Exponent®
Engineering & Scientific Consulting

Amy Courtney, Ph.D., CAISS

Principal | Biomechanics
Tampa
+1-678-412-4811 | acourtney@exponent.com

Professional Profile

Dr. Courtney provides technical expertise in the area of injury biomechanics, including orthopaedic, spine, and traumatic brain injury, blast injury, and ballistics. She addresses issues related to traumatic events, motor vehicle safety, and product safety. Dr. Courtney's ballistics expertise includes the safe operation of small arms and the internal physics, trajectories, and terminal behavior of ammunition. She has been active in research on the material and structural properties of musculoskeletal tissues in normal, aging, and disease conditions for more than 35 years.

In addition to her engineering training and expertise, her doctoral studies in the Harvard/MIT Division of Health Sciences and Technology, Medical Engineering and Medical Physics program included medical coursework and clinical training at Harvard Medical School. She is also a certified Abbreviated Injury Scale (AIS) specialist. Her research is documented in more than 75 publications in the medical and scientific literature.

Prior to joining Exponent, Dr. Courtney was a researcher in the Department of Biomedical Engineering at The Cleveland Clinic Foundation and the Orthopedic Biomechanics Laboratory of Beth Israel Hospital and Harvard Medical School. She also held an appointment as Assistant Professor teaching physics at the United States Military Academy at West Point.

Dr. Courtney has designed and conducted laboratory-based and field-based experiments, human subject testing, and testing with Anthropomorphic Test Devices (ATDs, or crash test dummies) for basic scientific purposes as well as to investigate specific situations. She has provided scientific consultation in the areas of injury mechanisms and injury tolerance, experimental design, techniques for data collection and analysis, and prototype evaluation. Her work includes novel experiments and mathematical modeling of internal, external, and terminal ballistics of small arms. She collaborated in the invention and characterization of novel experimental tools and techniques for laboratory-based blast experiments.

Academic Credentials & Professional Honors

Ph.D., Engineering Sciences, Harvard University, 1994

M.S., Engineering Sciences, Harvard University, 1991

B.S., Engineering Mechanics, Michigan State University, 1989

Department of the Army, Commander's Award for Public Service

International Society of Biomechanics Promising Scientist Award

National Science Foundation Graduate Fellow

MSU Alumni Distinguished Scholar

Licenses and Certifications

IDPA Safety Officer Certification

High Master Classification, High Power Rifle Competition

Certified Abbreviated Injury Scale Specialist (CAISS)

Professional Affiliations

American Society for Bone and Mineral Research

Association for the Advancement of Automotive Medicine (AAAM), Scientific Program Committee

International Ballistics Society, Senior Member

International Defensive Pistol Association

Publications

Biomechanics and Injury Mechanisms

Courtney A, Crosby C, Miller B, Osterhout A, Walker J, Gondek J. Effects of anthropometry and passive restraint deployment timing on occupant metrics in moderate-severity offset frontal collisions. SAE Technical Paper 2024-01-2749.

Sharpe S, Grijalva S, Allin L, Courtney A, et al. Evaluation of occupant kinematics and kinetics during moderate severity simulated frontal impacts with and without frontal airbag deployment. SAE Technical Paper 2023-01-0559.

Parenteau C, Courtney A, Campbell I, and Lau E. An update on front-seat occupant injury rates in frontal crashes: focus on modern vehicles. IRCOBI, September 8-10, 2021; Paper No. IRC-21-50.

Kirschman J, Pokutta-Paskaleva A, Courtney A, Courtney M. Blast pressures and waveforms of consumer firecrackers. Shock Waves 2021; 31:301-306.

Parenteau C, Lau E, Campbell I, Courtney A. "Prevalence of spine degeneration diagnosis by type, age, gender, and obesity using Medicare data" Nature: Scientific Reports 2021; DOI 10.1038/s41598-021-84724-6.

Pasquesi SA, Bruno A, Courtney A, Imler SM et al. Risk of concussion in low- to moderate-speed frontal and rear end motor vehicle collisions evaluated using head acceleration-based metrics. SAE Technical Paper 2019-01-1218, 2019.

Courtney A, Campbell IC, Courtney E, and Pasquesi SA. Risk of concussion due to head acceleration in rear impact sled tests of passenger automobile seats. Traffic Injury Prevention 2018; 19(S2):S133-S135

Courtney A, Courtney M. The complexity of biomechanics causing primary blast-induced traumatic brain injury: a review of potential mechanisms. Frontiers in Neurology 2015; 6:221, -.

Courtney A, Corrigan C, Steffey D. Letter to the Editor regarding Bajaj D, et al., The resistance of cortical

bone tissue to failure under cyclic loading is reduced with alendronate. Bone 2014; 64:57-64.

Courtney A, Berg A, Michalke G, Courtney M. A history of blast exposure may affect the transmission properties of cranial bone. Experimental Mechanics 2013; 53(2):319-325.

Courtney M, Courtney A. History and evidence regarding hydrostatic shock. Neurosurgery 2011; 68(2):E596-E597.

Courtney M, Courtney A. Working toward exposure thresholds for blast-induced traumatic brain injury: Thoracic and acceleration mechanisms. NeuroImage 2011; 54:S55-S61.

Courtney A, Courtney M. Physical mechanisms of soft tissue injury from penetrating ballistic impact. Defense Technology Information Center 2012; ADA570804.

Courtney A, Courtney M. A thoracic mechanism of mild traumatic brain injury due to blast pressure waves. Medical Hypotheses 2009; 72(1):76-83.

Courtney A, Courtney M. Links between traumatic brain injury and ballistic pressure waves originating in the thoracic cavity and extremities. Brain Injury 2007; 21:657-662.

Courtney M, Courtney A. Apparent measurement errors in "Development of biomechanical response corridors in the thorax to blunt ballistic impacts." Journal of Biomechanics 2007; 41:486-487.

Perusek G, Davis B, Courtney A, D'Andrea S. An extensometer for global measurement of bone strain suitable for use in vivo in humans. Journal of Biomechanics 2001; 34:385-391.

Courtney A, Davis B, Manning T, Kambic H. Effects of age, density and geometry on the bending strength of human metatarsals. Foot & Ankle International 1997; 18(4):216-221.

Hayes W, Myers E, Robinovtich S, Van Den Kroonenberg A, Courtney A, McMahon T. Etiology and prevention of age-related hip fractures. Bone 1996; 18(1) Supplement.

Courtney A, Hayes W, Gibson L. Age related differences in post-yield damage in human cortical bone—Experiment and model. Journal of Biomechanics 1996; 29(11):1463-1471.

Courtney A, Wachtel E, Myers E, Hayes W. Age-related reductions in the strength of the femur tested in a fall-loading configuration. Journal of Bone and Joint Surgery 1995; 77-A(3):387-396.

Bouxsein M, Courtney A, Hayes W. Ultrasound and densitometry of the calcaneus correlate with the failure loads of cadaveric femurs. Calcified Tissue International 1995; 56(2):99-103.

Courtney A, Wachtel E, Myers E, Hayes W. Effects of loading rate on strength of the proximal femur. Calcified Tissue International 1994; 55:53-58.

Courtney A, Myers E, Wachtel E, Hayes W. Multiple angle and anteroposterior dual energy x-ray absorptiometry predict femoral strength in vitro. J Bone Miner Res 1996; 8(Supp 1):S350.

Haut RC, [Courtney] Powlison AC. The effects of test environment and cyclic stretching on the failure properties of human patellar tendons. Journal of Orthopaedic Research 1990; 8(4):532-540.

Haut, RC, [Courtney] Powlison AC, Rutherford, GW, Kateley JR. Order of irradiation and lyophilization on the strength of patellar tendon allografts. Trans Orthop Res Soc 1989; 14(514).

[Courtney] Powlison, AC, Haut, RC. Effects of testing environment and cyclic loading on mechanical properties of human patellar tendon. 13th Annual Mtg. Amer. Soc. Biomech. August 23-25, 1989.

Haut RC, [Courtney] Powlison AC, Rutherford OW, Kateley JR. Some effects of donor age and sex on the mechanical properties of patellar tendon graft tissues. ASME Adv Bioeng 1988; 8:75-78.

Ballistics and Blast

Streifel B, Courtney A, Courtney M, (2025) Thermochemical analysis and field performance of small arms propellants from 1953 (30-06 M2 AP) and 2012 (M855A1) ammunition, Defence Technology, https://doi.org/10.1016/j.dt.2025.02.009

Courtney E, Andrusiv L, Courtney A, Courtney M. Quantifying handgun recoil with high-speed video. Proceedings of the 32nd International Symposium on Ballistics, pp. 670-678, May 2022

Courtney E, Courtney A, Courtney M. Comparing lead-based (CCI 41) and lead-free (Ruag SINTOX) primer performance in 5.56 mm NATO. Proceedings of the 32nd International Symposium on Ballistics, pp. 441-445, May 2022

Courtney J, Courtney A, and Courtney M. Laboratory simulation of underwater blast waves by high speed water entry. Proceedings of the 32nd International Symposium on Ballistics, pp. 63-68, May 2022

Courtney E, Courtney A Andrusiv L, Courtney M. Clear Ballistics Gel ®: Retarding force analysis of paraffin-based alternative to gelatin-based lead-free bullet testing. Proceedings of the 30th International Symposium on Ballistics, September 2017.

Courtney ER, Courtney A, Courtney M. External ballistics and accuracy of lead free bullets in 5.56 x 45 mm NATO. Proceedings of the 30th International Symposium on Ballistics, September 2017.

Courtney ER, Courtney A, Couvillion R, Courtney M. Effects of sound suppressors on muzzle velocity, bullet yaw, and drag. Proceedings of the 30th International Symposium on Ballistics, September 2017.

Courtney E, Courtney A, Andrusiv L, Courtney M. Experimental studies of terminal performance of lead-free pistol bullets in ballistic gelatin using high speed video. Investigative Sciences Journal 2017; 9(1):1-18.

Courtney E, Courtney AC, Andrusiv LP, Courtney MW. Experimental test of the acoustic impedance model for underwater blast wave transmission through plate materials. J Engineering Mechanics 2017; 143(4):06017001.

Courtney E, Courtney A, Courtney M. Device for underwater laboratory simulation of unconfined blast waves. Review of Scientific Instruments 2015; 86:066103.

Kabu S, Jaffer H, Petro M, Dudzinski D, Stewart D, Courtney A, Courtney M, Labhasetwar V. Blast-associated shock waves result in increased brain vascular leakage and elevated ROS levels in a rat model of traumatic brain injury. PLoS ONE 2015; 10(5):e0127971.

Courtney E, Courtney A, Courtney M. Shock tube design for high intensity blast waves for laboratory testing of armor and combat materiel. Defence Technology 2014; 10(2):245-250.

Courtney M, Courtney ER, Courtney A, Summer PD. Performance testing of lead free primers: Blast waves, velocity variations, and environmental testing. Paper #160, 28th International Symposium on Ballistics, Atlanta, GA, September 22-26, 2014.

Courtney M, Courtney ER, Courtney A. Experimental tests of the proportionality of aerodynamic drag to air density for supersonic projectiles. Paper #159, 28th International Symposium on Ballistics, Atlanta, GA, September 22-26, 2014.

Courtney AC, Andrusiv LP, Courtney MW. A test of the acoustic impedance model of blast wave

transmission. Journal of Battlefield Technology 2013; 16(3):1-4.

Gaylord S, Blair R, Courtney M, Courtney A. Bullet retarding forces in ballistic gelatin by analysis of high speed video. Cornell University Library, Medical Physics, 2013.

Sherrill M, Powers R, Courtney A, Courtney M. Relative armor penetration of jacketed lead, solid copper, solid brass and steel core bullets. Defense Technology Information Center 2012; ADA567525.

Courtney M, Courtney A. Ballistics of the 30-06 rifle cartridge. Defense Technology Information Center 2012; ADA570469.

Courtney ER, Courtney A, Courtney W. Detecting pitch and yaw and in-flight damping with optical chronographs. Defense Technology Information Center 2012; ADA570911.

Her H, Courtney A, Courtney M. Quantifying momentum transfer due to blast waves from oxy-acetylene driven shock tubes. Defense Technology Information Center 2012; ADA564113.

Courtney EDS, Courtney A, Courtney M. Blast wave transmission through transparent armour materials. Journal of Battlefield Technology 2012; 15(2):19-22.

Courtney A, Andrusiv L, Courtney M. Oxy-acetylene driven laboratory scale shock tubes for studying blast wave effects. Review of Scientific Instruments 2012; 83:045111.

Courtney M, Courtney A. Using sound of target impact for acoustic reconstructions of shooting events. Medicine, Science, and the Law 2012; 52(2):89-92.

Courtney M, Courtney A. Comparing blast pressure variations of lead styphnate based and diazodinitrophenol based primers. Weapons Systems Technology Information Analysis Center (WSTIAC) Journal 2011; 11(2):3-5.

Courtney M, Courtney A. A table-top blast driven shock tube. Review of Scientific Instruments 2010; 81(12):126103.

Courtney M, Courtney A. Comments on "Ballistics: A Primer for the Surgeon." Injury 2008; 39(8):9654-9655.

Courtney M, Courtney A. A method for testing bullets at reduced velocity. Cornell University Library, Medical Physics, 2008.

Quantitative Fisheries Science

Courtney J, Courtney A, Courtney M. Nutrient loading increases red snapper population in the western Gulf of Mexico. Hypotheses in the Life Sciences 2013; 1:7-14.

Courtney J, Courtney A, Courtney M. Do rainbow trout and their hybrids outcompete cutthroat trout in a lentic ecosystem? Fisheries and Aquaculture Journal 2013; FAJ-78.

Courtney J, Courtney A, Courtney M. Estimating interaction strengths with correlations in annual relative weight: interspecific competition and predation in fishes, Pueblo Reservoir, Colorado. Cornell University Library, Populations and Evolution, 2013.

Courtney J, Klinkmann T, Courtney A, Torano J, Courtney M. Relative condition factors of fish as bioindicators one year after the Deepwater Horizon oil spill. Defense Technology and Information Center 2012; ADA564207.

STEM (Science, Technology, Engineering and Mathematics) Education

Courtney A, Courtney M. Illuminating Fourier series with audacity. Cornell University Library, Physics Education, 2012.

Courtney M, Courtney A. Science and math education: Who is the customer? Cornell University Library, Physics Education, 2012.

Courtney M, Slusher T, Courtney A. EI Videos. Mathematica Militaris, April 2012.

Courtney M, Courtney A. Measuring thrust and predicting trajectory in model rocketry. Cornell University Library, Popular Physics, 2009.

Courtney M, Courtney A. Comments regarding "On the Nature of Science." Physics in Canada 2008; 64:3.

Courtney M, Courtney A. Acoustic measurement of potato cannon velocity. The Physics Teacher 2007; 45:496-497.

Courtney M, Althausen N, Courtney A. Five frequently fatal freshman physics fantasies. Physics Education 2007; 42:116.

Additional Education & Training

Forensic Shooting Incident Reconstruction Course

Blood Detection, Documentation & Collection Techniques

International Defensive Pistol Association

Certified IDPA Safety Officer (2023-2025)

Peer Reviews

Reviewer for the US Army Medical Research and Development Command (USAMRDC)

- Military Operational Medicine Research Program (MOMRP)

- 2024 – BBAI-3 [Blast, Blunt, and Accelerative Injury Prevention and Sensory Injury Treatment]

- 2025 BI [Blast Injury]

- 2026 TBI-1 [Traumatic Brain Injury]

- Combat Casualty Care Research Program (CCCRP)

- 2025 PM [Pain Management]

Reviewer for the Defense Health Agency

- 2027 Traumatic Brain Injury, Science & Technology Porfolio Management Division

Journal of Biomechanics

Journal of Neurotrauma

Advances in Life Sciences and Medicine

NeuroImage

Journal of Neuroscience Research

Defence Technology

International Journal of Energetic Materials and Chemical Propulsion

Shock Waves

Journal of Visual Experiments (JoVE)

Traffic Injury Prevention

SAE International Journal of Transportation Safety

Accident Analysis and Prevention