

Ann Bailey Good, Ph.D.

Curriculum Vitae

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Biocore, LLC

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EDUCATION

Doctor of Philosophy in Mechanical Engineering

September 2016

Department of Mechanical and Aerospace Engineering

University of Virginia, Charlottesville, Virginia

Dissertation Title: Injury Assessment for the Human Leg Exposed to Axial Impact Loading

Advisors: Jeff Crandall, Ph.D., Robert Salzar, Ph.D.

Bachelor of Science in Mechanical Engineering

May 2011

Minor: Biomedical Engineering

Department of Mechanical and Aerospace Engineering

University of Virginia, Charlottesville, Virginia

Thesis Title: Design and Testing of a Bi-leaflet Mechanical Heart Valve

Advisors: Houston Wood, Ph.D. and Alexandrina Untaroiu, Ph.D.

PROFESSIONAL EXPERIENCE

Biocore, LLC

2016-Present

Senior Mechanical Engineer

- Project manager for helmet evaluation
- Head injury and concussion biomechanics research
- Research on foot and ankle injury in sports
- Helmet and cleat laboratory performance testing and data analysis
- Football impact reconstruction using anthropomorphic test devices (ATDs)

University of Virginia, Department of Mechanical and Aerospace Engineering 2011-2016

Graduate Research Assistant

- Project manager for Department of Defense research grant to study lower extremity injuries caused by military vehicle underbody blast
- Managed a team of students, machinists, and engineers in design of a test rig for simulating underbody blast in a laboratory environment
- Performed anthropomorphic test device (ATD) and cadaveric testing using dynamic sled system
- Duties included test matrix design, instrumentation of test subjects, data acquisition, data analysis, finite element modeling, presentations to sponsors, and publication of results

- Developed an injury criterion for the human leg exposed to axial impact loading
- Developed PMHS and ATD kinematic response corridors for simulated underbody blast
- Collaborated with other universities through the Warrior Injury Assessment Manikin Project (WIAMan), and attended and presented at meetings with Department of Defense representatives

**University of Virginia, Department of Mechanical and Aerospace Engineering 2010-2011
Independent Undergraduate Research**

- Supervisors—Alexandrina Untaroiu, Ph.D., Olga Pierrakos, Ph.D.
- Performed an independent research project for undergraduate thesis, in addition to the required Senior Capstone research project
- Designed a bi-leaflet mechanical heart valve for reducing backflow and unnatural vortex
- Used a computational fluid dynamics (CFD) program to evaluate preliminary designs
- Used Solidworks and a 3D printer to build heart valve prototypes
- Performed experimentation using an in-vitro heart simulator to evaluate performance compared to existing mechanical and biological heart valves

**University of Virginia, Department of Mechanical and Aerospace Engineering 2010-2011
Capstone Research Project**

- Supervisor—Hilary Bart-Smith, Ph.D.
- Designed and prototyped a robotic underwater vehicle
- Led the design team for body design, waterproofing, and temperature control
- Directed the 3D-printed prototyping process and testing protocol

**University of Virginia, Department of Mechanical and Aerospace Engineering 2010
Undergraduate Grader**

- Supervisor—Sylvia Blemker, Ph.D.
- Graded student assignments for an undergraduate dynamics class

**James Madison University, Department of Engineering 2009-2010
Undergraduate Researcher**

- Supervisor—Olga Pierrakos, Ph.D.
- Performed research on vortex ring structures produced by prosthetic heart valves
- Oversaw operation of a Vivitro heart simulator and trained other students on its operation
- Participated in preliminary set-up and troubleshooting of particle image velocimetry (PIV) system for use in imaging vortex formation through heart valves

**Kluge Children's Rehabilitation Center 2009-2010
Undergraduate Research Volunteer**

- Supervisor—Brad Bennett, Ph.D.
- Processed patient kinematic data in the gait lab

University of Virginia, Department of Biomedical Engineering 2008-2009

Undergraduate Research

Supervisor—William Walker, Ph.D.

- Designed and manufactured military vehicle and body armor test prototypes
- Tested armor prototypes at Aberdeen Proving Grounds
- Obtained funding from Ross Technology Corporation for further prototype development

HONORS

- University of Virginia Engineering Research Symposium Finalist: April 2016
- John D. States Best Student Paper Award at AAAM: October 2015
- 5th Place Presentation at University of Virginia Engineering Research Symposium: February 2015
- Murray McKay Young Researcher Award at IRCOBI Conference: September 2013
- Pi Tau Sigma Mechanical Engineering Outstanding Student of the Year Award: May 2011
- Pi Tau Sigma Mechanical Engineering Honor Society Vice President: 2010-2011
- Graduated Cum Laude: May 2011
- Undergraduate Deans' List: Fall 2007, Spring 2009, Fall 2010, Spring 2011
- Alumni Foundation Scholarship: August 2007-2011
- Robert F. Byrd Scholarship: August 2007-2011
- Spotswood High School Valedictorian: June 2007

AREAS OF EXPERTISE/RESEARCH INTERESTS

- Head injury and concussion
- Injury biomechanics
- Biostatistics and injury risk assessment
- Lower extremity injury
- Military vehicle safety evaluation
- Military and traffic injury prevention
- Personal protective equipment design and evaluation
- Anthropomorphic test device design and biofidelity assessment
- Characterization of human body kinematics and injury thresholds
- Human body finite element modeling
- Mechanical heart valve design

CERTIFICATIONS/PROFESSIONAL MEMBERSHIPS

- Fundamentals of Engineering Certification (2011)
- Pi Tau Sigma Mechanical Engineering Honor Society

RELATED SKILLS

- Laboratory testing: data acquisition, instrumentation, design of test fixtures
- Data Analysis: MATLAB, Mathematica
- Technical design: Solidworks, Autodesk Inventor
- Statistics/Biostatistics: R, Minitab

- Medical Imaging: Mimics
- Finite element modeling: LS-Dyna
- Dynamic systems modeling
- Technical communication
- Project management

PUBLICATIONS

A. Book Chapters

- A1. Salzar, R, Lievers, B, Bailey, A, Crandall, J, "Leg, Foot, and Ankle Injury Biomechanics," *Accidental Injury – Biomechanics and Prevention*, 3rd Edition, Springer New York, pages 499-547, 2015.

B. Refereed Journal Publications

- B1. Bailey, A, Funk, J, Crandall, J, Myers, B, Arbogast, K. Laboratory Evaluation of Shell Add-on Products for American Football Helmets for Professional Linemen. *Annals of Biomedical Engineering*, 2021.
- B2. Bosch, K, Bailey Good, A, Spratley, M, Salzar, R, Begeman, P, Cavanaugh, J. Optimization of Underbody Blast Energy-Attenuating Seat Mechanisms using Modified MADYMO Human Body Models. *Journal of Biomechanical Engineering*, 143(16), 2021.
- B3. Park, G, Gabler, L, Bailey, A, Dau, N, Sherwood, C, Crandall, J. Head Shape Analysis of National Football League Players. *Journal of Sports Engineering Technology*, 2021.
- B4. Bailey, A, McMurry, T, Cormier, J, Funk, J, Crandall, J, Mack, C, Myers, B, Arbogast, K. Comparison of Laboratory and On-Field Performance of American Football Helmets. *Annals of Biomedical Engineering*, 48, pages 2531-2541, 2020.
- B5. Bailey, A, Sanchez, E, Park, G, Gabler, L, Funk, J, Crandall, J, Wonnacott, M, Withnall, C, Myers, B, Arbogast, K. Development and Evaluation of a Test Method for Assessing the Performance of American Football Helmets. *Annals of Biomedical Engineering*, 48, pages 2566-2579, 2020.
- B6. Bailey, A, Sherwood, C, Funk, J, Crandall, J, Carter, N, Hessel, D, Beier, S, Neale, W. Characterization of Concussive Events in Professional American Football Using Videogrammetry, *Annals of Biomedical Engineering*, 48, pages 2678-2690, 2020.
- B7. Funk, J, Jadischke, R, Bailey, A, Crandall, J, McCarthy, J, Arbogast, K, Myers, B. Laboratory Reconstructions of Concussive Helmet-to-Helmet Impacts in the National Football League, *Annals of Biomedical Engineering*, 48, pages 2652-2666, 2020.
- B8. Kent, R, Forman, J, Bailey, A, Cormier, J, Park, G, Crandall, J, Arbogast, K, Myers, B. Surface Contact Features, Impact Obliquity, and Preimpact Rotational Motion in Concussive Helmet-to-Helmet Ground Impacts: Assessment via a New Impact Test Device, *Annals of Biomedical Engineering*, 48, pages 2639-2651, 2020.

- B9. Kent, R, Forman, J, Bailey, A, Funk, J, Sherwood, C, Crandall, J, Arbogast, K, Myers, B. The Biomechanics of Concussive Helmet-to-Ground Impacts in the National Football League, *Journal of Biomechanics*, 99(3), pages 109551, 2000.
- B10. Guidice, J, Park, G, Kong, K, Bailey, A, Kent, R, Panzer, M. Development of Open Source Dummy and Impactor Models for the Assessment of American Football Helmet Finite Element Models, *Annals of Biomedical Engineering*, 47(2), pages 464-474, 2019.
- B11. Joodaki, H, Bailey, A, Lessley, D, Funk, J, Sherwood, C, Crandall, J. Relative Motion Between the Helmet and Head in Football Impact Test, *Journal of Biomechanical Engineering*, 141(8), pages 081006, 2019.
- B12. Bailey, A, McMurry, T, Salzar, R, Crandall, J. An Injury Risk Function for the Leg, Foot, and Ankle Exposed to Axial Impact Loading Using Force and Impulse, *Journal of Biomechanical Engineering*, 141(2), pages 021009, 2019.
- B13. Bailey, A, Funk, J, Lessley, D, Sherwood, C, Crandall, J, Neale, W, Rose, N. Validation of a Videogrammetry Technique for Analyzing American Football Helmet Kinematics, *Sports Biomechanics*, 19(5), pages 678-700, 2018.
- B14. Sanchez, E, Gabler, L, Good, A, Funk, J, Crandall, J, Panzer, M. A Reanalysis of Football Impact Reconstructions for Head Kinematics and Finite Element Modeling, *Clinical Biomechanics*, 2018.
- B15. Bailey, A, Perry, B, Salzar, R, Response and Injury of the Human Leg for Axial Impact Durations Applicable to Automotive and Underbody Blast Environments, *Journal of Crashworthiness*, 22(5), pages 479-487, 2017.
- B16. Bailey, A, Poplin, G, McMurry, T, Salzar, R, Crandall, J, Improved Survival Model for Foot/Ankle/Leg High Rate Axial Impact Injury Data, *Traffic Injury Prevention*, 16, pages S96-S102, 2015.
- B17. Bailey, A, Christopher, J, Salzar, R, Brozoski, F, Comparison of Hybrid-III and Post Mortem Human Surrogate Response to Simulated Underbody Blast Loading, *Journal of Biomechanical Engineering*, 137(5), 2015.
- B18. Bailey, A, Christopher, J, Salzar, R, Brozoski, F, Post Mortem Human Surrogate Injury Response to Simulated Underbody Blast, *Annals of Biomedical Engineering*, pages 1-11, 2014.
- B19. Bailey, A, Boruah, S, Christopher, J, Shafieian, M, Cronin, D, Salzar, R, Injury Potential of Shock Induced Compressive Waves on Human Bone, *Dynamic Behavior of Materials*, 1, pp. 149-156, Springer New York, 2013.
- B20. Funk, J, Rudd, R, King, R, Srinivasan, S, Bailey, A, Crandall, J, Injuries Caused by Brake Pedal Loading of the Midfoot, *Biomedical Sciences Instrumentation* 48:134, 2012.

C. Refereed Conference Publications

- C1. Gabler, L, Bailey, A, Funk, J, Crandall, J, Arbogast, K, Myers, B. Development of a Metric for Ranking the Performance of Football Helmets, *Proceedings of the 2019 Biomedical Engineering Society Conference*, Philadelphia, PA, 2019.

- C2. Bailey, A, Poplin, G, McMurry, T, Salzar, R, Crandall, J, Improved Survival Model for Foot/Ankle/Leg High Rate Axial Impact Injury Data, Association for the Advancement of Automotive Medicine Conference, Philadelphia, PA, October 4-7, 2015.
- C3. Bailey, A, Panzer, M, Salzar, R, Development of a Transfer Function for Interpreting Hybrid-III Leg Data from Axial Loading, Proceedings of the International Conference on the Biomechanics of Impact, Berlin, Germany, 2014.
- C4. Perry, B, Gabler, L, Bailey, A, Henderson, K, Brozoski, F, Salzar, S. Lower Extremity Characterization and Injury Mitigation. Proceedings of the International Conference on the Biomechanics of Impact, Berlin, Germany, 2014.
- C5. Perry, B, Bailey, A, Gabler, L, Henderson, K, Brozoski, F, Salzar, R, Optimization of Combat Boot Properties to Mitigate Underbody Blast Injuries to the Lower Extremity, Personal Armor Systems Symposium, Cambridge, UK, September 8-12, 2014.
- C6. Bailey, A, Christopher, J, Henderson, K, Brozoski, F, & Salzar, R. Comparison of Hybrid-III and PMHS Response to Simulated Underbody Blast Loading Conditions. Proceedings of the International Conference on the Biomechanics of Impact, Goteborg, Sweden, 2013.
- C7. Henderson, K, Bailey, A, Christopher, J, Brozoski, F, & Salzar, R. Biomechanical Response of the Leg Under High Rate Loading. Proceedings of the International Conference on the Biomechanics of Impact, Goteburg, Sweden, 2013.
- C8. Funk, J, Rudd, R, King, R, Srinivasan, S, Bailey, A, Crandall, J, Injuries caused by brake pedal loading of the midfoot, Rocky Mountain Bioengineering Symposium, Blacksburg, VA, March 23-24, 2012.
- C9. Xiao, M, Bailey, A, Pierrakos, O, In-Vitro Modeling of Heart Failure in the Presence of a Prosthetic Heart Valve using Particle Image Velocimetry, ASME Summer Bioengineering Conference, Farmington, PA, USA, June 22-25, 2011.

D. Non-Refereed Conference Publications and Abstracts

- D1. Guidice, J, Park, G, Bailey, A, Kent, R, Panzer, M, Effect of Initial Positioning of the Hybrid III Head-Neck in Frontal and Oblique Bare Head Impact, Proceedings of the International Conference on the Biomechanics of Impact, 2018.
- D2. Bailey, A, Salzar, R, Crandall, J, Development of an Injury Criterion for the Human Leg Exposed to High-Rate Axial Loads, University of Virginia Engineering Research Symposium, Charlottesville, VA, 2016.
- D3. Bailey, A, Panzer, M, Salzar, R, Development of a Hybrid-III to Human Leg Transfer Function for Axial Loading, Ohio State University Injury Biomechanics Symposium, Columbus, OH, 2014.
- D4. Perry, B, Henderson, K, Bailey, A, Gabler, L, Salzar, R, Mitigation of Underbody Blast Injuries to the Lower Extremity by Optimization of Combat Boot Properties, Ohio State University Biomechanics Symposium, Columbus, OH, 2014.

- D5. Salzar, R, Bailey, A, An Investigation of the Effects of Personal Protection Equipment on the Response of Vehicle Occupants in Under-Body Blast Scenarios, World Congress of Biomechanics, Boston, MA, USA, July 6-11, 2014.
- D6. Bailey, A, Boruah, S, Christopher, J, Shafieian, M, Cronin, D, Salzar, R, Injury Potential of Shock Induced Compressive Waves on Human Bone, International Congress & Exposition on Experimental and Applied Mechanics, Costa Mesa, CA, USA, June 11-14, 2012.
- D7. Bailey, A, Boruah, S, Christopher, J, Shafieian, M, Cronin, D, Salzar, R, Finite Element Analysis of the Injury Potential of Shock-Induced Compressive Waves on Human Bone, Ohio State University Injury Biomechanics Symposium, Columbus, OH, 2012.
- D8. Bailey, A, Beatty, M, Pierrakos, O, Investigating Vortex Ring Propagation Speed Past Prosthetic Heart Valves: Implications for Assessing Valve Performance, 26th Southern Biomedical Engineering Conference, College Park, MD, USA, May 2, 2010.

E. Presentations

- E1. NFL Helmet Challenge Symposium, Youngstown, OH, USA, November 13-15, 2019
- E2. Biomechanics: The Super Bowl of Science and Engineering. Invited lecture at Laurentian University, Sudbury, Ontario, USA, February 3, 2020
- E3. Development of an Injury Criterion for the Human Leg Exposed to High-Rate Axial Loads, University of Virginia Engineering Research Symposium, Charlottesville, VA, USA, April 1, 2016
- E4. Improved Survival Model for Foot/Ankle/Leg High Rate Axial Impact Injury Data, Association for the Advancement of Automotive Medicine Conference, Philadelphia, PA, USA, October 4-7, 2015
- E5. Development of a Transfer Function for Interpreting Hybrid-III Leg Data from Axial Loading, International Conference on the Biomechanics of Impact, University of Virginia Engineering Research Symposium, Charlottesville, VA, USA, March 20, 2015
- E6. Investigation of Injuries to Armored Vehicle Personnel Subject to Blast: Preliminary Study with Emphasis on Lower Extremity Fractures, Military Operational Medicine Research Program Injury Biomechanics Research Panel Briefing, Ft. Detrick, MD, USA, June 18-19, 2015
- E7. Development of a Transfer Function for Interpreting Hybrid-III Leg Data from Axial Loading, International Conference on the Biomechanics of Impact, Berlin, Germany, 2014
- E8. Development of a Hybrid-III to Human Leg Transfer Function for Axial Loading, Ohio State University Injury Biomechanics Symposium, Columbus, OH, USA, 2014
- E9. Comparison of Hybrid-III and PMHS Response to Simulated Underbody Blast Loading Conditions, International Conference on the Biomechanics of Impact, Goteborg, Sweden, 2013

- E10. Injury Potential of Shock Induced Compressive Waves on Human Bone, International Congress & Exposition on Experimental and Applied Mechanics, Costa Mesa, CA, USA, June 11-14, 2012
- E11. Finite Element Analysis of the Injury Potential of Shock-Induced Compressive Waves on Human Bone, Ohio State University Injury Biomechanics Symposium, Columbus, OH, USA, 2012
- E12. Injuries caused by brake pedal loading of the midfoot, Rocky Mountain Bioengineering Symposium, Blacksburg, VA, USA, March 23-24, 2012
- E13. Investigating Vortex Ring Propagation Speed Past Prosthetic Heart Valves: Implications for Assessing Valve Performance, 26th Southern Biomedical Engineering Conference, College Park, MD, May 2, 2010.