Amirhamed (Hamed) Bakhtiarydavijani (Ph.D.)
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Education

Ph.D.	2019	**Mississippi State University**, Biomedical Engineering, G.P.A. 3.6/4 Advisors: R.K. Prabhu, Mark F. Horstemeyer; Topic: A multiscale modeling approach to investigate traumatic brain injury.
M.Sc.	2012	**Sharif University of Technology**, Materials Science, GPA 3.23/4 Advisor: Ali Karimi Taheri; Topic: Severe plastic deformation of as-cast Al-Mg using equal channel extruding.
B.Sc.	2009	University of Semnan, Materials Science, Abbas Honrabakhsh, Thixotropic casting of Aluminum alloys - a review.

Research Expertise

Traumatic brain injury biomechanics, multiscale modeling, material modeling, finite element analysis, mesh development, continuum mechanics, high rate testing.

Research Projects

Hydrogen embrittlement of high strength steels - a multiscale approach (on going)

Multiscale approach to capture the effects of hydrogen embrittlement on premature considering hydrogen enhanced localized plasticity (HELP) and hydrogen enhanced decohesion (HEDE).

Development of mechano-physiological damage criteria for the brain.

Mechano-physiological damage evolution equations were developed as informed from nanoscale-molecular dynamics simulations and combined with Nernst-Planck diffusion equations to provide a measure of the disruption of internal neuronal ion homeostasis. These damage evolution equations are then extended to microscale finite element models of realistic neurons as an internal state variable (ISV). (One published and one under preparation (see J.1. and J.P.1.) journal article)

Development and troubleshooting of VUMAT material subroutine for ABAQUS finite element analysis.

Mechano-physiological, or mechanoporation, damage to neuronal cells that can cause cell death was captured through molecular dynamic (MD) simulations and upscaled to the microscale. This is then introduced into a hyper-viscoelastic material model of the brain and implemented in a subroutine for the Abaqus finite element software.

A multiscale modeling approach to quantifying the effects of brain geometry effects in chronic traumatic encephalopathy (on going)

The effect of sulci on stress wave propagation is studied using mesoscale brain models. These mesoscale brain models were informed by validated macroscale finite element models of football player head impact. (J.R.1)

Intermediate and high rate testing

Construction of an intermediate serpentine bar

The lower end of strain rates achievable by conventional Split-Hopkinson pressure bars (SHPB) is limited by the wave speed in the bars that dictate the length of the device. A polyethylene serpentine bar can significantly reduce the length of this device. A serpentine bar was designed and built to allow for the testing of soft tissue at intermediate strain rates.

High rate testing of brain tissue

Adult porcine brain tissue is tested at high strain rates using an SHPB with two High speed digital image correlation (HS-DIC) cameras to study the Poisson ratio of brain tissue at high rates while providing high rate data for the calibration of the ISV brain material model. (J.P.2)

Image analysis of temperature variation and flow in rats post-trauma

A Matlab code was developed to map thermal images taken from rats before and after blunt impact and provide thermal gradients, temperature change maps and temperature distribution. (J.P.3 and C.P.1)

Teaching Experience

- Assisted Undergraduate direct individual study (DIS) Fall 2018

Santana Holloway: "High rate mechanical properties of porcine brain tissue"

- Transport (TA) Fall 2016
- Transport (TA) Fall 2015
- Physical Properties of Materials – Instructor Spring 2012
- Undergraduate Material Bonding - Instructor Spring 2012

Publications

Peer Reviewed Journal Articles

J.1. GA Khalid, **A. Bakhtiarydavijan**i, WR Whittington, R Prabhu, MD Jones, "Material response characterization of three poly jet printed materials used in a high fidelity human infant skull", Materials Today: Proceedings, 2019.

J.2. **A. Bakhtiarydavijani**, M. A. Murphy, S. Mun, M. D. Jones, D. J. Bammann, M. C. LaPlaca, M. F. Horstemeyer, R. K. Prabhu. "Damage Biomechanics for Neuronal Membrane Mechanoporation", MSMSE, 2019.

J.3. M. A. Murphy, Sungkwang Mun, M. F. Horstemeyer, Mike Baskes, **A. Bakhtiarydavijani**, Michelle LaPlaca, Steven R. Gwaltney, Lakiesha Williams, R. Prabhu, "Strain state effect on membrane mechanoporation damage via molecular dynamics", Journal of Biomolecular Structure and Dynamics, 1-14, 2017.

J.4. G. A. Khalid, M. D. Jones, R. Prabhu, A. Mason-Jones, W. Whittington, **A. Bakhtiarydavijani**, P. S. Theobald, "Development of a Paediatric Head Model for the Computational Analysis of Head Impact Interactions", International Journal of Mathematical, Computational, Physical, Electrical and Computer Engineering Vol:11, No:3, 2017.

J.5. M.Abdi, A.K.Taheri, **A. Bakhtiarydavijani**, "A New Analysis Method of the Dry Sliding Wear Process Based on the Low Cycle Fatigue Theory and the Finite Element Method", Journal of Materials Engineering and Performance, 2014 (23)

Journal Articles (under journal review)

J.R.1. **A. Bakhtiarydavijani,** M.A. Murphy, K. L. Johnson, G. Khalid, M. Jones, M. F. Horstemeyer, A. C. Dobbins, R. K. Prabhu, "Mesoscale Finite Element Modeling of Traumatic Brain Injury to Quantify the Brain Morphological and Material Heterogeneity Effects". Medical Enginering and Physics.

J.R.2. S. A. Jensen, **A. Bakhtiarydavijani**, A. M. Dulaney, John Wood, P. R. Berthelson, Allison Oversen, S. Mun, J. M. Feugang, R. K. Prabhu. "Using Thermography to Monitor Inflammation as a Non-Invasive Supplementary Diagnostic Tool for Mild Traumatic Brain Injury"

Journal Articles (under preparation)

J.P.1. **A. Bakhtiarydavijani,** M. T. Scimone, C. Franck, A. C. Dobbins, R. K. Prabhu. "Microscale Mechanoporation Related Neuronal Deformation and Injury."

J.P.2. **A. Bakhtiarydavijani,** L. Whittington, W. Whittington, R. Prabhu, "Brain Poisson Ratio at High Deformation Rates"

Conferences - Oral Presentations (*Presenting author)

C.O.1. **C.O.1. A. Bakhtiarydavijani,** Mark T. Scimone, Christian Franck, Allan C. Dobbins, R. K. Prabhu, "Multiscale modeling of mechanoporation related neuronal damage under mechanical loading", 8th International Conference on Mechanics of Biomaterials and Tissues, Waikoloa Beach, Hawaii, Dec. 2019

C.O.2. **A. Bakhtiarydavijani**, M. A. Murphy, S. Mun, M. D. Jones, M. F. Horstemeyer, R. K. Prabhu, "Multiscale modeling of the damage biomechanics of traumatic brain injury", Biophysical Society 2019 Annual Meeting (BPS19), Baltimore, MD, March 2019.

C.O.3. **A. Bakhtiarydavijani ***, M. A. Murphy, M. D. Jones, D. Bammann, M. F. Horstemeyer, R. K. Prabhu, "A multiscale approach to model mechanoporation damage in neurons", ASME – IMECE Pittsburg, PA. Nov 9-15, 2018.

C.O.4. **A. Bakhtiarydavijani**, M.A. Murphy, S. Mun, M.D. Jones, M.F. Horstemeyer, R.K. Prabhu*, "Damage Biomechanics of Neuronal Membrane Mechanoporation" 55th Annual Technical Meeting of the Society of Engineering Science, Madrid, Spain. Oct 10-12, 2018.

C.O.5. **A. Bakhtiarydavijani,** M. A. Murphy, S. Mun, M. D. Jones, M. C. LaPlaca, M. F. Horstemeyer, R. Prabhu*. "Multiscale damage modelling of neuronal membrane mechanoporation due to mechanical insult", 8th World Congress of Biomechanics, Dublin, Ireland. July 8-12, 2018.

C.O.6. **A. Bakhtiarydavijani*,** M. A. Murphy, S. Mun, M. D. Jones, M. C. LaPlaca, M. F. Horstemeyer, R. Prabhu, "Mechano-physiological damage modeling of neuronal death due to traumatic brain injury", ASME IMECE, Tampa Florida, Nov. 3-9, 2017.

Conferences (Poster Presentations)

C.P.1. S. A. Jensen, **A. Bakhtiarydavijani**, A. M. Dulaney, John Wood, P. R. Berthelson, Allison Oversen, S. Mun, J. M. Feugang, R. K. Prabhu. "Using Thermography to Monitor Inflammation as a Non-Invasive Supplementary Diagnostic Tool for Mild Traumatic Brain Injury", Proceedings of the 3rd Joint Symposium of the International and National Neurotrauma Societies and AANS/CNS, Toronto, CA. Aug. 11-16, 2018.

C.P.2. **A. Bakhtiarydavijani**, A. Dobbins, K. Johnson, M. F. Horstemeyer, R. Prabhu*. "A multiscale modeling approach to quantifying the effects of brain geometry effects in chronic traumatic encephalopathy", BMES, Phoenix, AZ, Oct .11-14, 2017.

C.P.3. **A. Bakhtiarydavijani***, A. E. Florence, M. A. Murphy, S. Mun, J. Liao, L. N. Williams, M. F. Horstemeyer, M. C. LaPlaca, R. Prabhu, "Strain rate dependency of the intracellular calcium ion concentration during neuronal membrane mechanoporation", 31th Biomechanics, Bioengineering, and Biotransport Conference Snowbird, Utah, June 17-20, 2015.

C.P.4. **A. Bakhtiarydavijani***, A. E. Florence, M. A. Murphy, S. Mun, J. Liao, L. N. Williams, M. F. Horstemeyer, Michelle C. Laplaca, R. K. Prabhu. "Strain rate dependency of the intracellular calcium ion concentration during neuronal membrane mechanoporation", GSRS, Mississippi State. March 21, 2015.