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Education

2011-2014	**Doctor of Philosophy**, *University of Illinois at Urbana-Champaign*, GPA 3.96/4.00 Major: Civil and Environmental Engineering Advisor: Robert Dodds, Jr. Dissertation: *Micromechanical models of delamination in Al-Li alloys* Computational Science and Engineering Certificate
2010-2011	**Master of Science**, *University of Illinois at Urbana-Champaign*, GPA 3.96/4.00 Major: Civil and Environmental Engineering Advisor: Robert Dodds, Jr. Computational Science and Engineering Certificate
2006-2010	**Bachelor of Science**, *University of Illinois at Urbana-Champaign*, GPA 3.97/4.00 Major: Civil and Environmental Engineering, Minor: German Degree awarded with Highest Honors and University Honors

Appointments

2016-	**Principal Mechanical Engineer**, *Argonne National Laboratory* Research topics: High temperature structural materials, design of high temperature nuclear reactors and concentrating solar power systems, crystal plasticity, machine learning methods for material and material model design, qualification of AM nuclear components Supervised a team of 2-3 postdocs and 1-2 staff on several projects supported by the U.S. Department of Energy, Office of Nuclear Energy and the Office of Energy Efficiency and Renewable Energy and the U.S. Nuclear Regulatory Agency Initiated funded projects in new topic areas on concentrating solar power and advanced manufacturing Led work on the revision and improvement of several parts of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code, Section III, Division 5 covering the design and construction of high temperature nuclear reactors
2014-2016	**Postdoctoral Researcher**, *Lawrence Livermore National Laboratory* Supervisor: Nathan Barton Research topics: Multiscale material modeling of additively manufactured structured materials, modeling and optimization of lattice-structured meta-materials, multiscale modeling of HCP metals
2010-2014	**Research Assistant**, *University of Illinois at Urbana-Champaign* Supervisor: Robert Dodds, Jr. Research topics: Parallel performance of WARP3D, crystal plasticity, mesoscale modeling of fatigue/fracture processes, homogenization and multiscale damage calculations

Honors/Awards

2012-14	National Defense Science & Engineering Graduate Fellowship
2010-11	University Fellowship
2008-	Tau Beta Pi

Professional Affiliations

2016-	ASME
2016-	ANS
2014-2016	APS
2006-	ASCE, EMI

Professional Service

2018-	Generation IV Forum: Task Group on Advanced Manufacturing and Materials Engineering *co-chair*
2018-	ASME Boiler & Pressure Vessel Code *committee chair*: BPV III SWG on Inelastic Analysis Methods
2017-	ASME Boiler & Pressure Vessel Code *committee member*: BPV III SG High Temperature Reactors, SWG on Inelastic Analysis, Methods, WG on Analysis Methods, WG High Temperature Flaw Evaluation, WG Creep-Fatigue and Negligible Creep; BPTCS/BNCS Special Committee on Use of Additive Manufacturing for Pressure Retaining Equipment
2017-2019	PVP Conference: *Technical Program Representative*, co-Technical Program Representative, track co-chair
2018-2019	WCCM/USNCCM: *track organizer*
2019	*Reviewer for (past year)*: Modelling and Simulation in Materials Science and Engineering, Acta Materialia, Computer Methods in Applied Mechanics and Engineering, Additive Manufacturing, Nuclear Science and Engineering, ASME Journal of Applied Mechanics, ASME Journal of Pressure Vessel Technology, ASME PVP Conference Proceedings

Institutional and Community Service

2015-2019	Volunteer at middle school/high school DOE Science Bowl
2017-2018	Undergraduate and graduate student summer research program mentor
2013-2014	Qualification exam review course, course organizer

Funding Awards

2019-2021	DOE:NE FOA: Modeling and Simulation Development Pathways to Accelerate KP-FHR Licensing (topic PI) – $500k
2018-2020	DOE:EERE Gen3 CSP: Creep-fatigue design for CSP receivers (topic PI) – $375k
2016	LLNL TechBase: Adaptive smart materials – $65k
2015	LLNL TechBase: Material model library for lattice structured meta-materials – $50k

Other Skills and Qualifications

Security Clearance:	DOE Q
Languages:	German (Proficient)

Publications/Presentations

Refereed journal publications

[1] M. C. Messner. "Convolutional neural network surrogate models for the mechanical properties of periodic structures". In: *Journal of Mechanical Design (accepted)* (2019).

[2] M. C. Messner et al. "A Method for Including Diffusive Effects in Texture Evolution". In: *Journal of the Mechanics and Physics of Solids* 125 (2019), pp. 785–804.

[3] M. C. Messner et al. "Combined Crystal Plasticity and Grain Boundary Modeling of Creep in Ferritic-Martensitic Steels, Part 2: The Effect of Stress and Temperature on Engineering and Microstructural Properties". In: *Modelling and Simulation in Materials Science and Engineering* 27.7 (2019), p. 075010.

[4] Omar Nassif et al. "Combined Crystal Plasticity and Grain Boundary Modeling of Creep in Ferritic-Martensitic Steels, Part 1: Theory and Implementation". In: *Modelling and Simulation in Materials Science and Engineering* 27.7 (2019), p. 075009.

[5] Julie A Jackson et al. "Field responsive mechanical metamaterials". In: *Science advances* 4.12 (2018), eaau6419.

[6] H. D. Carlton et al. "Mapping local deformation behavior in single cell metal lattice structures". In: *Acta Materilia* 129 (2017), pp. 239–250.

[7] M. C. Messner et al. "A crystal plasticity model for slip resistance and junction formation in HCP metals". In: *Modelling and Simulation in Materials Science and Engineering* 25.4 (2017), p. 044001.

[8] Mark C Messner. "A fast, efficient direct slicing method for slender member structures". In: *Additive Manufacturing* 18 (2017), pp. 213–220.

[9] J. A. Hawreliak et al. "Dynamic Behavior of Engineered Lattice Materials". In: *Scientific Reports* 6 (2016).

[10] M. C. Messner. "Optimal lattice-structured materials". In: *Journal of the Mechanics and Physics of Solids* 96 (2016), pp. 162–183.

[11] M. C. Messner, A. J. Beaudoin, and R. H. Dodds, Jr. "A grain boundary damage model for delamination". In: *Computational Mechanics* 56 (2015), pp. 1–20.

[12] M. C. Messner, R. H. Dodds, Jr., and A. J. Beaudoin. "Consistent crystal plasticity kinematics and linearization for the implicit finite element method". In: *Engineering Computations* 32.6 (2015), pp. 1526–1548.

[13] M. C. Messner et al. "Wave propagation in equivalent continuums representing truss lattice materials". In: *International Journal of Solids and Structures* 73-74 (2015), pp. 55–66.

[14] M.C. Messner, A. J. Beaudoin, and R. H. Dodds, Jr. "An interface compatibility/equilibrium mechanism for delamination fracture in aluminum-lithium alloys". In: *Engineering Fracture Mechanics* 133 (2015), pp. 70–84.

[15] M.C. Messner, A. J. Beaudoin, and R. H. Dodds, Jr. "Mesoscopic modeling of crack arrestor delamination in Al-Li: Primary crack shielding and T-stress effect". In: *International Journal of Fracture* 188.2 (2014), pp. 229–249.

Pending refereed journal publications

[16] Holly D. Carlton et al. "The Effects of Defects on the Mechanical Behavior of Metal Lattice-Structured Materials". In: *Submitted for publication* (2019).

[17] M. C. Messner, V.-T. Phan, and T.-L. Sham. "Evaluating and modeling rate sensitivity in advanced reactor structural materials: 316H, Gr. 91, and A617". In: *Submitted for publication* (2019).

Refereed conference publications

[18] B. Barua, M. C. Messner, and M. McMurtrey. "Comparison and Assessment of the Creep-fatigue Design Methods for a Reference Gen3 Molten Salt Concentrated Solar Power Receiver". In: *ASME 2019 Pressure Vessels and Piping Conference*. American Society of Mechanical Engineers. 2019.

[19] B. Barua et al. “Design Methodologies for High Temperature Reactor Structural Components Cladded with Noncompliant Materials”. In: *ASME 2019 Pressure Vessels and Piping Conference*. American Society of Mechanical Engineers. 2019.

[20] M. C. Messner, R. I. Jetter, and T.-L. Sham. “A Method for Directly Assessing Elastic Follow up in 3D Finite Element Calculations”. In: *ASME 2019 Pressure Vessels and Piping Conference*. American Society of Mechanical Engineers. 2019.

[21] M. C. Messner and T.-L. Sham. “Isochronous Stress-Strain Curves for Alloy 617”. In: *ASME 2019 Pressure Vessels and Piping Conference*. American Society of Mechanical Engineers. 2019.

[22] V.-T. Phan, M. C. Messner, and T.-L. Sham. “A Unified Engineering Inelastic Model for 316H Stainless Steel”. In: *ASME 2019 Pressure Vessels and Piping Conference*. American Society of Mechanical Engineers. 2019.

[23] Y. Wang et al. “Development of Simplified Model Test Methods for Creep Fatigue Interaction”. In: *ASME 2019 Pressure Vessels and Piping Conference*. American Society of Mechanical Engineers. 2019.

[24] M. C. Messner, R. I. Jetter, and T.-L. Sham. “Establishing Temperature Upper Limits for the ASME Section III, Division 5 Design by Elastic Analysis Methods”. In: *ASME 2018 Pressure Vessels and Piping Conference*. American Society of Mechanical Engineers. 2018.

[25] M. C. Messner, V.-T. Phan, and T.-L. Sham. “A Unified Inelastic Constitutive Model for the Average Engineering Response of Grade 91 Steel”. In: *ASME 2018 Pressure Vessels and Piping Conference*. American Society of Mechanical Engineers. 2018.

[26] M. C. Messner and T.-L. Sham. “Detection of Ratcheting in Finite Element Calculations”. In: *ASME 2018 Pressure Vessels and Piping Conference*. American Society of Mechanical Engineers. 2018.

[27] M. C. Messner, T.-L. Sham, and Yanli Wang. “N-bar Problems as Approximations to the Bree Problem”. In: *ASME 2018 Pressure Vessels and Piping Conference*. American Society of Mechanical Engineers. 2018.

[28] M. C. Messner et al. “A Basis for Applying Elastic Perfectly-Plastic Design Methods to Cyclic Softening Materials”. In: *ASME 2018 Pressure Vessels and Piping Conference*. American Society of Mechanical Engineers. 2018.

[29] M. C. Messner et al. “Assessment of Passively Actuated In-Situ Cyclic Surveillance Test Specimens for Advanced Non-Light Water Reactors”. In: *ASME 2018 Pressure Vessels and Piping Conference*. American Society of Mechanical Engineers. 2018.

[30] M. C. Messner et al. “The Mechanical Interaction of Clad and Base Metal for Molten Salt Reactor Structural Components”. In: *ASME 2018 Pressure Vessels and Piping Conference*. American Society of Mechanical Engineers. 2018.

[31] M. C. Messner et al. “The Role of Material Modeling on Strain Range Evaluation for Elevated Temperature Cyclic Life Evaluation”. In: *ASME 2018 Pressure Vessels and Piping Conference*. American Society of Mechanical Engineers. 2018.

[32] M. C. Messner, T.-L. Sham, and R. I. Jetter. “Verification of the EPP code case for strain limits evaluations by inelastic analysis method”. In: *Proceedings of the ASME 2017 Pressure Vessels and Piping Conference*. Vol. PVP2017-65418. 2017, pp. 1–10.

[33] M. C. Messner et al. “Modeling shocks in periodic lattice materials”. In: *AIP Conference Proceedings*. 1793. 2017, p. 080012.

[34] Y. Wang et al. “Combined load and displacement controlled testing to support development of simplified component design rules for elevated temperature service”. In: *Proceedings of the ASME 2017 Pressure Vessels and Piping Conference*. PVP2017-65455. 2017, pp. 1–6.

Patents

[35] Julie A Jackson et al. “Systems and methods for additive manufacturing to encapsulate transformative colloidal suspensions”. 15/239,306 (United States). 2018.

[36] Mark Christian Messner. “A fast, efficient direct slicing method for lattice structures”. 15/683,953 (United States). 2018.

Non-refereed publications

[37] Robert I. Jetter et al. *Background Information for Addressing Adequacy or Optimization of ASME Section III, Division 5 Rules for Metallic Components*. American Society of Mechanical Engineers (In press), 2019.

[38] Robert I. Jetter et al. *Gap Analysis for Addressing Adequacy or Optimization of ASME Section III, Division 5 Rules for Metallic Components*. American Society of Mechanical Engineers (In press), 2019.

[39] M. C. Messner, V.-T. Phan, and T.-L. Sham. *Development of the Technical Basis of a Unified Viscoplastic Model of 316H Stainless Steel for Incorporation into ASME Division 5*. Tech. rep. ANL-ART-166. Argonne National Laboratory, 2019.

[40] M. C. Messner and T.-L. Sham. *Development of a Multiaxial Deformation Measure and Creep-Fatigue Damage Summation for Multiple Load Cycle Types in Support of an Improved Creep-Fatigue Design Methods*. Tech. rep. ANL-ART-164. Argonne National Laboratory, 2019.

[41] M. C. Messner and T.-L. Sham. *Draft ASME Section III Division 5 Code Cases to Extend EPP Strain Limits and Creep-Fatigue Design Methods to Grade 91*. Tech. rep. ANL-ART-165. Argonne National Laboratory, 2019.

[42] M. C. Messner and T.-L. Sham. *Inelastic Analysis Procedure based on the Grade 91 Unified Viscoplastic Constitutive Model for ASME Implementation*. Tech. rep. ANL-ART-167. Argonne National Laboratory, 2019.

[43] M. C. Messner et al. *Initial Development of an Improved Creep-Fatigue Design Method that Avoids the Separate Evaluation of Creep and Fatigue Damage and Eliminates the Requirement for Stress Classification*. Tech. rep. ANL-ART-168. Argonne National Laboratory, 2019.

[44] A. Rovinelli et al. *Initial Study of Notch Sensitivity of Grade 91 using Mechanisms Motivated Crystal Plasticity Finite Element Method*. Tech. rep. ANL-ART-171. Argonne National Laboratory, 2019.

[45] Y. Wang et al. *Report on FY19 Testing in Support of Grade 91 Core Block Code Case*. Tech. rep. ORNL/TM-2019/1280. Oak Ridge National Laboratory, 2019.

[46] M. C. Messner, V.-T. Phan, and T.-L. Sham. *Development of Grade 91 inelastic model for incorporation in ASME Division 5*. Tech. rep. ANL-ART-137. Argonne National Laboratory, 2018.

[47] M. C. Messner and T.-L. Sham. *Development of ASME Division 5 Code proposal on temperature limits for simplified design methods*. Tech. rep. ANL-ART-132. Argonne National Laboratory, 2018.

[48] M. C. Messner and T.-L. Sham. *Initial development and extension of EPP methods to Grade 91*. Tech. rep. ANL-ART-133. Argonne National Laboratory, 2018.

[49] M. C. Messner and Y. Yu. "Multiphysics Simulation of Thermal Striping for Determining Creep-Fatigue Life". In: *Transactions of the American Nuclear Society* 118 (2018), pp. 1439–1441.

[50] M. C. Messner, X. Zhang, and T.-L. Sham. *Report on the completion of the development of processing map from as-cast Alloy 709 materials*. Tech. rep. ANL-ART-142. Argonne National Laboratory, 2018.

[51] M. C. Messner et al. *Evaluation of methods to determine strain ranges for use in SMT design curves*. Tech. rep. ANL-ART-138. Argonne National Laboratory, 2018.

[52] M. C. Messner et al. *Evaluation of statistical variation of microstructural properties and temperature effects on creep fracture of Grade 91*. Tech. rep. ANL-ART-143. Argonne National Laboratory, 2018.

[53] M. C. Messner et al. *Finite element analysis of compliant cladding and base metal systems*. Tech. rep. ANL-ART-134. Argonne National Laboratory, 2018.

[54] R. I. Jetter et al. *Report on an Assessment of the Application of EPP Results from the Strain Limit Evaluation Procedure to the Prediction of Cyclic Life Based on the SMT Methodology*. Tech. rep. ANL-ART-96. Argonne National Laboratory, 2017.

[55] M. C. Messner, V. T. Phan, and T.-L. Sham. *FY17 Status Report on the Initial Development of a Constitutive Model for Grade 91 Steel*. Tech. rep. ANL-ART-93. Argonne National Laboratory, 2017.

[56] M. C. Messner and T.-L. Sham. *FY17 Status Report on the Initial EPP Finite Element Analysis of Grade 91 Steel*. Tech. rep. ANL-ART-94. Argonne National Laboratory, 2017.

[57] M. C. Messner et al. *FY17 Status Report on the Micromechanical Finite Element Modeling of Creep Fracture of Grade 91 Steel*. Tech. rep. ANL-ART-95. Argonne National Laboratory, 2017.

[58] Y. Wang, M. C. Messner, and T.-L. Sham. *FY17 Status Report on Testing Supporting the Inclusion of Grade 91 Steel as an Acceptable Material for Application of the EPP Methodology*. Tech. rep. ORNL/TM2017/388. Oak Ridge National Laboratory, 2017.

[59] Brian Healy et al. *WARP3D release 17.0: 3-D dynamic nonlinear fracture analyses of solids using parallel computers*. Civil Engineering Studies Structural Research Series No. 607. University of Illinois at Urbana-Champaign, 2011.

Invited talks

[60] M. C. Messner. "Predicting long-term properties of nuclear reactor structural materials using physically-based models". In: *University of Wisconsin Applied Materials Division Seminar Series*. 2018.

[61] M. C. Messner. "The mechanics of lattice-structured materials". In: *ASME 2017 International Mechanical Engineering Congress & Exposition*. 2017.

[62] M. C. Messner. "Understanding the link between processing, structure, and performance in additively manufactured lattice materials". In: *New Industrial and Scientific Opportunities for Structural Materials: Data, Modeling, Manufacturing*. 2016.

[63] M. C. Messner, A. J. Beaudoin, and R. H. Dodds, Jr. "A multiscale model for delamination fracture in Al-Li alloys". In: *IUTAM Symposium on Ductile Fracture and Localization*. 2015.

Numerous conference presentations