



# Shannon Kroeker

PhD PEng CPST

Biomechanical Engineer

## contact

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📍 Vancouver

## expertise

Injury Biomechanics

## areas of specialization

Injury mechanics/causation

Injury potential

Motor vehicle collision injury

Seat belt investigations

Helmet investigations

Slip/trip/fall injuries

Sport injuries

Dr. Shannon Kroeker is a biomechanical engineer and a member of MEA Forensic's Injury Biomechanics group. Shannon investigates injuries related to vehicle collisions, child restraint system, sports and recreational accidents and slips, trips and falls. She uses her injury biomechanics expertise and engineering principles to determine the effect of forces upon the body. During her eight years at the firm, she has worked on more than 400 cases.

Shannon holds a Master of Applied Science from the University of British Columbia and a Doctor of Philosophy from the University of Washington in Mechanical Engineering. Her doctoral research involved measuring the injury thresholds of the spine and spinal cord. She has continued to pursue research at MEA, studying helmet effectiveness and publishing the results in peer-reviewed journals. "We are always working on research projects at MEA," she says. "This satisfies both our own professional curiosity and provides us with specific insight into aspects of real incidents."

With her background in experimental research, Shannon also makes use of MEA's laboratory and testing facilities to answer questions related to specific cases when required. A crash test dummy, a linear sled, a helmet drop tower and a crash barrier are some of the tools that are available. "We can perform testing specific to the case," she says.

Shannon began her career at MEA as a member of the Collision Reconstruction group providing her with an understanding of the dynamics of vehicle collisions and rollovers. Now in Injury Biomechanics, her investigations involve determining whether a particular injury is related to a particular incident. She also helps clients understand alternate scenarios. For example, if an individual were not wearing a seat belt, what would their injury risk have been had they, instead, been wearing their belt? "Often, we're looking at whether someone would have been injured—or injured differently—in an alternate scenario," says Shannon.

## education

Doctor of Philosophy, Mechanical Engineering, University of Washington, 2010

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Master of Applied Science, Mechanical Engineering, University of British Columbia, 2005

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Bachelor of Science, Mechanical Engineering, Queen's University, 2003

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## professional status

Professional Engineer, Engineers and Geoscientists British Columbia (EGBC), Registration No. 38598.

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## professional associations

American Association of Automotive Medicine (AAAM), since 2012.

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Reviewer, International Journal of Crashworthiness, since 2013.

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Reviewer, Journal of Biomechanics, since 2014.

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Technician, Child Passenger Safety Association of Canada (CPSAC), since 2019.

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International Society of Biomechanics, since 2019.

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Reviewer, Frontiers in Bioengineering and Biotechnology, since 2021.

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## professional experience

### **MEA Forensic Engineers & Scientists, Vancouver, BC**

Project Engineer, April 2010 to present

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Conducts analyses and research into the biomechanics of injury, including assessments of the loads applied to the body, injury mechanics, and the relationship between the applied loads and the injury. Performs seat belt effectiveness analyses to determine the potential for injury with seat belt use. Involved in over 400 technical investigations related to motor vehicle collisions, bicycle collisions, pedestrian impacts, and slip and fall accidents. Research activities focus on biomechanics of injury and helmet performance.

### **University of Washington, Department of Mechanical Engineering, Seattle, WA**

Research Assistant and PhD Candidate, January 2006 to March 2010

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Experimental design and execution of studies to measure the injury thresholds of the spine and spinal cord in axial tension. Supervised a Senior Bioengineering student completing requirements for design project at the University of Washington.

### **Ciren Seattle, Crash Injury Research Engineering Network, Seattle, WA**

Team Member, May 2008 to March 2010

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Evaluated crash data, medical records, accident scenarios, and evidence to determine mode of injury. The database of accidental and medical evidence was used to answer a variety of research questions.

### **University of British Columbia, Department of Mechanical Engineering, Vancouver, BC**

Research Assistant and MASC Candidate, September 2003 to December 2005

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Design and application of instrumentation and equipment to study the properties and behaviour of the spinal cord. Conducted research relevant to the spinal cord including spinal cord properties, in vitro lab experimentation, and development of surrogate spinal cords.

## **University of Leeds, United Kingdom**

Research Assistant, April 2005 to May 2005

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Participated in collaborative research studying the effects of CSF on the biomechanics of impact upon the spinal cord. Conducted research under the supervision of Dr. Richard Hall, in conjunction with a University of Leeds Master student.

## **Prince of Wales Medical Research Institute, Randwick, Australia**

Research Assistant, May 2004 to June 2004

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Studied under Dr. Lynne Bilston during Master of Applied Science at UBC. Learned techniques for constructing surrogate cords. Participated in collaborative efforts between the University of New South Wales, AUS, the University of Leeds, UK, and the University of British Columbia, CAN.

## **Queen's University, Occupational Biomechanics Laboratory, Kingston, ON**

Research Assistant, June 2003 to August 2003

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Designed a computer model of a backpack for studies in strap pressure for military personnel comfort level using Unigraphics. Assisted in pressure and acceleration data collection of volunteer subjects wearing military backpacks.

## **research activities**

Immature Cervical Spine Testing, Applied Biomechanics Laboratory, University of Washington, Seattle, WA.

Sponsor: NHTSA

Research Assistant, September 2007 to August 2008

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Prepared in vitro cervical baboon spines for testing. Designed testing protocol and managed testing to measure the kinematics of the cervical spine in flexion-extension, axial rotation, lateral bending, and in combined loading.

Paediatric Window Falls Pilot Study, Applied Biomechanics Laboratory, University of Washington, Seattle, WA.

Sponsor: Harborview Injury Prevention & Research Center, Seattle, WA.

Engineer, March 2009 to May 2009

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Equipment and instrumentation was designed and developed to replicate a 3-year-old child applying pressure to a window screen and to measure the applied forces. The results from this study will be used to propose window screen design modifications in order to prevent children from falling through window screens.

Lead investigator for a study comparing the injury severity between drivers and passengers in the same collision.

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Lead investigator for a study investigating the impact attenuation performance of bicycle helmets over a wide range of impact severities.

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Lead investigator for a study investigating the material properties of bicycle helmet foam liners in new, old and used helmets.

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## **awards**

AAAM Endowment Student Grant, \$10,000, January 2008 to December 2009.

Cervical Spinal Cord Injury due to Axial Tension: Age Effects

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Louis and Katherine Marsh Fellowship Endowment, \$9083, September 2006 to June 2007.

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## publications

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Density Variation in the Expanded Polystyrene Foam of Bicycle Helmets and Its Influence on Impact Performance

Age does not affect the material properties of expanded polystyrene liners in field-used bicycle helmets

Coupling between the spinal cord and cervical vertebral column under tensile loading

Driver-related delay in emergency braking response to a laterally-incurring hazard

The Development of an Improved Physical Surrogate Model of the Human Spinal Cord — Tension and Transverse Compression

The effect of cerebrospinal fluid on the biomechanics of spinal cord: an ex vivo bovine model using bovine and physical surrogate spinal cord

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## lectures & presentations

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January 27, 2021 – Presentation to West Vancouver Secondary School, Title: Forensic Engineering, online.

May 20, 2015 – Does age affect the impact properties of helmet foam liners? Shirtsleeves Technical Meeting, ASTM F08.53 Headgear Subcommittee, Anaheim, CA.

October 4-7, 2009 – Cervical Spinal Cord Injury as a Result of Axial Tension, AAAM 53rd Annual Scientific Conference, Baltimore, MD.

September 7-11, 2009 – Cervical Spinal Cord Injury: A Relationship Between Column and Cord Strains in Tension-Extension Injuries, Neurotrauma 2009, Santa Barbara, CA.

June 5-6, 2009 – Cervical Spine and Spinal Cord Coupling in Tension, Proceedings of the 5th Annual Northwest Biomechanics Symposium, Pullman, WA.

May 9-10, 2008 – A Histological Analysis of Spinal Cord Injury In Vitro, Proceedings of the 4th Annual Northwest Biomechanics Symposium, Boise, ID.

October 23, 2008 – Panel discussion regarding engineering topics surrounding pediatric window falls. Community Forum: Understanding and Preventing Paediatric Window Falls. Harborview Medical Center. Seattle, WA.

April 27, 2005 – The Human Spinal Cord: An Improved Physical Model. Tissue Engineering Laboratory, University of Leeds, Leeds, UK.

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## training and professional development

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June 15-16, 2021 – Advances in Child Injury Prevention Conference (ACIP), Online.

March 22–25, 2021 – iNPUT-ACE Video Evidence Symposium 2021, Online.

October 12-16, 2020 – AAAM 64th Annual Scientific Conference, online.

July 31 – August 3, 2019 – International Society of Biomechanics/American Society of Biomechanics Congress, Calgary, AB.

April 26-29, 2019 – Child Passenger Safety Technician, North Vancouver, BC.

January 28, 2019 – Children, Booster Seats, and Pre-Crash Evasive Maneuvers, Association for the Advancement of Automotive Medicine, Webinar.

October 7-10, 2018 – AAAM 62nd Annual Scientific Conference, Nashville, TN.

October 7, 2018 – Understanding AIS: Practical Information for Analyzing Injuries using AIS Codes, AAAM Workshop, Nashville, TN.

June 6 – 8, 2017 – 25th International Technical Conference on the Enhanced Safety of Vehicles (ESV), Detroit, MI.

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July 6, 2015 – Building Code Overview, Ontario Society of Professional Engineers, Mississauga, ON.

July 6-11, 2014 – 7th World Congress of Biomechanics, Boston, MA.

September 22-25, 2013 – AAAM 57th Annual Scientific Conference, Quebec City, Quebec, Canada.

October 14-17, 2012 – AAAM 56th Annual Scientific Conference, Seattle, WA.

July 12, 2012 – The Pathophysiology of Traumatic Brain Injury, Vancouver, BC.

November 7-9, 2011 – 55th Stapp Car Crash Conference, Detroit, MI.

November 2011 – International Workshop on Human Subject for Biomechanical Research, Detroit, MI.

November 3-5, 2010 – 54th Stapp Car Crash Conference, Phoenix, AZ.

November 2, 2010 – 38th International Workshop on Human Subjects for Biomechanical Research, Phoenix, AZ.

October 2010 – Motorcycle Skills Course, JIBC, New Westminster, BC.

August 2010 – Expert Scripting with PC-Crash, MEA Forensic, Vancouver, BC.

August 2010 – PC-Crash Essentials, MEA Forensic, Vancouver, BC.

August 2010 – Expert Animation with PC-Crash, MEA Forensic, Vancouver, BC.

June 2010 – The Tire as a Vehicle Component and Tire and Wheel Safety, Dr. Joseph D. Walter, Richmond, BC.

October 4-7, 2009 – AAAM 53rd Annual Scientific Conference, Baltimore, MD.

September 7-11, 2009 – The 27th Annual National Neurotrauma Symposium, Santa Barbara, CA.

June 5-6, 2009 – Proceedings of the 5th Annual Northwest Biomechanics Symposium, Pullman, WA.

May 9-10, 2008 – Proceedings of the 4th Annual Northwest Biomechanics Symposium, Boise, ID.

June 1-3, 2006 – Proceedings of the Canadian Medical and Biological Engineering Conference, Vancouver, BC.

October 17, 2005 – Proceedings of the 3rd International Collaboration on Repair Discoveries (ICORD) Annual Research Meeting, Vancouver, BC.

June 23 – 25, 2005 – 2005 Summer Bioengineering Conference, Vail, CO.

October 22-24, 2004 – 5th Alberta Biomedical Engineering Conference, Banff, AB.

October 25-26, 2004 – Alberta Provincial CIHR Training Program in Bone and Joint Health, Banff, AB.

October 18, 2004 – Proceedings of the 2nd International Collaboration on Repair Discoveries (ICORD) Annual Research Meeting, Vancouver, BC.