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William Bussone, PE

Managing Engineer

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Mr. William Bussone, P.E., is the Managing Engineer at CBE Consultants, Inc., and possesses experience applying biomechanics to a variety of real-world problems. A biomechanical engineer with an M.S. in Mechanical Engineering (from Virginia Tech) and a B.S. in Biomedical Engineering (from Michigan Tech), Mr. Bussone has testifying experience and more than 15 years research experience in biomechanics, accident reconstruction, and human injury / tolerance to mechanical load, especially head injury tolerance and concussion in sports. He specializes in issues involving injury biomechanics, case-specific injury analyses and using engineering principles to determine the severity and mechanism of injuries. His areas of expertise include amusement rides and devices, sports (including football, baseball, and motor sports), transportation, occupational and industrial accidents, injuries involving helmets, injuries occurring in falls, and injuries to children.

Mr. Bussone has extensive experience analyzing helmet performance and head injury mechanisms, both for contemporary and historical comparisons. He has analyzed concussions and other head injuries based on linear and rotational injury thresholds and mechanisms for manufacturers, as well as for teams and operators. Mr. Bussone has tested and analyzed current and historic football helmet performance. He has critically evaluated claims made by experts on the bases of assumptions made, execution of methodology, and consistency with published literature and past positions. While at Virginia Tech, he performed in vivo analyses of concussions and other brain injuries in collegiate football and head accelerations in everyday events.

Mr. Bussone has conducted analyses of amusement rides to examine the rider kinematics and the potential for injuries associated with the ride, and compared forces experienced during activities of daily living with those experienced on rides. He has experience obtaining, analyzing, and evaluating ride acceleration profiles; obtaining and analyzing patron head and torso accelerations; evaluating restraint performance; evaluating accessibility; and evaluating standards-compliance. Mr. Bussone has consulted for amusement ride manufacturers in the design and approval of their products.

Mr. Bussone has more than a decade of experience reviewing medical records for the purpose of evaluating the extent, distribution, and severity of injuries; the health and biomechanical status of the individual; and the past medical history as it relates to the biomechanical analysis and claims. He also has experience reviewing medical imaging films/modalities such as CT, MRI, and plain films that illustrate the distribution and extent of injuries in the context of the anatomy.

For CBE Consultants, Inc., Mr. Bussone provides analyses for injury accident reconstruction on a variety of projects. His background includes evaluating diverse and unusual events, from helmeted sports injury to automotive collisions to falls and impacts from falling objects to evaluations of guardrail construction. He has assessed whether the motions, accelerations, and loads caused injury, and he has performed biomechanical reconstructions of incidents involving industrial equipment, including forklifts, skid-steer loaders, and gantry cranes, and amusement devices, including roller-coasters and spinning rides, to determine how traumatic injuries occurred.

Previously a senior engineer at JP Research, Inc., and prior to that a senior engineer with Exponent, Inc.'s biomechanics practice, Mr. Bussone's previous consulting experience includes analyses and reconstructions of motor vehicle crashes; amusement, sports, and occupational injuries; and falls. He has evaluated biomechanical issues and injury potential associated with alternate scenarios, such as changes in design or safety equipment, and has used biomechanical analyses to evaluate whether a described scenario could have occurred during a fall, electrical contact, vehicle collision, sports incident, or other event. Mr. Bussone's research interests include applying injury data and anthropometry to sports equipment analyses, self-imposed head and neck loads in adults and children, amusement ride biomechanics, methods for analyzing rotational kinematics data, and sports and transportation helmet design.

Mr. Bussone has been an active member of the ASTM International F24 Committee on Amusement Rides and Devices since 2004. He is currently a member of the F24 Acceleration Task Group. His work has been cited within the SAE J211/1 (Instrumentation for Impact Test - Part 1 - Electronic Instrumentation) standard. Mr. Bussone is a licensed professional engineer in Connecticut, Maryland, and Pennsylvania.

Education, Memberships, and Professional Honors

Virginia Tech	M.S, Mechanical Engineering	2005
Michigan Technological University (summa cum laude)	B.S., Biomedical Engineering	2003

Licenses and Certifications

Licensed Professional Engineer, Connecticut, #28224

Licensed Professional Engineer, Maryland, #39199

Licensed Professional Engineer, Pennsylvania, #PE084181

Honors and Awards

National Science Foundation Graduate Research Fellow

Tau Beta Pi Honor Society

National Merit Scholar

Memberships and Professional Affiliations

ASTM International, F24 committee (member), 2004-present

- F24.24 G-force Task Group

Society of Automotive Engineers (member)

Professional Experience

Throughout his professional career, Mr. Bussone has gained experience that includes: Conducting analyses of amusement park rides to examine the rider kinematics and the potential for injuries associated with the ride, comparing forces experienced on rides with activities of daily living, and evaluating standards-compliance. Performing biomechanical reconstructions and analyses of the causation of injuries from incidents involving helmets and other protective equipment, including football helmets, bicycle helmets, motorcycle and auto-racing helmets, as well as pads and protectors. Evaluating a wide variety of incident circumstances, including falls from height, falling objects, industrial equipment accidents, construction accidents, automotive injuries, slips and falls, incidents involving furniture, aircraft incidents, electrical and fire incidents, and transit accidents. Utilizing medical records, physical evidence, and testimony to reconstruct accidents and determine how injuries may or may not have been caused. Performing demonstrative testing to illustrate mechanisms of injury. Reviewing medical records for the purpose of evaluating the extent, distribution, and severity of injuries; the health and biomechanical status of the individual; and the past medical history as it relates to biomechanical analyses and claims. Performing reviews of medical imaging films/modalities such as CT, MRI, and plain films to determine the distribution and extent of injuries in the context of the anatomy.

CBE Consultants, Inc., Media, Pennsylvania

Managing Engineer, 2020-Present

Directs, manages, and provides technical support for biomechanics-focused research and litigation projects for a variety of clients. Project experience and expertise includes biodynamics, biomechanics, and investigation of human injury in the areas of human tolerance, occupant kinematics, and rigid body dynamics, including evaluation of injury causation, and premises, accessibility, and product liability issues for amusement rides and devices; vehicles, industrial and construction equipment, and sporting equipment. Expertise in all aspects of head injury, including skull fracture, concussion, mild traumatic brain injury, and experimental testing pertaining to head injuries and helmet performance.

JP Research, Inc., Philadelphia, Pennsylvania

Senior Engineer, Philadelphia Office, 2016–2020

Directed, managed, and provided technical support for biomechanics-focused research and litigation projects throughout JP Research. Mentored biomechanics staff of the Pennsylvania office of JP Research.

Exponent, Inc., Philadelphia, Pennsylvania

Senior Engineer, Philadelphia Office, 2005–2016

Responsible for biomechanical analyses and reconstruction of events leading to human injury in diverse scenarios, including amusement ride incidents, electrical contacts, falls, incidents involving industrial equipment, motor vehicle collisions, and incidents involving sports equipment, especially helmets. Efforts included evaluation of safety equipment and alternate accident and safety scenarios. Managed projects for biomechanics and occupant kinematics investigations. Applied engineering and physics principles to evaluate injury mechanisms in traumatic events and to reconstruct accidents. Communicated technical issues needed to make business and legal decisions to decision makers. Created standard

method to analyze kinematics data in context of normal human exposure. Qualified as an expert in US courts.

Virginia Tech – Wake Forest Center for Injury Biomechanics

Virginia Polytechnic Institute and State University (Virginia Tech), Blacksburg, Virginia

Graduate Research Associate, 2003–2005

Relevant Volunteer Experience

Journal Reviewer

Annals of Biomedical Engineering, 2010-2022

ASME International Mechanical Engineering Congress and Exposition (IMECE), 2015

ASCE-ASME Journal of Risk and Uncertainty in Engineering Systems, Part B:

Mechanical Engineering, 2016-2019¹

Biomechanics and Modeling in Mechanobiology, 2019

SAE Journals, 2007-2022

Selected Presentations and Publications

Published Papers

Bussone WR, Moore T, Locey C, Cargill R. Frontal, lateral, and free-operation impacts of amusement bumper cars: vehicle kinematics and occupant kinematics. SAE 2018-01-0543, 2018.

Bussone WR, Olberding J, Prange M. Six-degree-of-freedom accelerations: linear arrays compared with angular rate sensors in impact events. SAE 2017-01-1465, 2017.

Bussone WR, Prange M. Measurements of non-injurious head accelerations of young children. SAE 2014-01-0493, 2014.

Bussone W, Prange M, Bove R, Daniel T. Neck loads in playground activities in a pediatric population. SAE 2012-01-0560, 2012.

McGowan J, **Bussone W**, Raasch C, Smith J, Smedley J. Tractor-semitrailer driver and sleeping compartment occupant responses to low-speed impacts. SAE 2012-01-0566, 2012.

Bussone WR, Baxter JN, Mkandawire C. Foot injury patterns with protective footwear after lift truck impact. ASME International Mechanical Engineering Congress & Exposition, IMECE2010-39131, Vancouver, British Columbia, Canada, 2010.

Bussone WR, Duma SM. The effect of gender and body size on angular accelerations of the head observed during everyday activities. Biomedical Sciences Instrumentation 2010; 46:166–171.

Bussone WR, Bove RT, Thomas R, Richards D, Prange MT. Six-degree of freedom accelerations: Linear arrays compared with angular rate sensors. SAE 2010-01-1017.

¹ Reviewer of Year, 2017

- Bussone WR**, Moore TLA, Richards D, Bove RT, Scher I, Prange MT. Measurements of non-injurious head accelerations of a pediatric population. SAE 2009-01-0383.
- Ng TP, **Bussone WR**, Duma SM. The effect of gender and body size on linear accelerations of the head observed during daily activities. *Biomedical Sciences Instrumentation* 2006; 42:25–30.
- Ng TP, **Bussone WR**, Duma SM, Kress TA. Thoracic and lumbar spine accelerations in everyday activities. *Biomedical Sciences Instrumentation* 2006; 42:410–415.
- Duma SM, Manoogian SJ, **Bussone WR**, Brolinson PG, Goforth MW, Donnenwerth JJ, Greenwald RM, Chu JJ, Crisco JJ. Analysis of real-time head accelerations in collegiate football players. *Clinical Journal of Sports Medicine* 2005; 15:3–8.

Theses, Presentations and Published Abstracts

- Bussone W**. Linear and Angular Head Accelerations in Daily Life. M.S. Thesis, Virginia Polytechnic Institute and State University (Virginia Tech), 2005.
- Bussone W**. Biomechanics of amusement rides and devices. Presented at the Pennsylvania Spring Amusement Ride Safety Seminar, Harrisburg, PA, March 2, 2022.
- Bussone W**. Future Developments in Amusement Ride Design: F2291, F2137, and F1159. Presented at the Pennsylvania Spring Amusement Ride Safety Seminar, Harrisburg, PA, March 2, 2022.
- Bussone W**. Inclusivity: Pathways and Roadblocks – A Biomechanical Perspective. Presented at the Pennsylvania Spring Amusement Ride Safety Seminar, Harrisburg, PA, March 2, 2022.
- Bussone W**. Pathways and Roadblocks to Inclusivity – a Biomechanical Perspective. Presented at the IAAPA Expo 2021, Orlando, FL, November 18, 2021.
- Bussone W**, Bortles W, and Stone D. Effectively Conveying Accident Reconstruction and Biomechanical Concepts. American Bar Association – 2018 Emerging Issues in Motor Vehicle Product Liability Litigation. Phoenix, AZ, April 4, 2018.
- Bussone W**. Biomechanics of pool inlet injuries—The Virginia Baker Act. Presented at the Pennsylvania Spring Amusement Ride Safety Seminar, Grantville, PA, March 1, 2012.
- Heller M, Mkandawire C, Gloeckner DC, **Bussone W**, Scher I, Cargill R. Head motion in the coronal plane during low-speed lateral impact collisions. Presented at the Conference of the International Society of Biomechanics, Taipei, Taiwan, July 2007.
- Cargill RS, **Bussone WR**, Scher I, Heller MF. Current trends in amusement industry biomechanics: introduction to biomechanics and rider kinematics. Presented at the IAAPA Attractions Expo Education Programs, Atlanta, GA, November 13–17, 2006.
- Duma SM, Manoogian SJ, **Bussone WR**, Brolinson PG, Goforth MW, Donnenwerth JJ, Greenwald RM, Chu JJ, Crisco JJ. Measuring real time head accelerations in collegiate football players. Presented at the Fundamentals and Advanced Concepts for Automobile and Sports Injury Biomechanics Conference, Roanoke, VA, October 22–23, 2004.

Duma SM, Manoogian SJ, **Bussone WR**, Brolinson PG, Goforth MW, Donnenwerth JJ, Greenwald RM, Chu JJ, Crisco JJ. Sports injury biomechanics: head impact research in collegiate football. Presented at the Fundamentals and Advanced Concepts for Automobile and Sports Injury Biomechanics Conference, Roanoke, VA, February 7, 2004.

Manoogian SJ, **Bussone WR**, Stitzel JD, Duma SM, Brolinson G, Goforth M, Donnenwerth J, Greenwald R, Chu J, and Crisco T. Measuring in situ Head Accelerations and Evaluating Clinical Outcomes in Collegiate Football Players. Proceedings of the 31st International Workshop on Human Subjects for Biomechanical Research (NHTSA), San Diego, CA, October 23, 2003.