aperture
formerly american bio engineers

March 10, 2022

Mike W.J. Arun, PhD

Accident Reconstruction/Biomechanical Specialist

EDUCATION

- Post-Doctoral Fellowship in Biomechanics
  Medical College of Wisconsin, Milwaukee, 2018

- Doctor of Philosophy in Mechanical Engineering (Thesis in Biomechanics)
  Indian Institute of Technology Delhi, India, 2014

- Master of Engineering in Mechanical Engineering
  Anna University, India, 2005

- Bachelor of Engineering in Mechanical Engineering
  Bharathiar University, India, 2002

CERTIFICATIONS

- PC-Crash training courses for Collision Reconstruction

EXPERIENCE

American Bio Engineers, LLC, 2021/Present
2305 Historic Decatur Blvd., #100
San Diego, CA 92106

- Accident Reconstruction with areas of expertise in Vehicular Accidents, Vehicular Dynamics, Speed Analysis, Time/Motion Studies, Biomechanics, Product Defects, and Design Strength Analysis.

  Types of cases reconstructed include: Auto v. Auto Collisions, Auto v. Heavy Truck/Trailer Collisions, Auto v. Truck Collisions, Auto v. Motorcycle Collisions, Auto v. Bicycle Collisions, Auto v. Pedestrian Collisions, Vehicle Rollovers, and SRS Air Bag Deployment.

Talas Engineering, 2018/2021
20902 Cabot Blvd
Hayward, CA 94545

- Accident Reconstruction with areas of expertise in Vehicular Accidents, Vehicular Dynamics, Speed Analysis, Time/Motion Studies, Biomechanics, Product Defects, and Design Strength Analysis.

  Types of cases reconstructed include: Auto v. Auto Collisions, Auto v. Heavy Truck/Trailer Collisions, Auto v. Truck Collisions, Auto v. Motorcycle Collisions, Auto v. Bicycle Collisions, Auto v. Pedestrian Collisions, Vehicle Rollovers, and SRS Air Bag Deployment.

Medical College of Wisconsin, Milwaukee, 2012/2018
8701 W Watertown Plank Rd
Wauwatosa, WI 53226

- Theoretical works:

  Injury biomechanics, forensic biomechanics, failure causation and analyses, accident reconstruction, bone and soft tissue mechanics, human – machine interaction safety, safety design mitigation, injury risk analysis, injury tolerance and threshold, linear and nonlinear finite element analysis, metamodel analyses, multi body dynamics, damage mechanics, plasticity, optimization, inverse finite element analysis, statistical analyses, statistical empirical models using experimental data.

- Computational works:

  Ls-Dyna, Ls-Opt, design of experiments and optimization using Ls-Dyna and Ls-Opt, human body models (finite element and multibody models), Madymo, Abaqus, Ansys, User-material subroutines in Ls-Dyna and Abaqus, Hypermesh, Materialise Mimics, Solidworks, PC-Crash, and interpretation, analyses, syntheses, reporting and communication of simulation data.

- Experimental works:

  Design, and conduct experiments using anthropomorphic test device (ATD), injury risk analyses, material characterization, and interpretation, analyses, syntheses, reporting and communication of test data.

Marquette University, Milwaukee, 2014/2018
1250 W Wisconsin Ave
Milwaukee, WI 53233
- Adjunct Assistant Professor
- Courses taught

CEEN 2130	Mechanics of Materials
CEEN 6220	Advanced Mechanics of Materials
BME 3101	Fundamentals of Biomechanics
BME 6230	Computational Modeling

HONORS AND AWARDS

- Swedish Volvo Foundation Research Scholarship, 2009 to 2012
- Institute Merit Scholarship, Indian Institute of Technology, India, 2008 to 2012
- International Research Council on Biomechanics of Injury Travel Grant (IRCOBI), 2010 - 2012

PUBLICATIONS

- Peer-Reviewed Full Paper Conference Publications

Chawla, A., S. Mukherjee and Mike W.J. Arun (2010). Predicting fractures in human bones under impact. 6th World Congress of Biomechanics. Singapore. 1: 160-172.

Mike W.J. Arun, S. Mukherjee and A. Chawla (2010). Reconstructing fracture progression in impact. Expert Symposium on Accident Research. Hannover, Bundesanstalt für Straßenwesen (BASt). 7: 89-98.

Mukherjee, C. Anoop, H. Saurabh, S. Debashish and Mike W.J. Arun (2011). Dynamic properties of the shoulder complex bones. Society of Automotive Engineers, SAE. 11-0428: 7.

Mike W.J. Arun, A. Chawla and Mukherjee (2011). Predicting fracture initiation, propagation and diversion in long bones under impact using Drucker-Prager plastic model and damage modeling. American Society of Biomechanics. Long Beach, California. 3: 56-64.

Mike W.J. Arun., A. Chawla, S. Mukherjee, G. Sharma, P. Shah and C. Ageorges (2012). Dynamic properties of long bones under impact bending using inverse finite element method. Computer Methods in Biomechanics and Biomedical Engineering. Berlin. 2: 112-120.

Mike W.J. Arun., A. Chawla, S. Mukherjee, G. Sharma, P. Shah and C. Ageorges (2013). Characterization of Human Long Bones Using Experiments, Imaging and Inverse Finite Element Techniques. The International Research Council on Biomechanics of Injury Berlin, IRCOBI. 1: IRC-13-21.

Z Mingxin; Mike W.J. Arun; Masoudi, Aidin; Buckland, Daniel; Yoganandan, Narayan; Stemper, Brian; Szabo, Thomas; Snyder, Brian. Real Time Ultrasound Can Measure Dynamic Properties of Cervical Spine Intervertebral Disc. Orthopedic Research Society. 2014; pp. 1-4.

Mike W.J. Arun, John R. Humm, Narayan Yoganandan, Frank A. Pintar (2015). "Biofidelity Evaluation of a Restrained Whole Body Finite Element Model under Frontal Impact using Kinematics Data from PMHS Sled Tests." The International Research Council on Biomechanics of Injury, IRCOBI. 1: IRC-15-69.

Mike W.J. Arun, John R. Humm, Narayan Yoganandan, Frank A. Pintar (2015). "Parametric Study of Axial Loads in the Lower Spine with Varying Pulse and Seat Pan Angle using GHBMC Finite Element Model." The Association for the Advancement of Automotive Medicine, pp. 251-259.

Mike W.J. Arun, S. Umale, J. R. Humm, N. Yoganandan, and F. A. Pintar, "Impact Response Evaluation of a Restrained Whole Human Body Finite Element Model under Far-side 90 and 60 Degree Impacts.," in The International Research Council on Biomechanics of Injury, 2016, pp. 694–706.

Mike W.J. Arun, S. Umale, D. Halloway, F. A. Pintar, and N. Yoganandan, "Can 1 – DOF Sled Tests Reproduce Real World Far-Side Crashes? A Finite Element Study," in The International Research Council on Biomechanics of Injury, 2017, pp. 298–311

- Peer-Reviewed Journal Publications

Yoganandan N, Humm JR, Mike W.J. Arun, Pintar FA. Oblique lateral impact biofidelity deflection corridors from post mortem human surrogates. Stapp Car Crash J. 2013 Nov;57:427-40.

N. Yoganandan, Mike W.J. Arun, B. Stemper, F. Pintar, D. Maiman. Biomechanics of human throcolumbar spinal column trauma from vertical impact loading. Ann Adv Automot Med. 2013;57:155-66.

Mike W.J. Arun, N.Yoganandan, F.Pintar, C. Wolfla. Failure biomechanical responses of isolated and intact human thoracic spine structures. International Journal of Vehicle Safety. 2014 Vol.7, No.3/4, pp.265 – 281

Mike W.J. Arun, N.Yoganandan, B. Stemper, M. Zheng, A. Masoudi, B.Snyder. Sensitivity and stability analysis of a nonlinear material model of cervical intervertebral disc under cyclic loads using the finite element method. Biomed Sci Instrumentation. 2014. 50:19-30.

Yoganandan N, Mike W.J. Arun, Humm J, Pintar FA. (2014). "Deflection corridors of abdomen and thorax in oblique side impacts using equal stress equal velocity approach: comparison with other normalization methods." J Biomech Eng 136(10).

Yoganandan N, Mike W.J. Arun, Pintar FA (2014). "Normalizing and scaling of data to derive human response corridors from impact tests." J Biomech 47(8): 1749-1756.

Yoganandan N, Mike W.J. Arun, Frank A. Pintar, Aniko Szabo (2014). "Optimized lower leg injury probability curves from post-mortem human subject tests under axial impacts" Traffic Injury Prevention 15(sup1): S151-S156.

Yoganandan N, Mike W.J. Arun, Dale E. Halloway, Frank A. Pintar, Dennis J. Maiman, Aniko Sazabo, Rodney Rudd (2014). "Crash characteristics and injury patterns of restrained front seat occupants in far-side impacts" Traffic Injury Prevention 15(sup1): S27-S34.

Mike W.J. Arun, N.Yoganandan, B. Stemper , Frank A. Pintar (2014) "A methodology to condition distorted acoustic emission signals to identify fracture timing from human cadaver spine impact tests" Journal of the Mechanical Behavior of Biomedical Materials 40(0): 156-163.

Yoganandan, N., Schlick, M., Mike W.J. Arun, & Pintar, F. A. (2014). "Military boot attenuates axial loading to the lower leg" Biomedical sciences instrumentation, 50, 179-185.

Yoganandan, N., Mike W.J. Arun, Pintar, F. A, & Banerjee.A (2015). "Lower Leg Injury Reference Values and Risk Curves from Survival Analysis for Male and Female Dummies: Meta-analysis of Postmortem Human Subject Tests." Traffic Inj Prev 16(sup1): S100-S107.

Mike W.J. Arun, "Evaluation of kinematics and injuries to restrained occupants in far-side crashes using full-scale vehicle and human body models." Traffic injury prevention 17.sup1 (2016): 116-123.

Mike W.J. Arun, Hadagali, P., Driesslein, K., Curry, W., Yoganandan, N., Pintar, F.A. "Biomechanics of Lumbar Motion-Segments in Dynamic Compression", Stapp Car Crash J. 2017

Mike W.J. Arun, Hadagali, P., Pintar, F.A., Yoganandan, N. "Normalized Frontal Impact Biofidelity Kinematic Corridors Using Post Mortem Human Surrogates", J Mech Behav Biomed Mater. 2017

Daniel Jobin, Yoganandan, N., Mike W.J. Arun; Gurunathan, S., Influence of morphological variations on cervical spine segmental responses from inertial loading, Traffic injury prevention, 2017

Mike W.J. Arun, Hadagali, P., Pintar, F.A., Yoganandan, N. "Sensitivity of Lumbar Spine Loads to Occupant and Vehicle Parameters in Frontal Crashes", J Mech Behav Biomed Mater. 2017

Umale, S., Yoganandan, N., Pintar, F, Mike W.J. Arun*. "Factors Influencing the Effectiveness of Occupant Retention under far-side Impacts: A parametric study". J Mech Behav Biomed Mater. 2017

- Book Chapters

Mike W. J. Arun, Dennis J. Maiman, Narayan Yoganandan. "Thoracic spine injury biomechanics." Chapter 15 Accidental Injury and Prevention, Springer 2014

Narayan Yoganandan, Mike W.J. Arun, Curtis Dickman, Edward Benzel. "Practical Anatomy and Fundamental Biomechanics." Chapter 7 Benzel's Spine Surgery 4e, Taylor and Francis 2015

ASSOCIATIONS

- Member of the Association for the Advancement of Automotive Medicine
- Member of the Society of Automotive Engineers
- Reviewer: Accident Analysis and Prevention
- Reviewer: Annals of Biomedical Engineering
- Reviewer: Journal of Biomechanics
- Reviewer: Journal of Biomechanical Engineering
- Reviewer: Medical Engineering Physics

SPECIALIZED TRAINING SEMINARS ATTENDED

- World Congress of Biomechanics, August 1-6, 2010, Singapore
    - Adjusting legs for stable running in three dimensions
    - Vestibular research during spaceflight – the role of the gravity vector
    - Cycling aerodynamics: wind tunnel testing versus track testing
    - Biofluidmechanics of avian flight: recent numerical and experimental investigations
    - Mathematical model of blood flow in arteries with porous effects
    - Computational investigation of two interventions for neck and upper extremity pain in office workers
    - Kinematics of a standing passenger subjected to an emergency braking deceleration pulse

- International Research Council on Biomechanics of Injury, 15-16 September 2010, Hanover, Germany
    - Motion of the head and neck of female and male volunteers in rear impact car-to-car tests at 4 and 8 km/h
    - Cervical spine segment finite element model validation and verification at traumatic loading levels for injury prediction
    - Influence of the body on head rotational acceleration in motorcycle helmet oblique impact tests
    - Traumatic brain injury at multiple length scales: relating diffuse axonal injury to discrete axonal impairment
    - Investigation on pedestrian pelvis loading mechanisms using finite element simulations
    - A new method to determine rib geometry for a personalized fem of the thorax
    - Comparison of hybrid iii and human body models in evaluating thoracic response for various seat belt and airbag loading conditions
    - Upper extremity fractures in car accidents

- International Research Council on Biomechanics of Injury, 12 - 14 September 2012 - Dublin (Ireland)
    - Age-related differences in ais 3+ crash injury risk, types, causation and mechanisms
    - Effectiveness of rollover-activated side curtain airbags in reducing fatalities in rollovers
    - Pedestrian passive safety during the SUV impact: regulations vs. reality
    - Whole-body kinematics: response corridors for restrained PMHS in frontal impacts
    - Effect of pedestrian buck contact area and force-deflection property on pedestrian pelvis and lower limb injuries

- Occupant classification for an adaptive restraint system: the methodology and benefits in terms of injury reduction
- A method to induce navicular-cuneiform/cuneiform-first metatarsal sprain in Athletes3
- Determination of ligament strain during high ankle sprains due to excessive external foot rotation in sports
- Validation of pedestrian lower limb injury assessment using subsystem impactors
- Effects of pre-impact swerving/steering on physical motion of the volunteer in the low-speed side-impact sled test

- Stapp Car Crash Conference, November 11-13, 2013 – Orlando, Florida
  - Driver kinematic and muscle responses in braking events with standard and reversible pre-tensioned restraints: validation data for human models
  - Effects of driver characteristics on seat belt fit
  - Observations on pedestrian pre-crash reactions during simulated accidents
  - Development of brain injury criteria (BrIC)
  - Quantification of liver anatomical changes and assessment of occupant liver injury patterns
  - Volunteer kinematics and reaction in lateral emergency maneuver tests
  - Oblique lateral impact biofidelity deflection corridors from post-mortem human surrogates
  - PMHS impact response in 3 m/s and 8 m/s nearside impacts with abdomen offset

- SAE World Congress, April 8-10, 2014 – Detroit, Michigan
  - Optimal seat dynamic parameters determination for minimizing virtual driver's fatigue
  - Expansion of motorized seatbelt control that adjusts to vehicle behavior and the effect of that expansion
  - Estimation of body mass index effect on lower extremity injuries for lateral collision with-out airbag
  - Measurements of non-injurious head accelerations of young children
  - Likelihood of lumbar spine injuries for far-side occupants in low to moderate speed lateral impacts
  - Measurement of tolerable and non-injurious levels of back-to front whole body accelerations
  - Finite-element-based transfer equations: post-mortem human subjects versus Hybrid III test dummy in blunt impact
  - Head accelerations in out-of-position postures in low-speed rear impacts: a comparison between volunteer data and GATB simulation

- Independent control of steering force and wheel angles to improve straight line stability
- Sprung mass identification of suspension in a simplified model
- Evaluation of ejection risk and injury distribution using data from the large truck crash causation study

- Stapp Car Crash Conference, November 10-12, 2014 – San Diego, California
  - Evaluation of axonal strain as predictor of mild traumatic brain injury using finite element modeling
  - Influence of neck muscle tonus and posture on brain tissue strain in pedestrian head impacts
  - Dynamic responses of intact postmortem human surrogates from inferior to superior loading at the pelvis
  - Structural design strategies for improved small overlap crashworthiness performance
  - Features of the vision of elderly pedestrians when crossing a road
  - Occupant kinematics in laboratory rollover tests: ATD response and biofidelity
  - Contribution of pre-impact spine posture on human body model response in whole-body side impact
  - Response and tolerance of female and/or elderly PMHS to lateral impact
  - Effect of upper body mass and initial knee flexion on the injury outcome of postmortem human subject pedestrian isolated legs

- Stapp Car Crash Conference, November 9-11, 2015 – New Orleans, Louisiana
  - Oblique loading in human cadavers in full vehicle lateral impact tests using chest band data
  - Development and validation of the Total Human Model for Safety (THUMS) version 5
  - Side impact regulatory trends, crash environment and injury risk in the USA
  - Characterization of human rib biomechanical responses due to three-point bending
  - Reference PMHS sled tests to assess submarining
  - Integration of active and passive safety technologies - a method to study and estimate field capability
  - Testing and modeling the responses of hybrid iii crash-dummy lower extremity
  - Measurements of non-injurious head accelerations of young children

- Association for the Advancement of Automotive Medicine, September 17-21, 2016
  - Presented a paper on experimental lumbar spine injury tolerance

- Stapp Car Crash Conference, November 7-9, 2016 – Washington DC, USA
    - Effect of rib shape on stiffness
    - Age-specific injury risk curves for distributed, anterior thoracic loading of various sizes of adults based on sternal deflections
    - Investigation of pelvic injuries on eighteen postmortem human subjects submitted to oblique lateral impacts
    - Morphomics of the talus
    - Development and full body validation of a 5th percentile female finite element model
    - Thoracic injury risk curves for rib deflections of the SID-IIs build level d
    - Traffic accidents involving cyclists identifying causal factors using questionnaire survey
    - Responses and injuries to PMHS in side-facing and oblique seats in horizontal longitudinal sled tests per FAA emergency landing conditions

- Association for the Advancement of Automotive Medicine, October 7-10, 2017- Las Vegas, Nevada
    - Parametric cervical spine model for rear-end impact simulations
    - Comparison of WorldSID to PMHS shoulder-to-belt interaction in far-side impact configurations
    - Vehicle safety for wheelchair users: the role of anthropometry
    - Response of the knee joint to translational and bending loads
    - Effectiveness of lowering the blood alcohol concentration (bac) limit for driving from .10 to .08 in the United States
    - Association of cell phone bans with fatal crashes among young drivers
    - Influence of morphological variations on cervical spine segmental responses from inertial loading
    - Trunk muscle recruitment patterns in simulated pre-crash events

- Stapp Car Crash Conference, November 13-15, 2017 – Charleston, SC
    - Biomechanics of lumbar motion-segments in dynamic compression
    - Human shoulder response to high velocity lateral impact
    - Strain-rate dependency of axonal tolerance for uniaxial stretching
    - An overview of the magnitude and nature of the chest injury problem in frontal crashes
    - Observations on thoracic injury prediction and the influence of age
    - Chest deflections of the THOR and Hybrid III dummies in equal severity impacts
    - Insurance Institute for Highway Safety's perspective on addressing chest injuries in car crashes
    - Optimizing seat belt and airbag designs for rear seat occupant protection in frontal crashes

- Occupant kinematics in simulated autonomous driving vehicle collisions: influence of seating position, direction and angle

- Stapp Car Crash Conference, November 12-14, 2018 – San Diego, California
  - Effects of inboard shoulder belt and lap belt loadings on chest deflection
  - Reference PMHS sled tests to assess submarining of the small female
  - Injury risk curves for the human cervical spine from inferior-to-superior loading
  - Relation between Sacro ilium and other pelvic fractures based on real world automotive accidents
  - Front airbag deployment rates in real-world car accidents in Japan and implications for activation of accident emergency calling system
  - Driver assistance and fully autonomous systems: their implications on safety
  - Validation of a finite element 50th percentile THOR anthropomorphic test device in multiple sled test configurations

- Stapp Car Crash Conference, November 11-13, 2019 – San Antonio, Texas
  - Human response and injury resulting from head impacts with unmanned aircraft systems
  - Investigating combined thoracic loading using the elderly female dummy (EFD)
  - Far side impact injury threshold recommendations based on 6 paired WorldSID/post-mortem human subject tests
  - Factors affecting child injury risk in motor-vehicle crashes
  - Pediatric cervical spine strength and stiffness in the sagittal plane
  - A novel approach to scaling age-, sex-, and body size-dependent thoracic responses using structural properties of human ribs
  - Quantifying relative brain motion in a postmortem human subject

- Association for the Advancement of Automotive Medicine, October 12-16, 2020
  - Target population for motorcycle-detecting automatic emergency braking systems
  - Construction of injury prediction model using random forest algorithm with resampling methods for imbalanced accident data
  - Novel experiments to assess stiffness response of lumbar spine in flexion
  - Development of an upper cervical spine model for use in an omnidirectional surrogate neck
  - Female and male volunteer kinematics during relaxed and braced pre-crash braking events
  - Finite element reconstruction of a vehicle-to-pedestrian impact

RESEARCH

- **Experimental Research:**

  - Calculation of level-wise linear z-stiffness, and angular y-stiffness in lumbar spine. A total of 50 human lumbar spines were tested to derive the stiffness data. The data were used to establish injury threshold and tolerance. The established tolerance was later used to calculate injury risk due to wearing a shoulder mounted equipment. Further the equipment's center of gravity was optimized to reduce the risk of lumbar spine injury.

  - Evaluation of force transmitted to the pelvis of original equipment manufacturers (OEM) bicycle and car seats using H III anthropomorphic test device and controlled sled tests. The pelvic forces were then used to access the injury risk for fracture. The seats were then redesigned using parametric mathematical models in order to mitigate high pelvic forces.

  - Designed and performed a series of 28 ES-2 anthropomorphic tests in order to evaluate the injury risks on the cervical and thoracic spines. The head of the ATD was laterally loaded with several types of prototype helmets. The objective was to identify a helmet design that would transmit lower forces and moments to the cervical and thoracic spines.

  - Characterization of human humeri bone under three-point bending. A total of 112 bones were tested under three-point bending with various orientations. The data from these tests were used to establish directional injury tolerances. Further the ash densities were statistically and empirically related to the bone strength under bending loading mode.

  - Derivation of injury criteria for lumbar spine. A total of 18 whole lumbar spine tests were performed to derive an evidence- based injury criteria to the lumbar spine.

  - Took the lead to interpret and synthesize the test data. The findings were communicated to the research community through physical and online meetings, peer-reviewed conferences and journal publications.

Computational Research:

- Development of a 75-year-old whole human body model using morphing techniques. The model was validated using various experimental data. The model is currently being used for occupant safety research in Highly Automated Vehicles for assessing injury risk to the occupants.

- Thoracic injury research to analyze the influence of upper torso posture on rib fractures using GHBMC and THUMS whole human body model. A base whole-body model was morphed to reflect various thoracic and cervical spine postures. Parametric studies were performed to mitigate loads to the lumbar spine. The restraints, seat cushion and structures were optimized to minimize injury risks.

- Compare injury severities on spines (cervical, thoracic and lumbar), foot and ankle, and knee between 26 and 75 year old whole body models under similar loading and boundary conditions. The objective of this project was to minimize injury risks during bicycling activities, while wearing head and shoulder mounted wearables.

- Study the influence of material and geometrical changes on the occupant response using GHBMC and THUMS whole body FE models. A base FE model was morphed to a 75-year-old geometry, and another 75-year-old model was generated with an updated 75-year-old geometry and material properties. Parametric studies were performed to decipher the influence of geometry and material properties on the injury risk of head fractures and spinal subluxation.

- Development of a 5th percentile thorax FE model to assess Behind Armor Blunt Trauma. A full human body female model was developed to assess rib deformations due to a projectile impact to the chest. Failure of the existing body armor was simulated. A new design of body armor was conceptualized (and eventually manufactured) using parametric FE simulations by reducing injury risks to the chest while constraining the mass of the body armor.

- Development of a detailed osteo-ligamentous head and neck model for active military personnel safety research. The model was developed using mapping block methodology and validated using various experimental data

- Analyze the influence of Head Supported Mass like Night Vision Goggles mounted to the helmet on the cervical spine injuries using a detailed FE model. Parametric studies were performed by loading a head-T1 spine model using eccentric loading simulating head supported mass. The mass, moment of inertia and CG location of the head supported mass equipment were optimized to reduce the risk of injury to the cervical spine.

- Derive a neck injury criterion for female active military personnel using a detailed validated finite element model and cadaver test data. Matched pair simulations were performed between the male and female cervical spine models to calculate the difference in injury tolerances. This data was then used to derive an injury risk function of a female cervical spine.

- Study the efficacy of artificial cervical spine discs in active military personnel during rapid maneuvers, using a detailed FE model. Three different artificial discs were modeled and validated using experimental data. These discs were incorporated into a FE head-T1 FE model and the injury risks were evaluated. The physical characteristics of the artificial discs were parametrically redesigned and optimized to reduce concentrated loads to the spine. The redesigned discs were later commercialized.

- Study the influence of 3-point seatbelt and OEM car seats on the lumbar spine loads using GHBMC model. Several parametric studies were performed to delineate the injury mechanism that caused severe lower spine injuries during horizontal impacts. Further the restraints and seat characteristics were redesigned to minimize these injuries. The redesigned seats were then implemented in Volvo cars.

- Study the retention of a three-point seatbelt during far-side crashes using GHBMC and THUMS models. Parametric studies with varying occupant and vehicle parameters were performed to identify the most influential parameters responsible for seatbelt

retention under far-side crashes, and hence reducing injuries to pelvis and thoracic spine.

- Development of subject specific lumbar spine model for clinical application. Personalized finite element models were developed to assist spine surgeons to make clinical decisions and to reduce the risk of follow-up surgeries.

- Development of user material routing (VUMAT) in ABAQUS commercial code to predict fracture patterns in human humerus bones under three-point bending loading. The VUMAT routing included the rate-dependent response, Drucker-Prager plasticity, and a deviotoric stress-based damage model (PhD thesis).

- Took the lead to interpret and synthesize the simulation data. The findings were communicated to the research community through physical and online meetings, peer-reviewed conferences and journal publications.