



Michael Carhart, Ph.D.
Principal Engineer

Professional Specialization

Dr. Carhart's expertise is in the biomechanics of human injury, accidental injury reconstruction, and occupant protection. He has more than 25 years of research, testing, and consulting experience analyzing traumatic injuries associated with motor vehicles crashes, as well as incidents involving recreational and sporting activities, falls, and industrial and workplace incidents.

Dr. Carhart has researched human motion, loading, and injury potential through the analysis and interpretation of the crash-test responses of anthropomorphic test devices (ATDs), human surrogates, the development and application of computational models of the human body, and field-data analyses.

His research and testing experience includes extensive experience with occupant protection systems, including the performance seat belts and pretensioners, vehicle roof structures, automotive safety glass, frontal and side impact airbags systems, and inflatable curtain systems, with an emphasis on occupant motion, loading, containment, and injury mechanics.

Education

Ph.D., Bioengineering, Biomechanics Emphasis, Arizona State University (ASU), 2000.
B.S., Biomedical Engineering, Milwaukee School of Engineering, 1991.

Professional Experience

Design Research Engineering, Principal Engineer, October 2025–Present.
Exponent, Inc., September 2003–October 2025: Manager (2003–2008), Principal (2008–2025), and Principal and Practice Director, Biomechanics (2013–2021).
Arizona State University (ASU), August, 2020–September 2023. Research Scientist in Harrington Department of Bioengineering and Arizona BioDesign Institute: Researcher and undergraduate and graduate course instructor for biomechanics, biomedical instrumentation, computer modeling, microcomputer applications in bioengineering, and computation and visualization.
Forensic Dynamics, LLC, President and Biomechanical Consultant, 2001–2003.
ASU Harrington Department of Bioengineering, Adjunct Professor.
ASU School of Biological and Health Systems Engineering, Adjunct Professor.

Professional Affiliations/Memberships

Society of Automotive Engineers (SAE)
Association for the Advancement of Automotive Medicine (AAAM)
International Society of Biomechanics (ISB)
American Society for Testing and Materials (ASTM)
Institute of Electrical and Electronics Engineers (IEEE)
IEEE Engineering in Medicine and Biology Society (IEEE-EMBS)

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Professional Honors

Arch T. Colwell Merit Award, Society of Automotive Engineers (SAE)
Sachiko Yahashi Memorial Award, International Society for Skiing Safety
Regent's Graduate Academic Scholar, ASU
Presidential Scholar, Milwaukee School of Engineering
Eta Kappa Nu
Tau Beta Pi
Phi Kappa Phi

Patent

US Patent Application Publication 20070129653: Spring-Over-Muscle Actuator, (with T. Sugar) June 07, 2007; and World Intellectual Property Organization WO/2004/096083, (with T. Sugar) International Filing Date April 26, 2004.

Select Publications

- Rapp van Roden E, Riggin CN, Holyoak DT, Amin D, Hall P, Paredes JJ, Day C, Rodowicz KA, Siskey R, Carhart MR. (2025). Influence of Spinal Bridging Ossification on Mechanical Properties and Fracture Tolerance Under Flexion/Extension Loading. *Annals of Biomedical Engineering*, 1-10.
- Sharpe SS, Grijalva S, Allin L, Courtney A, Toney-Bolger M, Pokutta-Paskaleva A, Crosby CC, Carhart M. Evaluation of Occupant Kinematics and Kinetics during Moderate Severity Simulated Frontal Impacts with and without Frontal Airbag Deployment. *SAE Technical Paper 2023-01-0559*.
- Miller, B., Dibb, A., Allin, L., Carhart, M. Krishnaswami, R. Seat Belt Restraint Evidence Generated by Unrestrained Occupant Interaction in a Rollover. *SAE Int. J. Adv. & Curr. Prac. in Mobility* 4(5):1642-1650, 2022, <https://doi.org/10.4271/2022-01-0846>.
- Parenteau, C., Smedley, J., Campbell, I., and Carhart, M. Evaluation of Laminated Side Window Glazing Coding and Rollover Ejection Mitigation Performance Using NASS-CDS, *SAE Technical Paper 2020-01-1216*, 2020, <https://doi.org/10.4271/2020-01-1216>.
- Parenteau, C., Smedley, J., Carhart, M., and Dibb, A. The Effect of Obesity on Rollover Ejection and Injury Risks. *SAE Technical Paper 2020-01-1219*, 2020, <https://doi.org/10.4271/2020-01-1219>.
- Miller B, Smedley J, Carhart M, Sharpe S, Krishnaswami R. Evaluation of laminated side glazing and curtain airbags for occupant containment in rollover. *SAE Technical Paper 2020-01-0976*, 2020, <https://doi.org/10.4271/2020-01-0976>.
- Heller M, Sharpe S, Newberry W, Dibb A, Zolock, J, Croteau, J, Carhart, M., et al. Occupant kinematics and injury response in steer maneuver-induced furrow tripped rollover testing. *SAE International Journal of Transportation Safety* 2015; 3(2). doi:10.4271/2015-01-1478.
- Newberry W, Imler S, Carhart M, Dibb A, et al. Belted occupant kinematics and head excursion during the airborne phase of vehicle rollover: evaluation of the effects of rollover-deployed curtain airbags. *SAE World Congress, 2014-01-0527*, Society of Automotive Engineers, 2014.
- Moralde M, Dibb A, Smedley J, Carhart M, Cooper E. Seat belt restraint evidence generated in the presence of fractured glass. *SAE World Congress, 2012-01-0084*, and *Transactions Journal of Passenger Cars*, Society of Automotive Engineers, 2012.

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- Newberry W, Carhart M, Larson R, Bridges A, Fowler G. Biomechanics of occupant responses during recreational off-highway vehicle (ROV) riding and 90-degree tip-overs. SAE World Congress, 2012-01- 0096, and Transactions Journal of Passenger Cars, Society of Automotive Engineers, 2012.
- Heller M, Newberry W, Smedley J, Eswaran S, Croteau J, Carhart M. Occupant kinematics and injury mechanisms during rollover in a high strength-to-weight ratio vehicle. SAE World Congress, 2010-01- 0516, Society of Automotive Engineers, 2010.
- Raasch C, Carhart M, Ivarsson BJ, Lucas S. Development of lower neck injury assessment reference values based on comparison of ATD and PMHS tests. SAE World Congress, 2010-01-0140, Society of Automotive Engineers, 2010.
- Welch T, Bridges A, Gates D, Heller M, Stillman D, Raasch C, Carhart M. An evaluation of the BioRID II and Hybrid III during low- and moderate-speed rear impact. SAE World Congress, 2010-01-1031, Society of Automotive Engineers, 2010.
- Richards D, Carhart M, Scher I, Thomas R, Hurlen N. Head kinematics during experimental snowboard falls: Implications for snowboard helmet testing. Journal of ASTM International 2008; 5(6), Paper ID JAI101406.
- Scher I, Richards D, Carhart M, Thomas R, Hurlen N, Lam T. Pediatric head and neck injuries in snow sports: Evaluating the influence of helmets. Journal of ASTM International 2008; 5(4), Paper ID JAI101400.
- Heller M, DiJorio S, Kuzel M, Carhart M, Ciccarelli L. Effect of shoe type on kinematics of stair negotiation in women. Proceedings, International Conference on Contemporary Ergonomics, April 2008.
- Luepke P, Carhart M, Croteau J, Morrison R, Loibl J, Ridenour J. An evaluation of laminated side window glass performance during rollover. SAE World Congress, 2007-01-0367, and Transactions Journal of Passenger Cars, Society of Automotive Engineers, 2007.
- Pierce J, Carhart M, Bare C, Blakeslee A, Heald J. Retention characteristics of production laminated side windows. SAE World Congress, 2007-01-0376, and Transactions Journal of Passenger Cars, Society of Automotive Engineers, 2007.
- Ashby B, Lai W, Carhart M, Newberry W, Weaver B, Corrigan C. Compressive neck preloading during the airborne phase of vehicle rollover. SAE World Congress, 2007-01-0377, and Transactions Journal of Passenger Cars, Society of Automotive Engineers, 2007.
- Raasch C, Carhart M. Comparison of ATD upper and lower neck flexion/extension moments, and implications for neck injury criteria. 5th World Congress on Biomechanics, Munich, Germany, July 29- August 4, 2006.
- Richards D, Carhart M, Raasch C, Pierce J, Steffey D, Ostarello A. Incidence for thoracic and lumbar spine injuries for restrained occupants in frontal collisions. Proceedings, 50th Annual Association for the Advancement of Automotive Medicine, Chicago, IL, October 16-18, 2006.
- Newberry W, Lai W, Carhart M, Richards D, Brown J, Raasch C. Modeling the effects of seat belt pretensioners on occupant kinematics during rollover. SAE World Congress, 2006-01-0246, and Transactions Journal of Passenger Cars, Society of Automotive Engineers, 2006.
- Yamaguchi G, Ashby B, Lai W, Carhart M, Richards D, Corrigan C. Occupant mechanics in rollover simulations of high and low aspect ratio vehicles. SAE World Congress, 2006-01-0451, and Transactions Journal of Passenger Cars, Society of Automotive Engineers, 2006.

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- Scher I, Richards D, Carhart M. Head injury in snowboarding: Evaluating the protective role of helmets. *Journal of ASTM International* 2006; 3(4), April (Paper ID JAI14203). Also in: *Skiing Trauma and Safety, Sixteenth Volume, ASTM STP 9034*, 2006.
- Huang H, He J, Herman R, Carhart M. Modulation effects of epidural spinal cord stimulation on muscle activities during walking. *IEEE Transactions on Neural Systems and Rehabilitation Engineering* 2006; 14(1), March.
- Scher I, Richards D, Carhart M. Head contact after catching an edge: An examination of snowboarding helmets. *Knee Surg Sports Traumatol Arthrosc* 2006; 14.
- Ganley K, Willis W, Carhart M, He J, Herman R. Epidural spinal cord stimulation improves locomotor performance in Low ASIA C, wheelchair-dependent, spinal cord-injured individuals: Insights from Metabolic Response. *Topics in Spinal Cord Injury Rehabilitation* 2005; 11(2), Fall.
- Richards D, Scher I, Vijayakumar V, Carhart M, Larson R, Taylor S, Corrigan C. Repetitive head loading: Accelerations during cyclic, everyday activities. *Proceedings, 20th Congress of the International Society of Biomechanics*, July 2005.
- Scher I, Richards D, Vijayakumar V, Carhart M, Corrigan C, Jaekel D. Coronal head accelerations during vigorous activities of daily living. *Proceedings, Summer Bioengineering Conference, American Society of Mechanical Engineers*, June 2005.
- Lai W, Ewers B, Richards D, Carhart M, Newberry W, Corrigan C. Evaluation of human surrogate models for rollover. *SAE World Congress, SAE 2005-01-0941, and Transactions Journal of Passenger Cars, Society of Automotive Engineers*, 2005.
- Newberry W, Carhart M, Lai W, Corrigan C, Croteau J, Cooper E. A computational analysis of the airborne phase of vehicle rollover: Occupant head excursion and head-neck posture. *SAE World Congress, 2005-01-0943, and Transactions Journal of Passenger Cars, Society of Automotive Engineers*, 2005.
- Yamaguchi G, Richards D, Larson R, Carhart M, Cargill R, Lai W, Corrigan C. Development of a computational method to predict occupant motions and neck loads during rollovers. *SAE World Congress, SAE 2005-01-0300, and Transactions Journal of Passenger Cars, Society of Automotive Engineers*, 2005.
- Yamaguchi G, Carhart M, Larson R, Richards D, Pierce J, Raasch C, Scher I, Corrigan C. Electromyographic activity and posturing of the human neck during rollover tests. *SAE World Congress, SAE 2005-01-0302, and Transactions Journal of Passenger Cars, Society of Automotive Engineers*, 2005.
- Carhart M, He J, Herman R, D'Luzansky S, Willis W, Dilli S. Epidural spinal cord stimulation facilitates functional walking recovery following incomplete spinal cord injury. *IEEE Transactions on Neural Systems and Rehabilitation Engineering* 2004; 12(1), March.
- Willis W, Carhart M, D'Luzansky S, Thompson A, He K, Thresher K, Herman R. Metabolic and performance effects of electrical stimulation of the spinal cord and peripheral nerve on locomotion. *Society for Neuroscience Abstracts, Program No. 824.17*, 2003.
- Carhart M, D'Luzansky S, He J, Abbas J, Herman R, Willis W. Gait performance with spinal cord stimulation and Reflex-FES in an incomplete spinal cord injured person. *Society for Neuroscience Abstracts, Program No. 824.18*, 2003.
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- Huang H, He J, Carhart M, D'Luzansky S, Herman R. Change of muscle activation pattern by epidural stimulation on a SCI patient. Proceedings, 2nd Joint Conference of the IEEE Engineering in Medicine and Biology Society and the Biomedical Engineering Society, 2002.
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- Carhart M, Yamaguchi G. Human lower extremity muscle parameters. In: Dynamic Modeling of Musculoskeletal Motion—A Vectorized Approach for Biomechanical Analysis in Three Dimensions. Kluwer Academic Publishers, Norwell, MA, 2001.
- Carhart M. Biomechanical analysis of compensatory stepping: Implications for paraplegics standing via functional neuromuscular stimulation. Ph.D. Dissertation, Arizona State University, 2000.
- Carhart M, Yamaguchi G. Estimation of muscle forces in normal human gait: Evaluation of the pseudoinverse method. Annals of Biomedical Engineering, Annual Fall Meeting of the Biomedical Engineering Society, Seattle, WA, 2000.
- Carhart M, Yamaguchi G. Biomechanical analysis of compensatory stepping: Implications for paraplegics standing via functional neuromuscular stimulation. Annals of Biomedical Engineering, 2000.
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- Carhart M, Yamaguchi G. Preparatory postural adjustments in perturbation induced stepping: A comparison to gait initiation. Neuroscience Abstracts, Vol. 1, No. 275.4, 1995.
- Carhart M and Yamaguchi G. The motor control of stepping responses to postural perturbations. Proceedings, 19th Annual Meeting of the American Society of Biomechanics, 1995.
- Carhart M, Yamaguchi G. The motor control of stepping responses to perturbations of posture: The automatic component. Annals of Biomedical Engineering, No. 319, 1994.
- Carhart M, Yamaguchi G and Green J. Dynamic balance recovery: Stepping responses to postural perturbations. Proceedings, 17th Annual Meeting of the American Society of Biomechanics, 1993.