan, Karthik Rajan*, and **Yongming Liu,** 'Subcycle Fatigue Crack Growth Formulation under Positive and Negative Stress Ratios', Engineering Fracture Mechanics, 189 (2018), 390–404
8. Wang, Da***, Yang Deng, Yong-ming Liu, and Yang Liu, 'Numerical Investigation of Temperature Gradient-Induced Thermal Stress for Steel–concrete Composite Bridge Deck in Suspension Bridges', Journal of Central South University, 25 (2018), 185–95
9. Wang, Da***, Yongming Liu, and Yang Liu, '3D Temperature Gradient Effect on a Steel–concrete Composite Deck in a Suspension Bridge with Field Monitoring Data', Structural Control and Health Monitoring, 25 (2018), e2179
10. Wu, Jun, Jingrui He, and Yongming Liu, 'ImVerde: Vertex-Diminished Random Walk for Learning Network Representation from Imbalanced Data', ArXiv Preprint ArXiv:1804.09222, 2018
11. Yuan, Hao, Wei Zhang, Gustavo M Castelluccio, Jeongho Kim, and Yongming Liu, 'Microstructure-Sensitive Estimation of Small Fatigue Crack Growth in Bridge Steel Welds', International Journal of Fatigue, 112 (2018), 183–97
12. Yuan, Ming***, Yun Liu***, Donghuang Yan, and Yongming Liu, 'Probabilistic Fatigue Life Prediction for Concrete Bridges Using Bayesian Inference', Advances in Structural Engineering, 22 (2019), 765–78
13. H. Wei*, **Y. Liu** (2017), A critical plane-energy model for multiaxial fatigue life prediction, Fatigue and Fracture of Engineering Materials and Structures, Volume 40, Issue 12, December 2017, Pages 1973–1983.
14. **Liu, Y.,** Venkatesan, K. R.*, & Zhang, W.* (2017). Time-based subcycle formulation for fatigue crack growth under arbitrary random variable loadings. Engineering Fracture Mechanics, 182, 1-18.
15. Cang, R., Xu, Y., Chen, S., Liu, Y., Jiao, Y., & Ren, M. Y. (2017). Microstructure Representation and Reconstruction of Heterogeneous Materials via Deep Belief Network for Computational Material Design. Journal of Mechanical Design, 139(7), 071404.
16. Chen Z, Li C, Ke L, Liu Y, Lin J. Study on fatigue damages and retrofit methods of steel box girder in a suspension bridge. Tumu Gongcheng Xuebao/China Civil Engineering Journal. 2017 Mar 1;50(3):91-100.
17. Yuan, H., Zhang, W., Kim, J., & Liu, Y. (2017). A nonlinear grain-based fatigue damage model for civil infrastructure under variable amplitude loads. International Journal of Fatigue, 104, 389-396.
18. Bridgeman, D., Tsow, F., Xian, X., Chang, Q., Liu, Y., & Forzani, E. (2017). Thermochemical Humidity Detection in Harsh or Non-Steady Environments. Sensors, 17(6), 1196.
19. Tahir, F.*, Dahire, S.*, & **Liu, Y.** (2017). Image-based creep-fatigue damage mechanism investigation of Alloy 617 at 950° C. Materials Science and Engineering: A, 679, 391-400.
20. Tahir F*, **Liu Y.** A new experimental testing method for investigation of creep-dominant creep-fatigue interaction in Alloy 617 at 950° C. International Journal of Pressure Vessels and Piping. 2017 Jul 1;154:75-82.

21. Liu, Y.***, Zhang, H., Liu, Y., Deng, Y., Jiang, N., & Lu, N. (2017). Fatigue reliability assessment for orthotropic steel deck details under traffic flow and temperature loading. Engineering Failure Analysis, 71, 179-194.
22. Wang, L.***, Zhang, X.***, Zhang, J., Dai, L., & Liu, Y. (2017). Failure analysis of corroded PC beams under flexural load considering bond degradation. Engineering Failure Analysis, 73, 11-24.
23. Zhang, X.***, Wang, L.***, Zhang, J., Ma, Y.***, & Liu, Y. (2017). Flexural behavior of bonded post-tensioned concrete beams under strand corrosion. Nuclear Engineering and Design, 313, 414-424.
24. Zhang, X.***, Wang, L.***, Zhang, J., & Liu, Y. (2017). Corrosion-induced flexural behavior degradation of locally ungrouted post-tensioned concrete beams. Construction and Building Materials, 134, 7-17.
25. Ma, Y.***, Guo, Z., Wang, L.***, Zhang, J. and Liu, Y., 2017. Effects of Stress Ratio and Banded Microstructure on Fatigue Crack Growth Behavior of HRB400 Steel Bar. Journal of Materials in Civil Engineering, 30(3), p.04017314.
26. Yuan, M.***, Yan, D., Zhong, H., & Liu, Y. (2017). Experimental investigation of high-cycle fatigue behavior for prestressed concrete box-girders. Construction and Building Materials, 157, 424-437.
27. Wang D***, Liu Y, Kong B, Cai CS, Liu Y. Simple Analytical Model for Vibration Frequency Calculation of Anchor Span Strand in Suspension Bridges. Journal of Engineering Mechanics. 2017 Jul 20;143(10):04017115.
28. Chen, H.*, Xu, Y., Jiao, Y., & **Liu, Y**. (2016). A novel discrete computational tool for microstructure-sensitive mechanical analysis of composite materials. Materials Science and Engineering: A, 659, 234-241.
29. H. Chen*, Y. Jiao and **Y. Liu** (2016). A Nonlocal Lattice Particle Model for Fracture Simulation of Anisotropic Materials. Composites Part B: Engineering, Volume 90, 1 April 2016, Pages 141–151
30. H. Chen*, and **Y. Liu** (2016). A Nonlocal 3D Lattice Particle Framework for Elastic Solids. International Journal of Solids and Structures. Volume 81, 1 March 2016, Pages 411–420.
31. Chen, H.*, & **Liu, Y.** (2016). Deformation and failure analyses of cross-ply laminates using a nonlocal discrete model. Composite Structures, 152, 1007-1013.
32. Peng, T.*, & **Liu, Y**. (2016). 3D crack-like damage imaging using a novel inverse heat conduction framework. International Journal of Heat and Mass Transfer, 102, 426-434.
33. Chen, H.*, Meng, L., Chen, S., Jiao, Y., & **Liu, Y**. (2016). Numerical investigation of microstructure effect on mechanical properties of bi-continuous and particulate reinforced composite materials. Computational Materials Science, 122, 288-294.
34. Yang, J., He, J.*, Guan, X.*, Wang, D., Chen, H., Zhang, W.*, & Liu, Y. (2016). A probabilistic crack size quantification method using in-situ Lamb wave test and Bayesian updating. Mechanical Systems and Signal Processing, 78, 118-133.
35. He, J.*, Zhou, Y., Guan, X.*, Zhang, W.*, Zhang, W., & Liu, Y. (2016). Time Domain Strain/Stress Reconstruction Based on Empirical Mode Decomposition: Numerical Study and Experimental Validation. Sensors, 16(8), 1290.

36. Wang, L.***, Zhang, X.***, Zhang, J., Yi, J., & Liu, Y. (2016). Simplified model for corrosion-induced bond degradation between steel strand and concrete. Journal of Materials in Civil Engineering, 04016257.
37. Zhang, X.***, Wang, L.***, Zhang, J., & Liu, Y. (2016). Model for Flexural Strength Calculation of Corroded RC Beams Considering Bond–Slip Behavior. Journal of Engineering Mechanics, 142(7), 04016038.
38. Zhang, X.***, Wang, L.***, Zhang, J., & Liu, Y. (2016). Bond Degradation–Induced Incompatible Strain between Steel Bars and Concrete in Corroded RC Beams. Journal of Performance of Constructed Facilities, 30(6), 04016058.
39. Wang, D.***, Zhang, W., Liu, Y., & Liu, Y. (2016). Strand Tension Control in Anchor Span for Suspension Bridge Using Dynamic Balance Theory. Latin American Journal of Solids and Structures, 13(10), 1838-1850.
40. Xiang Y**, **Liu Y.** Equivalent Stress Transformation for Efficient Probabilistic Fatigue-Crack Growth Analysis under Variable Amplitude Loadings. Journal of Aerospace Engineering. 2015 Sep 10:04015052.
41. **Liu Y**, Zhang C**, Xiang Y*. A critical plane-based fracture criterion for mixed-mode delamination in composite materials. Composites Part B: Engineering. 2015 Dec 1;82:212-20.
42. Peng, T.*, **Liu, Y**., Saxena, A., and Goebel, K., "In-situ fatigue life prognosis for composite laminates based on stiffness degradation," *Composite Structures*, Vol. 132, 2015, pp. 155-165.
43. Lin E**, Chen H*, **Liu Y.** Finite element implementation of a non-local particle method for elasticity and fracture analysis. Finite Elements in Analysis and Design. 2015 Jan 31;93:1-1.
44. H. Chen*, Y. Jiao and **Y. Liu** (2015). Investigating the Microstructural Effect on Elastic and Fracture Behavior of Polycrystals Using a Nonlocal Lattice Particle Model. Materials Science and Engineering: A 631, 173-180.
45. Yang J, He J*, Guan X, Wang D, Chen H, Zhang W*, Liu Y. A probabilistic crack size quantification method using in-situ Lamb wave test and Bayesian updating. Mechanical Systems and Signal Processing. 2015 Jul 7.
46. Ma Y***, Wang L***, Zhang J, Xiang Y*, Liu Y. Closure to "Bridge Remaining Strength Prediction Integrated with Bayesian Network and In Situ Load Testing" by Yafei Ma, Lei Wang, Jianren Zhang, Yibing Xiang, and Yongming Liu. Journal of Bridge Engineering. 2015 Mar 12.
47. Xuhui Zhang***, Lei Wang***, Jianren Zhang, Yongming Liu. "Model for flexural strength calculation of corroded RC beams considering bond-slip behavior." ASCE J. Eng. Mech. , 10.1061/(ASCE)EM.1943-7889.0001079 , 04016038.
48. Wang L***, Ma Y***, Zhang J, Zhang X***, Liu Y. Uncertainty Quantification and Structural Reliability Estimation Considering Inspection Data Scarcity. ASCE-ASME Journal of Risk and Uncertainty in Engineering Systems, Part A: Civil Engineering. 2015 Mar 17;1(2):04015004.
49. Wang Lei***, Ma Yafei***, Ding Wei, Zhang Jianren, Liu Yongming. "Comparative study of flexural behavior of corroded beams with different types of steel bars." Journal of Performance of Constructed Facilities, 29.6 (2015): 10.1061/(ASCE)CF.1943-5509.0000661.

50. Lei Wang***, Xuhui Zhang***, Jianren Zhang, Yafei Ma***, Yongming Liu. "Effects of stirrup and inclined bar corrosion on shear behavior of RC beams." Construction and Building Materials. 98 (2015): 537–546
51. H. Chen*, E. Lin**, Y. Jiao and **Y. Liu** (2014). A Generalized 2D Non-local Lattice Spring Model for Fracture Simulation. Computational Mechanics 54(6), 1541-1558.
52. H. Chen*, E. Lin** and **Y. Liu** (2014). A Novel Volume-Compensated Particle Method for 2D Elasticity and Plasticity Analysis. International Journal of Solids and Structures 51(9), 1819-1833.
53. Xiang, Y*; Liu, R*; Peng, T*; **Liu, Y.** "A Novel Subcycle Fatigue Delamination Growth Considering Stress Ratio Effect". Composite Structures.2014. 108(0): 31-40.
54. Peng, T.*, He, J.*, Xiang, Y.*, **Liu, Y**., Saxena, A., Celaya, J., and Goebel, K., Probabilistic fatigue damage prognosis of lap joint using Bayesian updating. Journal of Intelligent Material Systems and Structures, 2014. 1045389X14538328.
55. T. Peng*, A. Saxena, K. Goebel, Y. Xiang*, **Y. Liu**, Integrated experimental and numerical investigation for fatigue damage diagnosis in composite plates. Structural Health Monitoring , 2014. vol. 13 no. 5 537-547.
56. Ma, Y.***, Xiang, Y.**, Wang, L.***, Zhang, J., and **Liu, Y.** Fatigue life prediction for aging RC beams considering corrosive environments. Eng. Struct., 2014, 79: 211-221.
57. Ma, Y.***, Wang, L.***, Zhang, J., Xiang, Y.**, and Liu, Y. Bridge remaining strength prediction integrated with Bayesian network and in situ load testing. J. Bridge Eng., 2014, 19(10): 04014037.
58. Ma, Y.***, Wang, L.***, Zhang, J., Xiang, Y.**, Peng, T.*, and Liu, Y. Hybrid uncertainty quantification for probabilistic corrosion damage prediction for aging RC bridges. J. Mater. Civ. Eng., 2014, 10.1061/(ASCE)MT.1943-5533.0001096, 04014152.
59. Yang J*, Zhang W*, **Liu Y.** Existence and insufficiency of the crack closure for fatigue crack growth analysis. International Journal of Fatigue. 2014 May 31;62:144-53.
60. Wang Lei***, Zhang Xuhui***, Zhang Jianren, Ma Yafei***, Xiang Yibing**, Liu Yongming. Effect of insufficient grouting and strand corrosion on flexural behavior of PC beams. Construction & Building Materials, 2014, 53: 213-224.
61. Peng, T.*, Saxena, A., Goebel, K., Xiang, Y.**, Sankararaman, S., and **Liu, Y**., A novel Bayesian imaging method for probabilistic delamination detection of composite materials. Smart Mater. Struct., 2013. 22(12): p. 125019.
62. J He*, X Guan*, T Peng*, **Y Liu**, A Saxena, J Celaya, and K Goebel, A multi-feature integration method for fatigue crack detection and crack length estimation in riveted lap joints using Lamb waves, Smart Materials and Structures, 2013 22(10), 105007.
63. Li, H**, Xiang, Y*, Wang, L***, Zhang, J, **Liu, Y.** Uncertainty propagation in fatigue crack growth analysis using dimension reduction technique. International journal of reliability and safety. 2013 Jan 1;7(3):293-317.

64. Ma Yafei***, Zhang Jianren, Wang Lei***, Liu Yongming. Probabilistic prediction with Bayesian updating for strength degradation of RC bridge beams. Structural Safety, 2013, 44: 102-109.
65. Wang Lei***, Ma Yafei***, Zhang Jianren, Liu Yongming. Probabilistic analysis of corrosion of reinforcement in RC bridge considering fuzziness and randomness. Journal of Structural Engineering, 2013, 139(9): 1529-1540.
66. Lu Z*, Xu J, Wang L***, Zhang J, **Liu Y.** Curvilinear Fatigue Crack Growth Simulation and Validation under Constant Amplitude and Overload Loadings. Journal of Aerospace Engineering. 2013 Feb 21;28(1):04014054.
67. Guan, X.*, R. Jha, and **Y. Liu**, Maximum relative entropy-based probabilistic inference in fatigue crack damage prognostics. Probabilistic Engineering Mechanics, 2012. 29(0): p. 157-166.
68. Guan, X.*, R. Jha, and **Y. Liu**, An efficient analytical Bayesian method for reliability and system response updating based on Laplace and inverse first-order reliability computations. Reliability Engineering & System Safety, 2012. 97(1): p. 1-13.
69. Guan, X.*, R. Jha, and **Y. Liu**, Probabilistic fatigue damage prognosis using maximum entropy approach. Journal of Intelligent Manufacturing, 2012. 23(2): p. 163-171.
70. He, J.*, X. Guan*, and **Y. Liu**, Structural response reconstruction based on empirical mode decomposition in time domain. Mechanical Systems and Signal Processing, 2012. 28(0): p. 348-366.
71. **Liu, Y.,** Z. Lu*, and J. Xu, A simple analytical crack tip opening displacement approximation under random variable loadings. International Journal of Fracture, 2012. 173(2): p. 189-201.
72. Zhang, W.* and **Y. Liu**, In situ SEM testing for crack closure investigation and virtual crack annealing model development. International Journal of Fatigue, 2012. 43(0): p. 188-196.
73. X. Guan*, R. Jha, and **Y. Liu**, "Model Selection, Updating and Averaging for Probabilistic Fatigue Damage Prognosis", Structural Safety, Volume 33, Issue 3, May 2011, Pages 242-249.
74. Lu, Z.*, **Liu, Y**., Experimental investigation of random loading sequence effect on fatigue crack growth, Materials and Design, Volume 32, Issue 10, December 2011, Pages 4773–4785.
75. Lu, Z*, **Liu, Y.** A comparative study between a small time scale model and the two driving force model for fatigue analysis. International Journal of Fatigue. 2012 Sep 30;42:57-70.
76. Zhang, W.* and **Liu, Y**. "Plastic Zone Size Estimation under Cyclic Loadings Using In-Situ Optical Microscopy Fatigue Testing", Fatigue & Fracture of Engineering Materials & Structures, Volume 34, Issue 9, pages 717–727, September 2011.
77. Zhang W*, **Liu Y.** Investigation of incremental fatigue crack growth mechanisms using in situ SEM testing. International Journal of Fatigue. 2012 Sep 30;42:14-23.
78. He J*, Lu Z*, **Liu Y.** New method for concurrent dynamic analysis and fatigue damage prognosis of bridges. Journal of Bridge Engineering. 2011 Aug 10;17(3):396-408.

79. Guan, X.*, **Liu, Y.,** Jha, R., Saxena, A., Celaya, J. and Goebel, K., "Comparison of Two Probabilistic Fatigue Damage Assessment Approaches Using Prognostic Performance Metrics", International Journal of PHM Society. Vol 2 (1) 005, pages: 11, 2011.
80. Xiang, Y.* and **Liu, Y**. Application of Inverse first-order reliability method for probabilistic fatigue life prediction. Probabilistic Engineering Mechanics, Volume 26, Issue 2, April 2011, Pages 148-156.
81. Xiang, Y.* and **Liu, Y**. "Inverse first-order reliability method for probabilistic fatigue life prediction of composite laminates under multiaxial loading", ASCE Journal of Aerospace Engineering, 24, 189 (2011); doi:10.1061/(ASCE)AS.1943-5525.0000023.
82. Xiang Y*, **Liu Y**. EIFS-based crack growth fatigue life prediction of pitting-corroded test specimens. Engineering Fracture Mechanics;77(8):1314-1324.
83. Xiang Y*, Lu Z, **Liu Y**. Crack growth-based fatigue life prediction using an equivalent initial flaw model. Part I: Uniaxial loading. International Journal of Fatigue;32(2):341-349.
84. Xiang Y*, **Liu Y**. Mechanism modelling of shot peening effect on fatigue life prediction. Fatigue & Fracture of Engineering Materials & Structures;33(2):116-125.
85. Lu Z*, Xiang Y*, **Liu Y**. Crack growth-based fatigue-life prediction using an equivalent initial flaw model. Part II: Multiaxial loading. International Journal of Fatigue;32(2):376-381.
86. Zizi Lu*, **Yongming Liu**, Concurrent fatigue crack growth simulation using extended finite element method. Frontiers of Architecture and Civil Engineering in China. 2010(4)3: 339-347.
87. Zizi Lu*, **Yongming Liu**, Small time scale fatigue crack growth analysis. International Journal of Fatigue International Journal of Fatigue. 2010, 32(8): 1306-1321.
88. **Liu, Y.**, Mahadevan, S., "Probabilistic fatigue life prediction using an equivalent initial flaw size distribution", International Journal of Fatigue, Vol. 31, Issue 3, pp. 476-487, 2009.
89. **Liu, Y.**, Mahadevan, S., "Fatigue limit prediction of notched components using short crack growth theory and an asymptotic interpolation method", Engineering Fracture Mechanics, Volume 76, Issue 15, pp. 2317-2331, 2009.
90. **Liu, Y.**, Mahadevan, S. Efficient methods for time-dependent fatigue reliability analysis. AIAA Journal, Vol. 47, Number 3, pp. 494-504, 2009.
91. Liu, Y., Liu, L., Stratman, B., Mahadevan, S. Multiaxial fatigue reliability analysis of railroad wheels. Reliability Engineering and System Safety, Vol. 93, Issue 3, pp. 456-467, 2008.
92. Stratman, B., Liu, Y., Mahadevan, S. "Structural Health Monitoring of Railroad Wheels Using Wheel Impact Load Detectors". Journal of Failure Analysis and Prevention, Volume 7, Number 3, pp. 218-225, 2007.
93. Liu, Y., Liu, L., Mahadevan, S., Analysis of subsurface fatigue crack propagation under rolling contact loading. Engineering Fracture Mechanics, Vol. 74, pp. 2659-2674, 2007.

94. Liu, Y., Mahadevan, S., Stochastic fatigue damage modeling under variable amplitude loading. International Journal of Fatigue, Vol. 29, pp. 1149-1161, 2007.
95. Liu, Y., Mahadevan, S., Fatigue threshold intensity factor and crack growth rate prediction under mixed-mode loading. Engineering Fracture Mechanics, Vol. 74, pp. 332-345, 2007.
96. Liu, Y., Mahadevan, S., A unified multiaxial fatigue model for isotropic and anisotropic materials. International Journal of Fatigue, International Journal of Fatigue, pp. 347-359, Vol. 29, 2007.
97. Liu, Y., Stratman, B., Mahadevan, S., Fatigue crack initiation life prediction of railroad wheels. International Journal of Fatigue, Vol. 28, Issue 7, pp. 747-756, 2006.
98. Liu, Y., Mahadevan, S., Stain based multiaxial fatigue damage modeling. Fatigue & Fracture of Engineering Materials & Structures, Vol. 28, pp. 1177-1189, 2005.
99. Liu, Y., Mahadevan, S., Multiaxial high-cycle fatigue criterion and life prediction for metals. International Journal of Fatigue, Vol. 27, Issue 27, pp. 790-800, 2005.
100. Liu, Y., Mahadevan, S., Probabilistic fatigue life prediction of multidirectional composite laminates. Composite Structures, Vol. 69, pp. 11-19, 2005.
101. Rebba, R., Huang, S., Liu, Y., and Mahadevan S. Statistical validation of simulation models. International Journal of Materials and Product Technology, Vol. 25, pp. 164 – 181, 2006.
102. Liu, Y., Chen, Y.Y., Chen, Y.J. Hysteresis model of steel frame connection considering partial fracture. Journal of Tongji University (Natural Science), Vol.31, No.5, pp.525-530, 2003. (in Chinese)
103. Liu, Y., Zhang, Y., Chen, Y.Y. Chen, Y.J. Experimental research on fracture performance in weld heat-affect Zone. Shanghai Journal of Mechanics, Vol.23, No.2, 2002. (in Chinese)
104. Chen, Y.Y., Liu, Y., Yue, C., Earthquake response analysis of steel tube frames based on the hysteresis model of columns with axial loading change. World Information on Earthquake Engineering, Vol. 16, No.4, 2000. (in Chinese)

CONFERENCE PROCEEDINGS AND PRESENTATIONS

(highlighted **Liu, Y/Yongming Liu** indicating the corresponding author; * indicating my current/former students; ** indicating my current/former postdoc; *** indicating my current/former visiting scholars)

1. Chen, H.*, Jiao, Y. and Liu, Y. (2019) 'An Integrated Computational Framework for Microstructure-Sensitive Materials Modeling', in AIAA Scitech 2019 Forum, p. 691.
2. Gao, Y.* and **Liu, Y.** (2019a) 'Adjoint Gradient-enhanced Kriging Model for Time-dependent Reliability Analysis', in AIAA Scitech 2019 Forum, p. 441.
3. Gao, Y.* and **Liu, Y**. (2019b) 'Probabilistic Failure Analysis for ICME Using An Adjoint-based Lattice Particle Method.', in AIAA Scitech 2019 Forum, p. 970.
4. Wang, Y.* and **Liu, Y.** (2019) 'An Adaptive Probabilistic Maintenance Framework for Decision Planning Optimization', in AIAA Scitech 2019 Forum, p. 442.

5. Wei, H.* and **Liu, Y.** (2019) 'Simulation of elastoplastic deformation of isotropic material using a nonlocal yield criterion and Lattice Particle Model', in AIAA Scitech 2019 Forum, p. 964.
6. Yao, H.*, Ren, Y. and **Liu, Y.** (2019) 'FEA-Net: A Deep Convolutional Neural Network With PhysicsPrior For Efficient Data Driven PDE Learning', in AIAA Scitech 2019 Forum, p. 680.
7. Yu, Y.**, Venkatesan, K. R. R.* and **Liu, Y.** (2019) 'Fatigue damage prognosis of aircraft wing structures using time-based subcycle formulation and hybrid learning', in AIAA Scitech 2019 Forum, p. 2384.
8. Yu, Y.**, Yao, H.* and **Liu, Y.** (2019) 'A Hybrid Learning Approach for the Simulation of Aircraft Dynamical Systems', in AIAA Scitech 2019 Forum, p. 436.
9. Zhao, P.** and **Liu, Y.** (2019) 'Separation Risk Evaluation for NextGen Air Traffic Management System', in AIAA Scitech 2019 Forum, p. 1361.
10. Gao, Y.** and **Liu, Y.** (2018) 'Adjoint-FORM for efficient reliability analysis of large-scale structural problems', in 2018 AIAA Non-Deterministic Approaches Conference, p. 435.
11. **Liu, Y.** and Goebel, K. (2018) 'Information Fusion for National Airspace System Prognostics', in PHM Society Conference.
12. Wang, Y.*, **Liu, Y.,** Sun, Z., et al. (2018) 'A Bayesian-entropy Network for Information Fusion and Reliability Assessment of National Airspace Systems', in PHM Society Conference.
13. Wang, Y.*, **Liu, Y.,** Peng, T., et al. (2018) 'Probabilistic life prediction of plastic pipes using an equivalent crack growth model', in 2018 AIAA/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference, p. 1640.
14. Wang, Y.* and **Liu, Y.** (2018) 'A Novel Bayesian Entropy Network for Probabilistic Damage Detection and Classification', in 2018 AIAA Non-Deterministic Approaches Conference. American Institute of Aeronautics and Astronautics (AIAA SciTech Forum). doi: doi:10.2514/6.2018-1407.
15. Wei, H.* and **Liu, Y.** (2018) 'Energy-based multiaxial fatigue damage modelling', in 2018 AIAA/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference, p. 646.
16. Yu, Y.**, Yao, H.* and **Liu, Y.** (2018) 'Physics-based Learning for Aircraft Dynamics Simulation', PHM Society Conference, 10(1), pp. 1–9.
17. Yuan, H., Zhang, W. and Liu, Y. (2018) 'Correction: Quantification of Time Distribution to Initial Long Crack with Reduced Order Microstructural Representation on Microstructurally Short Fatigue Crack Growth Model', in 2018 AIAA Non-Deterministic Approaches Conference, pp. 1409-c1.
18. Yu, Y.**, **Liu, Y.,** Venkatesan, K.*, and Kurian, B.* (2018). "Concurrent fatigue crack growth and vehicle-bridge dynamics analysis using time-based subcycle formulation", 2018 Engineering Mechanics Institute (EMI) International Conference, Shanghai, China, Nov. 2-4, 2018.
19. Yu, Y.**, Yao, H.*, and **Liu, Y.** (2018). "Hybrid intelligence for solving complex engineering problems: an integrated human and machine learning approach", 2018 Engineering Mechanics Institute (EMI) International Conference, Shanghai, China, Nov. 2-4, 2018.

20. Yu, Y.**, Yao, H.*, and **Liu, Y.** (2018). “Physics-based Learning for Simulation and Prognostic of Aircraft Dynamical System”, 2018 INFORMS Annual Meeting, Phoenix, Arizona, United States, Nov. 4-7, 2018.
21. Yu, Y.**, **Liu, Y.** and Cai, C.S. (2018). “Time-dependent reliability analysis of a highway bridge subject to traffic growth and material deterioration using Bayesian inference”, 2018 Engineering Mechanics Institute (EMI) Conference, Cambridge, Massachusetts, United States, May 29 - June 1, 2018.
22. Haoyang Wei*, Yongming Liu, 'A Nonlocal Yield Criterion for Modeling Elastoplastic Deformation in Volume-Compensated Particle Model', presentation at the 13th World Congress on Computational Mechanics / 2nd Pan American Congress on Computational Mechanics, New York City, July 23, 2018.
23. Wang, Yuhao*, and **Yongming Liu.** "Maximum Entropy method in Bayesian framework for classification and inference." In Engineering Mechanics Institute Conference 2018. 2018
24. **Yongming Liu**, and Wang, Yuhao*. " A Hybrid Network Model for Information Fusion in National Airspace System." In 2018 INFORMS Annual Meeting. 2018.
25. Karthik Rajan*, **Yongming Liu,** Subcycle Fatigue Crack Growth Formulation under positive and negative stress ratios, International Congress of Fracture, Rhodes Island, Greece, June, 2017.
26. Fraaz Tahir*, **Yongming Liu,** Creep-Fatigue Damage Investigation and Modeling of Alloy 617 at High Temperatures, International Congress of Fracture, Rhodes Island, Greece, June, 2017.
27. Hailong Chen*, **Yongming Liu,** Micro/Meso Scale Fracture Modeling Using A Novel Discrete Model, , International Congress of Fracture, Rhodes Island, Greece, June, 2017.
28. Yuan, Hao, et al. "Mesoscale Simulation of Corrosion Fatigue by An Integrated Transgranular and Intergranular Crack Growth Method." 58th AIAA/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference. 2017.
29. Chang, Qinan*, and **Yongming Liu.** "A Novel Computational Method Modeling Wave propagation using K-space method and Damage Detection using Adjoint Method." 58th AIAA/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference. 2017.
30. Dahire, Sonam*, Yongming Liu, and Yang Jiao. "Probabilistic pipe strength and toughness estimation through information fusion with Bayesian updating." 19th AIAA Non-Deterministic Approaches Conference. 2017.
31. Qinan Chang*, Tishun Peng*, **Y. Liu,** Simulation of Wave Propagation in Damaged Anisotropic Material Using a K-space Method. ASME-IMECE2016-67755, 2016.
32. T. Peng*, **Y. Liu**, Probabilistic detection of delamination in composite laminates using Bayesian inference of Lamb wave signals, ASCE EMI and PMC 2016, Nashville, TN, 2016.
33. Fraaz Tahir*, **Y Liu,** " Creep-Fatigue Life Prediction of Alloy 617 at 950°C using an Effective Hold Time Approach " Transactions of ANS Winter Meeting, 2016,

34. Y. Ma***, L. Wang***, J. Zhang, **Y. Liu**, Probabilistic fatigue life assessment of reinforced concrete structures subjected to corrosion, ASCE EMI and PMC 2016, Nashville, TN, 2016.
35. Tahir F*, **Liu Y**. Development of creep-dominant creep-fatigue testing for Alloy 617. In57th AIAA/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference 2016 (p. 0668).
36. Pan D*, Tahir F*, **Liu Y**. An equivalent crack growth model for creep fatigue life prediction of metals. In57th AIAA/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference 2016 (p. 0724).
37. Peng T*, **Liu Y**. 3D delamination profile reconstruction for composite laminates using inverse heat conduction. In57th AIAA/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference 2016 (p. 0724).
38. Fraaz Tahir*, **Yongming Liu,** "Development of Creep-Dominant Creep-Fatigue Tests for Alloy 617." Transactions of ANS Winter Meeting, 2015, Vol. 113, Pg. 133-144
39. Tishun Peng* and **Yongming Liu.** "Probabilistic fatigue life prediction of composite laminates using Bayesian updating", 17th AIAA Non-Deterministic Approaches Conference, AIAA SciTech, (AIAA 2015-1145).
40. H. Chen* and **Y. Liu** (2015). The Effective Elastic and Fracture Properties of Particulate Reinforced Composites Using a New Non-local Particle Method. 56th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics and Materials Conference, Kissimmee, FL, USA.
41. E. Lin**, H. Chen* and **Y. Liu** (2015). Coupling between Non-local Particle and Finite Element Methods. 56th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics and Materials Conference, Kissimmee, FL, USA.
42. Ma Yafei***, Wang Lei***, Zhang Jianren, Yongming Liu. “EIC-based fatigue life prediction for aging reinforced concrete beams.” IABSE Conference 2015, Structural Engineering: Providing Solutions to Global Challenges, Geneva, 2015, September 23-25.
43. Ma Yafei***, Xiang Yibing**, Wang Lei***, Zhang Jianren, Liu Yongming. “Probabilistic fatigue life prediction of existing RC bridge members subjected to corrosion.” 2nd International Symposium on Life-Cycle Performance of Bridges and Structures, Changsha, 2015, December 18-20.
44. H. Chen* and **Y. Liu** (2014). Static and Dynamic Fracture Simulation Using a Novel Particle Method with Multi-body Potentials. 55th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics and Materials Conference, National Harbor, MD, USA.
45. H. Chen* and **Y. Liu** (2014). A Novel Volume-Compensated Particle Method (VCPM) for Elasticity and Plasticity Analysis. 55th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics and Materials Conference, National Harbor, MD, USA.
46. T. Peng*, Y**. Liu.** A novel Bayesian Imaging Method for probabilistic delamination detection of composite materials. 55th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics and Materials Conference, National Harbor, MD, USA.
47. T. Peng*, A. Saxena, K. Goebel, **Y. Liu**. Integrated experimental and numerical investigation for damage diagnosis in composite materials. 55th

AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics and Materials Conference, National Harbor, MD, USA.

48. Tahir, F.*, **Liu, Y.,** Wang, L., Fracture simulation of co-continuous composite materials under static loading, Society of Engineering Science 51st Annual Technical Meeting, Oct 2014
49. H. Chen* and **Y. Liu** (2014). Fracture Simulation using a Non-local Particle Model. SES Annual Technical Meeting, Purdue University, West Lafayette, IN
50. H. Chen*, Y. Jiao and **Y. Liu** (2014). A Unified Framework for Microstructure Evolution and Property Quantification. SES Annual Technical Meeting, Purdue University, West Lafayette, IN.
51. Zhang Wei*，Liu Yongming，"In-situ SEM Testing for Transient Fatigue Crack Growth Behavior Investigation Subjected to a Single Tensile Overload"，Proceedings of the ASME 2014 International Mechanical Engineering Congress & Exposition, November 14-20, 2014, Montreal, Quebec, Canada
52. T. Peng*, A. Saxena, K. Goebel, S. Sankararaman, Y. Xiang, **Y. Liu**, Probabilistic delamination diagnosis of composite materials using a novel Bayesian Imaging Method. 2013 Annual Conference of the Prognostics and Health Management Society, New Orleans, LA., Oct. 14 – 17, 2013.
53. Enqiang Lin**, Hailong Chen*, **Yongming Liu**, "atomistic simulations of fatigue crack growth in single crystal aluminum", ASME 2013 International Mechanical Engineering Congress & Exposition, San Diego, CA.
54. Jian Yang*, Wei Zhang*, **Yongming Liu**, "Subcycle fatigue crack growth mechanism investigation for allumnium alloys and steels", International Conference of Fracture, 2013, Beijing, China.
55. Jingjing He*; Xuefei Guan*; **Yongming Liu,** "Concurrent structural and material fatigue damage prognosis integrating sensor data", AIAA SDM conference, 2013, Boston, MA.
56. Wei Zhang*; **Yongming Liu,** "A time-based formulation for real-time fatigue damage prognosis under variable amplitude loadings", AIAA SDM conference, 2013, Boston, MA.
57. Jian Yang*; Wei Zhang*; **Yongming Liu**, "Subcycle Fatigue Crack Growth Mechanism Investigation for Aluminum Alloys and Steels", AIAA SDM conference, 2013, Boston, MA.
58. Wei Zhang*, **Yongming Liu,** "Subcycle fatigue damage mechanism investigation using In-situ SEM testing", ASME 2012 International Mechanical Engineering Congress & Exposition, Houston, TX.
59. X. Guan*, J. He*, R. Jha, **Y. Liu**, "Time-dependent reliability analysis using efficient Bayesian method", 53rd Structures, Structural Dynamics, and Materials and Co-located Conferences, Honolulu, Hawaii , April, 2012.
60. C. Zhang **, J. Xu, Z. Lu*, **Y. Liu**," General Fracture Criterion for Mixed-mode Delamination in Composite Materials", 53rd Structures, Structural Dynamics, and Materials and Co-located Conferences, Honolulu, Hawaii , April, 2012.
61. Z. Lu*, J. Xu, **Y. Liu**, "Experimental investigation and model analysis of uncertain loading effect on fatigue crack growth", 53rd Structures, Structural Dynamics, and Materials and Co-located Conferences, Honolulu, Hawaii , April, 2012.

62. H. Li**, Y. Xiang*, **Y. Liu**, "Probabilistic fatigue life prediction using Subset Simulation", 53rd Structures, Structural Dynamics, and Materials and Co-located Conferences, Honolulu, Hawaii , April, 2012.
63. W. Zhang*, **Y. Liu**, "In-situ fatigue testing on the existence and insufficiency of the crack closure", International Conference on Fatigue Damage of Structural Materials IX, Hyannis, MA, USA, September, 2012.
64. Tishun peng*, jingjing he*, **yongming liu**, abhinav saxena, jose r. celaya, kai goebel, "Integrated Fatigue Damage Diagnosis and Prognosis Under Uncertainties", Annual Conference of the Prognostics and Health Management Society 2012. ISBN: 978-1-936263-05-9
65. Jian yang*, wei zhang*, **yongming liu**, "A Multi-Resolution Experimental Methodology for Fatigue Mechanism Verification of Physics-Based Prognostics", Annual Conference of the Prognostics and Health Management Society 2012. ISBN: 978-1-936263-05-9
66. **Liu, Y.** "Uncertainty management in prognostics", Invited Tutorial Speaker, 2010 Annual Conference of the Prognostics and Health Management Society, Portland, OR, Oct. 10 – 16, 2010.
67. Xiang, Y.*, **Liu, Y.,** Optimization of Fatigue Maintenance Strategies based on Prognosis Results, Prognostics and Health Management 2011, Montreal, Canada, September, 2011.
68. Guan, X.*, Jha, R., **Liu, Y.** Bayesian Fatigue Damage and Reliability Analysis using Laplace Approximation and Inverse Reliability Method, Prognostics and Health Management 2011, Montreal, Canada, September, 2011.
69. Guan, X.*, Jha, R., **Liu, Y**. Probabilistic multi-model Bayesian network for fatigue damage prognosis. 52nd AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics and Materials Conference, April 2011, Denver, Co.
70. He, J.*, **Liu, Y.,** Fatigue prognosis integrating usage monitoring system. 52nd AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics and Materials Conference, April 2011, Denver, Co.
71. Zhang, W.*, **Liu, Y**., In-Situ Fatigue Crack Growth Testing of Al7075-T651 under Scanning Electron Microscopy. 52nd AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics and Materials Conference, April 2011, Denver, Co.
72. Xiang, Y.*, **Liu, Y**., An equivalent stress level model for efficient fatigue crack growth prediction. 52nd AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics and Materials Conference, April 2011, Denver, Co.
73. Zhang, W.*, **Liu, Y.,** Hypotheses verification of a novel multi-scale fatigue damage prognosis model, IEEE Aerospace Conference, March 2011, Big Sky, MT. 10.1109/AERO.2011.5747568.
74. Lu, Z.*****, **Liu, Y.,** "A comparative study of small time scale fatigue crack growth model and the two parameter approach. International Conference on Fatigue Damage of Structural Materials VIII, 19-24 September 2010, Hyannis, MA.
75. Zhang, W*. and **Liu, Y.,** "In-Situ Optical Microscopy/SEM Fatigue Crack Growth Testing of Al7075-T6", Aircraft Airworthiness & Sustainment 2010. 11 May–14 May. Austin, TX.
76. Zhang, W.*, Lu, Z* and **Liu, Y.,** " In-Situ Optical Microscopy Study on Plastic Zone Size Estimation of Aluminum Alloy 7075-T6 under Cyclic Loading",

Materials Science & Technology 2010. October 17-21 , Houston, Texas.

77. Zhang, W.* and **Liu, Y.,** "In-situ fatigue testing and imaging analysis for forward and reversed plastic zone measurements", International Conference on Fatigue Damage of Structural Materials VIII, 19-24 September 2010, Hyannis, MA.
78. He, J.* and **Liu, Y.,** "Structural fatigue prognosis using limited sensor data", 2010 Annual Conference of the Prognostics and Health Management Society, Portland, OR, Oct. 10 – 16, 2010.
79. X. Guan*, R. Jha, and **Y. Liu**, "Trans-dimensional MCMC for Fatigue Prognosis Model Determination, Updating, and Averaging," 2010 Annual Conference of the Prognostics and Health Management Society, Portland, OR Oct. 10 – 16, 2010
80. Lu, Z.*, **Liu, Y.** "Concurrent fatigue crack growth simulation using XFEM and a small time scale crack growth model", ASCE Engineering Mechanics Institute conference, 2010, LA, CA.
81. Li, H.**, Xiang, Y.*, **Liu, Y.** "Efficient probabilistic methods for crack growth-based fatigue life prediction", ASCE Engineering Mechanics Institute conference, 2010, LA, CA.
82. He, J.*, Lu, Z.* and **Liu, Y.,** "A new method for concurrent structural fatigue damage prognosis", International Symposium on Life-Cycle Performance of Bridges and Structures, Changsha, China, 2010.
83. Guan, X.*, Jha, R., and **Liu, Y.**, "Maximum entropy method for model and reliability updating using inspection data", SDM 2010. 12 April – 16 April 2010. Orlando, FL.
84. He, J.* and **Liu, Y.**, "Concurrent structural prognosis under random loading", 2010 AIAA SDM conference, Orlando, FL, 2010.
85. Xiang, Y.* and **Liu, Y.**, "Inverse FORM method for probabilistic fatigue prognosis", 51th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference, Orlando, April, 2010.
86. Lu, Z.* and **Liu, Y.**, "Small time scale fatigue crack growth analysis under variable amplitude loading", 51th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference, Orlando, April, 2010.
87. Xiang, Y.* and **Liu, Y.**, "Probabilistic fatigue crack growth prediction under variable amplitude loading", Aircraft Airworthiness & Sustainment Conference, 2010, Austin, Texas.
88. He, J.*, Lu, Z.*, **Liu, Y.**, " A New Method for Concurrent Multi-scale Fatigue Damage Prognosis", The 7th International Workshop Structural Health Monitoring, Stanford University, CA, 2009.
89. Guan, X.*, **Liu, Y.**, Saxena, A., Celaya, J., Goebel, K., "Entropy-based probabilistic fatigue damage prognosis and algorithmic performance comparison", annual conference of the prognostics and health management society, San Diego, CA, 2009.
90. He, J.* and **Liu, Y.**, "A state-space model for multi-scale fatigue damage prognosis", annual conference of the prognostics and health management society, San Diego, CA, 2009.
91. Lu, Z.* and **Liu, Y.,** "An Incremental Crack Growth Model for Multi-Scale Fatigue Analysis", 50th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference, Palm Springs, May, 2009.

92. Xiang, Y.* and **Liu, Y.,** "Probabilistic damage tolerance analysis considering shot peening", 50th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference, Palm Springs, May, 2009.
93. Lu, Z.* and **Liu, Y.,** "A new formulation for multi-scale fatigue damage modeling", Joint ASCE-ASME-SES conference on mechanics and materials, Blacksburg, VA, 2009.
94. Xiang, Y.* and **Liu, Y.,** "Fatigue reliability of composite laminates under multiaxial loading", Joint ASCE-ASME-SES conference on mechanics and materials, Blacksburg, VA, 2009.
95. **Liu, Y.,** "Probabilistic fatigue life prediction considering short crack growth", 12th international conference on fracture, Ottawa, Canada, 2009.
96. Lu, Z.*, **Liu, Y.,** "Crack growth-based multiaxial fatigue life prediction", 12th international conference on fracture, Ottawa, Canada, 2009.
97. Xiang, Y.*, **Liu, Y.,** "Fatigue life prediction of corroded specimen", 12th international conference on fracture, Ottawa, Canada, 2009.
98. He, J.*, Lu, Z.* and **Liu, Y.,** "A new method for concurrent multi-scale fatigue damage prognosis", International workshop on structural health monitoring, San Francisco, CA, September, 2009.
99. **Liu, Y.**, Xiang, Y.*, Shantz, C., Mahadevan, S. "A new EIFS methodology for fatigue life prediction of rotorcraft materials",11th Aging Aircraft Conference, Phoenix, AZ, April, 2008.
100. **Liu, Y.**, Mahadevan, S., "An Efficient Method for Equivalent Initial Flaw Size (EIFS) Calculation", 49th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference, Chicago, IL, 2008.
101. **Liu, Y.**, Mahadevan, S., "CORRELATION EFFECT OF S-N CURVES ON FATIGUE RELIABILITY ANALYSIS", Inaugural International Conference of the Engineering Mechanics Institute (EM08), Minneapolis, Minnesota, May, 2008.
102. Shantz, C., Liu, L., Liu, Y., Mahadevan, S., "Mixed-Mode Crack Growth Under Variable Amplitude Loading",11th Aging Aircraft Conference, Phenix, AZ, April, 2008.
103. Liu, L, Liu, Y., Mahadevan, S., "Mixed- Mode I+II Fatigue Crack Growth Prediction Using Local Stresses", 49th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference, Chicago, IL, 2008.
104. Liu, Y., Stratman, B., Liu, L., Mahadevan, S., Probabilistic fatigue life prediction of railroad wheels. SAE World Congress & Exhibition, April 16-19, 2007, Detroit, MI, USA.
105. F. Hernandez, V. Sura, L. Liu, Y., Liu, S. Mahadevan, D. H. Stone Investigation of the Effect of Defects on Wheel Fatigue Performance Life, 15th International Wheel Set Congress, September 23-27, 2007.
106. Liu, Y., Stratman, B., Liu, L., Mahadevan, S., Shattered rim failure analysis in railroad wheels. Proceedings of IMECE2006, ASME International Mechanical Engineering Congress and Exposition, Chicago, Illinois, USA, 2006.
107. Liu, Y., Mahadevan, S., Mixed-mode fatigue crack threshold and growth rate prediction. International Conference on Fatigue Damage of Structural Materials VI, Hyannis, MA, USA, 2006.

108. Liu, Y., Mahadevan, S., A Critical Plane Method for Multiaxial Fatigue Life Prediction. 9th International Congress of Fatigue, Atlanta, GA, May 2006.
109. Liu, Y., Mahadevan, S., Uncertainty Modeling in Fatigue Life Prediction. 9th International Congress of Fatigue, Atlanta, GA, May 2006.
110. Liu, Y., Mahadevan, S., Multiaxial High-Cycle Fatigue Life Prediction of Isotropic and Anisotropic Materials. 46th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics & Materials Conference, Austin, TX, April 2005.
111. Liu, Y., Mahadevan, S., Fatigue Damage Modeling of Composite Laminates. Proceedings of PMC'04, Albuquerque, New Mexico, USA, July 2004.
112. Liu, Y., Mahadevan, S., Probabilistic Fatigue Damage of Composite Laminates. ASC/ASTM-D30 Joint 19thAnnual Technical Conference, Atlanta, GA, USA, October 2004.
113. Liu, Y., Stratman, B., Mahadevan, S., Stochastic Multiaxial Damage Modeling for Metal Fatigue. 9th International Conference on Structural Safety and Reliability, Rome, Italy, June 2005.
114. Chen, Y.Y., Liu, Y., Bian, R., Numerical Model for Partial Fracture Failure of Steel Beam-to-Column Joints. Proceedings of 13th World Conference on Earthquake Engineering, Vancouver, BC Canada, Aug 2004.
115. Liu, Y., Chen, Y.Y., Chen, Y.J. Earthquake response of steel tube frames under multi-directional seismic shock. 9th National Conference on Structural Engineering and Engineering Mechanics, Vol. 3, pp 152~157, 2000.

TEACHING

During the past years, Dr. Liu developed and/or significantly improved both undergraduate and graduate courses covering: solid mechanics, structural mechanics, computational mechanics, fracture mechanics, damage and fatigue, probabilistic methods, and reliability engineering.

A new graduate course (MAE 598 – Probabilistic Methods for Engineering Analysis and Design) was developed at ASU. The systematic teaching of probabilistic methods in engineering analysis and design was lacking in the current ASU curriculum, while is very important. The development of this course was extremely successful. The continued improvement is ongoing as this is a newly developed class.

A new course (CE 525 – Mechanical Damage of Materials) was developed during 2008-2010. There are no course on the mechanical damage and aging of structures, especially on metals and composite materials, at Clarkson. Various topics on the fundamental mechanism, engineering analysis, and reliability estimation were covered in this class. This course significantly improves the current curriculum of engineering school at Clarkson. CE 525 is also very successful. Evaluation score for the instructor is 4.8~5.0 (university mean is 4.2).

A list of taught courses and the evaluation scores is given below.
Arizona State University

Term	Course Name	Course Evaluation (out of 5.00)	Instructor Evaluation (Out of 5.00)
2013 Spring	MAE 213 Solid Mechanics	4.38/5.00	4.43/5.00
2013 Fall	MAE 523 Fracture Mechanics	4.61/5.00	4.71/5.00
2014 Spring	MAE 213 Solid Mechanics	4.16/5.00	4.43/5.00
2014 Fall	MAE 598 Probabilistic Methods	4.34/5.00	4.38/5.00
2014 Fall	ASU 101-MEE	4.16/5.00	3.73/5.00
2015 Spring	MAE 213 Solid Mechanics	4.29/5.00	4.56/5.00
2015 Fall	ASU 101-MEE	4.44/5.00	4.83/5.00
2015 Fall	MAE 523 Fracture Mechanics	3.87/5.00	4.21/5.00
2016 Spring	MAE 213 Solid Mechanics	4.24/5.00	4.23/5.00
2016 Fall	MAE 598 Probabilistic Methods	4.67/5.00	4.66/5.00
2017 Spring	MAE 301 Experimental Statistics	4.04/5.00	4.12/5.00
2018 Spring	MAE 598 Probabilistic Methods	4.2/5.00	4.25/5.00

Clarkson University

Term	Course Name	Instructor Evaluation (Out of 5.00)
2007 Fall	CE 320 Structural Analysis	3.6/5.00
2008 Spring	CE 420 Computer Methods	4.8*/5.00
2008 Spring	CE 520 Computer Methods	4.5/5.00
2008 Fall	CE 525 Mechanical Damage	4.8/5.00
2009 Spring	CE 420 Computer Methods	4.7/5.00
2009 Spring	CE 520 Computer Methods	5.0/5.00
2009 Fall	CE 525 Mechanical Damage	4.8/5.00
2010 Spring	CE 420 Computer Methods	4.3/5.00
2010 Spring	CE 520 Computer Methods	4.0/5.00
2010 Fall	CE 525 Mechanical Damage	5.0/5.00
2011 Spring	CE 420 Computer Methods	4.4/5.00

*won the School for Engineering Teaching Excellence Award

STUDENT MENTORING

Students graduated:

PhD:

Zizi Lu (2011, Research Engineer, China Commercial Air Research Center, Beijing, China)

Yibing Xiang (2011, Structural Engineer, UTC Aerosapce, Dayton, Ohio)
Xuefei Guan –co advised with Prof. Jha (2011, Research Engineer, Simens, Princeton, NJ)
Jingjing He (2012, Associate Professor, Beihang University, Beijing, China)
Wei Zhang (2012, Associate Professor, Beihang University, Beijing China)
Hailong Chen (2015, Assistant Professor, University of Kentuky)
Tishun Peng (2016, research engineer at Gas Technology Institute)
Fraaz Tahir (2017, Corning, research engineer)
Qinan Chang (2018, Intel, engineer)
Sonam Dahire (expected graduation date: Spring 2019)

MS:
Yibing Xiang (2009), Runze Liu (2014), ROSHANBIR BHATIA (2014), Sahil Jain (2015), Rohan Cota(2015), Namitha Canapa (2015), Yuhao Wang(2015), Chen Liu (2016), Vishal Chandra (2016), Varun Desai (2016), Jayesh Zope (2016), Akshay Murkute (2017), Ankita Kardile (2017), Ivan Rodrigues (2017), Yutian Pang (2018) Dong Pan (2018)

Udergraduate:
Bradley Sherman (2011), Andrew Ballas (2012); Alex Wenderlich (2018), Andrew Park (2018), Rylie Lodes (2018); Tony Shen (2018); Alyssa Nazareno (2018)

Current students:
PhD:
Yuhao Wang (expected graduation date: Fall 2019)
Houpu Yao (co-advised, expected graduate date: Fall 2019)
Yi Gao (expected graduation date: Fall 2020)
Haoyang Wei (expected graduate date: Fall 2020)
Jie Chen (expected graduate date: Fall 2021)
Yutian Pang (expected graduate date: Fall 2021)
Jueming Hu (expected graduate date: Fall 2021)

MS:
Bianca Kurian (2019); Venkateshwaran Ravi Narayanan (2019); Nan Xu (2019); Aryabhat Darnal (2019); MADHAVA REDDY VARAKANTHAM (2019); Yun Zhao (2019); Rahul Rathnakumar (2020); Antriksh Sharma (2020); Michael Tucker (2020)

Undergraduate:

Current postdocs:
Yang Yu, Peng Zhao

Potdoctural resarch associate:

Hongshuang Li (2010-2011, Associate Professor at Nanhang University, China)
Chao Zhang (2011 -2012, Professor at Northwestern Poly University, China)
Yibign Xiang (2011 – 2014, Structural Engineer, UTC Aerosapce, Dayton, Ohio)
Wei Zhang (2012 – 2013, Associate Professor, Beihang University, China)
Enqiang Lin (2012- 2014, Potsdoc Research Associate, Virginia Tech)

Visiting Scholars:
Kun Wang (2012-2013), Lei Wang (2013~ 2014), Yafei Ma (2013 -2014), Changsong Chen (2014 -2015), Wei Bao (2013- 2014), Ming Yuan (2014 2015), Yun Liu (2014 - 2015), Da Wang (2015-2016), Xuhui Zhang (2015-2017), Guangen Luo (2016-2017)

Awards of mentored students/postdocs:
Yi Gao, SwRI best student paper award, 2019 AIAA Scitech
Yang Yu, best paper award, PHM scocitety 2018 annual conference
Tishun Peng, Harry H. and Lois G. Hilton Student Paper Award at 2016 AIAA SciTech
Tishun Peng, Student Paper Competition Award Final list, AIAA NDA conference, 2015
Tishun Peng, 2014 UGF Block Grant for distinguished graduate students at Arizona State University
Hailong Chen, Student Paper Competition Award Final List. AIAA SciTech 2014.
Hailong Chen, 2013 UGF Block Grant for distinguished graduate students at Arizona State University
Tishun Peng, 2012 PHM Doctoral Consortium Award
Yibing Xiang, first author of the best paper award in ASCE Journal of Aerospace Engineering, 2011
Jingjing He, Yibing Xiang, 2010 PHM Doctoral Consortium Award

CURRENT/PAST RESEARCH PROJECTS

Information fusion for real-time national air transportation system prognostics under uncertainty
Status: Active, 2017-2022
Amount: $10,000,000
Sponsor: NASA
Role: PI
Brief: The objectives of the proposed study are to develop an integrated real-time system-wide information fusion methodology for prognostics and safety assurance of the NAS. Various sources of uncertainties and their coupling effects will be systematically investigated for accurate failure and risk assessment of the extremely large-scale, complex NAS. A community-based collaborative simulation platform will be developed and deployed for continued sustainable prognostics technology evolution for the NAS safety research.

A novel structured light based sensing and probabilistic diagnostic technique for pipe internal corrosion detection and localization
Status: Active, 2018-2021
Amount: $300,000
Sponsor: DOT CAAP

Role: institutional PI (40% share)
Brief: Degradation of the pipeline health is susceptible to hazard due to failure. To prevent such failures, a major challenge for the maintenance crew to detect and repair corrosion still prevails due to difficult and expensive accessibility during scheduled maintenance. The proposed method will focus on the development of novel structural light-based imaging for internal corrosion detection, which simplifies the detection process while achieving superior spatial resolution. The proposed approach will develop an endoscopic structured light scanning tool that is based on phase measurement profilometry (PMP). The developed system will be simple to fabricate and easy to be used by maintenance personnel with minimal skillset due to its intuitive scans. The structured light system will be developed to generate high-resolution reconstructed images representing surface texture with high accuracy. Based on the images, additional processing capabilities developed using Bayesian updating technique will give the capability of automatic classification and identification of different types of precursors. A convolutional neural network based corrosion detection method will provide automated detection, which further minimizes the operator involvement. The uncertainty quantification technique will be integrated to enhance the probability of detection and to quantitatively determine the damage size and location.

Bayesian network-based data analytics for accurate pipe strength and toughness estimation

Status: Active, 2018-2021
Amount: $150,000
Sponsor: DOT through GTI
Role: PI
Brief: Pipeline infrastructure and its safety are critical for the recovering of U.S. economy and our standard of living. Accurate pipe material strength estimation is critical for the integrity and risk assessment of aging pipeline infrastructure systems. Existing techniques focus on the single modality deterministic estimation of pipe strength/toughness and ignores inhomogeneousity and uncertainties. In view of this, a Bayesian network-based data analytics approach is proposed to accurately estimate the pipe material strength and toughness. This approach uses information fusion of multimodality surface measurement (e.g., surface chemistry, surface indentation and scratch testing results, and microstructure observations) to accurately predict the material strength. In addition, the proposed Bayesian network will be used to reduce the uncertainties in the material property estimation and enhance the confidence for operators and regulators for their decision making. Specifically, the proposed project will be in close collaboration with GTI. The developed relationships and database from GTI will be collected to develop the proposed Bayesian network for pipe materials (e.g., x42, x52, x60, x65, x70 and x80).

Uncertainty quantification and reduction for pipeline assessment with interactive threats
Status: Active, 2018-2021
Amount: $210,000
Sponsor: DOT through GTI
Role: PI

Brief: Pipeline infrastructure and its safety are critical for the recovering of U.S. economy and our standard of living. Diverse types of damage and failure can contribute to the overall pipeline integrity. A recent report has shown that, among many failures reported in the past few decades, it is likely that there are interactive threats which can lead to the final failure. These interactive threats have not been fully addressed in the existing knowledge. One critical example is the interaction of corrosion and weld, which will lead to earlier fracture of pipes. Thus, there is a clear gap which is solicited in the PHMSA announcement for additional research. Another critical gap is the systematic inclusion of uncertainties in the failure and risk assessment of these interactive threats. Some known sources of these uncertainties are: 1) material intrinsic randomness; 2) material spatial variability; 3) defect geometric and location variabilities; 4) manufacturing and installation variability; and 5) operational and environmental conditions. All these input uncertainties will contribute to the outcome of the failure assessment. Strategies for the reduction of impact of these uncertainties to the final pipeline assessment is critical to enhance the confidence in integrity assessment.

Systematic Fatigue Test Spectrum Editing Using Wavelet Transformations
Status: Active, 2018-2019
Amount: $37,500
Sponsor: NAVY through TDA, SBIR
Role: PI
Brief: Perform multiaxial fatigue testing under random spectrum loading. Develop critical plan-based model for accurate life prediction.

Collaborative Research: Fatigue Damage Prognosis for Slender Coastal Bridges
Status: Active, 2015-2019
Amount: $235,000
Sponsor: NSF
Role: PI
Brief: A novel maximum entropy-based Bayesian network for multi-scale corrosion-fatigue damage prognosis for slender coastal bridges is planned. The framework fuses the information and knowledge from the material level, the structural level, and the system level for the probabilistic prognosis and reliability assessment. The inter-correlations among different levels of nodes in the network are developed by using coupled dynamic analysis and corrosion-fatigue damage analysis. Advanced experimental testing for fatigue and simulation methods will be combined together for the physics-based prediction of remaining useful life of costal bridges. Uncertainties will be propagated through the Bayesian network and the system level reliability will be updated and reassessed. The Bayesian network can update itself with information from experimental measurements, field observation, and historical experiences. In this methodology, coupled structure dynamics model will capture the realistic service and environmental loads during the lifetime span of the bridges.

Bayesian Network Inference and Information Fusion for Accurate Pipe Strength and Toughness Estimation

Status: Active, 2015 – 2018
Amount: $300,000
Sponsor: Federal DOT
Program: PHMSA
Role: PI
Brief: Pipeline infrastructure and its safety are critical for the recovering of U.S. economy and our standard of living. Accurate pipe material strength estimation is critical for the integrity and risk assessment of aging pipeline infrastructure systems. Existing techniques focus on the single modality deterministic estimation of pipe strength and ignores inhomogeneousity and uncertainties. In view of this, this project is a novel information fusion framework using multimodality diagnosis for pipe materials for accurate probabilistic strength and toughness estimation under uncertainties. The first task will be chemical composition, material microstructure, and basic surface mechanical properties are detected using various in situ and ex situ techniques. Advanced data analysis using Gaussian Processing model will be performed for surrogate modeling and uncertainty quantification. Following this, advanced sensing techniques using acoustic and electromagnetic sensing will be considered. Both simulation and prototype testing are proposed for model validation and demonstration. Finally, a generalized Bayesian network methodology is planned to fuse multiple sources of information from the multimodality diagnosis results. Probabilistic pipe strength and toughness estimation is inferred based on the posterior distribution after information fusion. If successful, this study can help to accurately and effectively assess the reliability of pipeline systems, and eventually help the decision making process to balance the pipeline safety and economical operations.

EAGER: Reconstruction and Optimal Design of Multi-scale Material Systems through Deep Networks
Status: Active, 2016-2017
Amount: $ 171,255.00
Sponsor: NSF
Role: co-PI
Brief: This EArly-concept Grant for Exploratory Research (EAGER) grant supports fundamental research to develop scalable computational design tools to enable efficient and effective materials design. Computational material design (CMD), such as identifying optimal material microstructures to achieve desirable performance, receives a growing interest as sophisticated material designs can be subsequently realized using advanced processing techniques such as additive manufacturing. Conceptually, solving CMD problems involves iterative search for the best solutions in a problem space. Since the cost of solution searching is sensitive to the size of the space, the lack of cost-efficiency hampers the application of existing CMD approaches to complex material systems, where the goodness of the material design depends on numerous details of the microstructure on multiple length scales. The use of CMD tools will enable the discovery of critical microstructure patterns and the reduction of the dimensionality of the problem space. The research will lead to efficient microstructure design and validation for high performance structural materials with superior durability and structural health. Therefore, results from this research will benefit various U.S. industries, and its economy and society. The required seamless integration of material science, engineering design, manufacturing, and data

science will help to broaden student participation and positively impact engineering education.

Slow Crack Growth Evaluation of Vintage Polyethylene Pipes
Status: Active, 2015 – 2017
Amount: $190,000
Sponsor: Federal DOT through GTI
Program: PHMSA
Role: co-PI and Institutional PI
Brief: Damage diagnosis and remaining life prediction of pipeline infrastructure systems is still a challenging problem despite tremendous progress made during the past several decades, such as the damage accumulation in plastic gas distribution pipes. The goal of our part of the project is to implement Bayesian network for classification via images taken inside the pipe. And develop a maintenance framework for plastic pipeline system. Various imaging processing techniques and feature extraction algorithms will be developed for the accurate representation of pipe damage. Advanced parallel computing will be developed for the automatic detection of large imaging datasets. Reliability-based optimization framework will be developed for the pipe infrastructure integrity assessment and maintenance.

Multi-resolution in-situ testing and multiscale simulation for creep fatigue damage analysis of Alloy 617
Status: Finished, 2014 – 2017
Amount: $800,000
Sponsor: DOE
Role: PI
Brief: The overall goal of this project is to develop novel testing and experimentally validated prediction methodologies for creep-dominated creep-fatigue response of structural materials for advanced reactor systems. The investigations will focus on the characterization and testing of Alloy 617, but the proposed testing and life-prediction methodologies are applicable to other structural materials as well. The research objectives of this proposal are: (1) Perform multi-resolution in-situ and ex-situ testing and imaging analysis for the fundamental creep-fatigue damage mechanism investigation; (2) Develop a new procedure for creep-fatigue testing at the coupon level and generate a database for model validation; (3) Formulate and implement models for simulation of creep-fatigue damage mechanisms and their interactions at the microstructure scale; and (4) Conduct microstructure simulations for creep-fatigue mechanism understanding and develop a microstructure-informed and experimentally validated phenomenological creep-fatigue life prediction model.

Optimized Diagnosis and Prognosis for Impingement Failure of PA and PE Piping Materials
Status: Finished, 2014 – 2016
Amount: $50,000
Sponsor: Federal DOT through University of Colorado Denver

Role: co-PI and institutional PI
Brief: The objectives of this pipeline safety research Competitive Academic Agreement Program (CAAP) will be well addressed and supported by our research. Development, demonstration and standardization to ensure the integrity of pipeline facilities will be carried out with this multi-university and collaborative effort. Another major objective of this proposed research that is coherent and relevant to the PHMSA's CAAP program is to engage MS and PhD students who may later seek careers in this field by exposing them to subject matter common to pipeline safety challenges. There are currently six CAAP students fully or partially supported by this excellent program since 2013. If funded, two more PhD students from both universities and several MS students will be trained through this CAAP program and apply their engineering disciplines to pipeline safety and integrity research.

Proactive and Hybrid Sensing based Inline Plastic Pipeline Defects Diagnosis and Prognosis
Status: Finished, 2013 – 2015
Amount: $50,000
Sponsor: Federal DOT through University of Colorado Denver
Role: co-PI and institutional PI
Brief: This proposal seeks support to develop a new form of sensing technique that can identify and characterize injurious pipe body internally and/or externally without contact using near-field microwave probing and induced ultrasonic waves due to microwave absorption and thermal expansion. Different from the current technology and tools such as remote field eddy current (RFEC), magnetic flux leakage (MFL), electromagnetic-acoustic transducer (EMAT) and magneto-strictive (MsS), etc. that can only apply to metallic piping materials or acoustic emission inspection that may lack sensitivity, the proposed hybrid Thermo-Electromagnetic-Acoustic Pipeline Inspection ProbE (TEA-PIPE) system can achieve both superior spatial resolution and high contrast simultaneously due to the innovative nature in laws of physics. The illustration of the TEA-PIPE approach is shown in Figure 1. We will integrate this advance sensor to the inline inspection (ILI) platforms and deliver the system to provide near-term solutions that will improve the safety and enhance the reliability of the pipeline transportation system. Defect characterization through analytics and signal processing will be developed for "in the ditch direct measurement". The detection results from the proposed advanced NDE sensing methodology can be further integrated with probabilistic methods and mechanical analysis for the accurate time-dependent reliability analysis. An information fusion framework integrating the residual strength calculation, uncertainty quantification and propagation analysis, and Bayesian updating is proposed for the accurate pipeline reliability evaluation and risk assessment using NDE testing results. If successful, the pipeline failure can be significantly reduced.

Probabilistic Remaining Useful Life Prediction of Composite Aircraft Components
Status: Finished, 2013 – 2015
Amount: $170,000
Sponsor: NASA through GEM
Role: co-PI and institutional PI

Brief: A discrete crack network model coupled with a critical-plane based fatigue delamination growth model under multiaxial loading will be developed and used as a physics-based deterministic solver for its subsequent probabilistic integration. Advanced probabilistic analysis methods with the Bayesian Maximum Entropy (BME) updating will be implemented for its probabilistic integration. Damage detection results are integrated/fused with the physics-based model using the BME framework.

Concurrent structural fatigue damage prognosis under uncertainties
Status: Finished, 2011-2014
Amount: $363,941
Sponsor: AFOSR
Program: Young Investigator Program
Role: PI
Brief: This project proposes a fundamentally different and innovative fatigue prognosis methodology based on a small time scale formulation is proposed for the real-time concurrent structural damage prognosis. The proposed novel damage model overcomes the inherent difficulties in existing fatigue theories. One of the most important benefits is that concurrent fatigue analysis across multiple spatial and temporal scales becomes feasible. Pervasive prognosis capability is addressed in this study, from material level up to structure level. Rigorous validation of model hypotheses and prediction will be performed using state-of-the-art experimental techniques, such as in-situ fatigue testing under scanning electron microscopy combined with digital image analysis. A special focus in the proposed study is on the systematic uncertainty modeling through multilevel computational simulations. Advanced reliability methods, Bayesian statistics and information theory are proposed to capture the stochastic nature of fatigue damage accumulation.

Validation and uncertainty management of prognostic algorithms
Status: Finished, 2008 – 2011
Amount: $600,000
Sponsor: NASA
Program: Integrated Vehicle Health Management (IVHM)
Role: PI
Brief: The overall goal of the proposed project is to develop, validate and demonstrate a general fatigue damage prognosis and uncertainty management methodology for implementations of the IVHM to aircraft structures. It combines fundamental fatigue mechanism modeling, efficient probabilistic methods, systematical model verification and validation, and hybrid simulation and experimental testing into a single framework for the reliability evaluation and uncertainty management.

Probabilistic Fatigue Life Prediction and Risk Assessment of Aging Bridges in Cold Regions
Status: Finished, 2009 – 2012
Amount: $180,000
Sponsor: NSF
Program: CMMI
Role: PI

Brief: The research objective of this award is to develop an innovative life prediction and risk assessment methodology for aging bridges in cold regions. The detailed fatigue mechanism modeling, corrosive environmental effects due to deicing salts, and advanced probabilistic methods will be systematically integrated into a general framework. Fatigue damage accumulation behavior under general multiaxial random loading will be considered in this project to represent the realistic service conditions of bridges. Coupled corrosion damage growth and fatigue crack growth analysis will be used to investigate the damage interaction of steel bridges in cold regions. A rigorous uncertainty quantification and propagation analysis will be performed using random process theory and Bayesian methodology. Efficient probabilistic methods will be employed to solve the time-dependent reliability problem of bridges considering mechanical and corrosive damage accumulation.

Rotorcraft damage tolerance risk assessment and management
Status: Finished, 2007 – 2011
Amount: $356,500
Sponsor: Federal Aviation Administration
Program: Aging Aircraft Program
Role: co-PI and institutional PI
Brief: The project aims to support FAA rulemaking and the implementation of rotorcraft damage tolerance requirements. It combines uncertainty quantification and propagation analysis, multi-scale fatigue and fracture modeling, risk assessment and reliability-based inspection and maintenance scheduling to develop a general risk management methodology. Demonstration and implementation of the developed methodology are given to show its impact on the applicable FAR regulations.

IRES in China - Advanced Materials for a Sustainable Development
Status: Finished, 2011~2014
Amount: $148,947
Sponsor: NSF
Role: co-PI
Brief: This award is a grant in response to Program Solicitation, International Research Experiences for Students (IRES). The research topic of this program is the development of advanced materials for applications in energy generation and storage and environmental remediation processes. The Clarkson University program will collaborate with Corning, Inc., in New York State, Corning Research China and host research mentors at Tsinghua University and the Chinese Academy of Science Institute of Physics in Beijing, China. Six to twelve undergraduates and three graduate students will travel to China in each of three summers, starting in 2011. Student recruitment will be national, and an effort will be made to include underrepresented minorities.

Self-healing of fatigue damage in metallic materials
Status: Active, 2010~2011
Amount: $5,500
Sponsor: Clarkson CSoE Seed Grant
Role: PI

Brief: This project proposes an innovative and fundamentally different fatigue damage mitigation methodology based on the self-healing mechanism. Detailed mechanism modeling, numerical methods, state-of-the-art experimental techniques, and advanced material synthesis are integrated together for system development and validation. Three major tasks are proposed: 1) Investigate the self-healing mechanism using the newly developed multiscale fatigue damage simulation model for metallic materials; 2) Synthesize a new epoxy/polymer coating material with desired transient temperature and mechanical properties from mechanism modeling; 3) Perform fatigue crack growth testing of Al-7075-T6 specimens with and without self-healing for model validation.

Mesh Independent Probabilistic Residual Life Prediction of Metallic Airframe Structures
Status: Finished, 2011
Amount: $30,000 (Phase I) not through division of research
Sponsor: NASA through GEM, Inc.
Role: Consulting
Brief: Global Engineering and Materials, Inc. (GEM) along with its team members, Clarkson University and LM Aero, propose to develop a mesh independent probabilistic residual life prediction tool for metallic airframe structures. The deterministic solver of this probabilistic analysis tool will be developed by integrating our cutting edge extended finite element toolkit for Abaqus (XFA) with a novel small time scale fatigue crack growth model for mesh independent fatigue crack growth prediction in a complex airframe structural component subjected to multiaxial and variable amplitude loading. The fast matching and narrow band technique will be implemented to track a curvilinear 3D crack growth without remeshing.

Innovative approaches for improving progressive damage modeling and structural life prediction of airframes
Status: Finished, 2009 – 2010
Amount: $25,000 (Phase I) not through division of research
Sponsor: NAVY- NAVAIR through GEM, Inc.
Role: Consulting
Brief: The project is to develop an integrated numerical simulation tool for structural level damage prognosis. An automatic tool for 3D fatigue crack growth prognosis of structural systems under realistic complex loading will be developed by integrating a unified growth model with a mesh independent extended finite element method. The tool will be able to model arbitrary non-planer crack growth over multiple growth regimes with an arbitrary stress ratio without user intervention or remeshing.

Advanced modeling capabilities for railroad wheel failure analysis
Status: Finished
Sponsor: Transportation Technology Center, Inc.
Program: Strategies to Prevent Wheel Failure
Role: Postdoctoral research associate
Period: 2006 - 2008

Brief: The project combines structural failure analysis, finite element methods, and fracture mechanics to develop a methodology to analyze and simulate railroad wheel failure. Experimental tests are performed to quantify initial defects in the wheel material. Failure analyses focuses on both fatigue crack growth and wear to model cracking failure mode and rim thinning, and implement these methods with finite element stress analysis. The results of these analyses lead to future guidance for railroad wheel design optimization.

Stochastic multiaxial fatigue and fracture modeling (Ph.D. dissertation)
Status: Finished
Sponsor: Union Pacific Railroad
Program: Reliability analysis of railroad wheels
Role: Student research assistant
Period: 2004 - 2006
Brief: Research combines fatigue theory, fracture mechanics, finite element analysis, and probabilistic methods to develop a general methodology for the fatigue reliability assessment of rotating mechanical components. Both the crack initiation and propagation under low-cycle and high-cycle fatigue loading were included. The damage accumulation and uncertainty quantification under service stochastic loading was studied in detail. The proposed method has been validated for various materials from different industries.

Residual stress and its effects on fatigue failure of spot-weld joint
Status: Finished
Sponsor: DaimlerChrysler.
Program: Automotive Spot-Weld Joint Reliability
Role: Student research assistant
Period: 2003 - 2004
Brief: Developed a general methodology to combine electro-thermal-structural finite element simulation, design of experiments, response surface method, random field expansion and Monte Carlo technique to simulate the residual stress during the manufacturing process. The results were integrated into a strain-based probabilistic fatigue life prediction model to analyze the reliability variation of spot-weld components.

Probabilistic life prediction of composite laminates
Status: Finished
Sponsor: Vanderbilt University
Role: Student research assistant
Period: 2004 - 2005
Brief: Developed a probabilistic fatigue life prediction framework for multi-directional composite laminates, which enables fatigue-resistant design and maintenance decision-making. The numerical simulation results were validated with experimental observations.