A look back at 2021

Wrapping up the year

Athlete Engineering
Mississippi State University
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MISSISSIPPI STATE UNIVERSITY
CENTER FOR ADVANCED VEHICULAR SYSTEMS

New Faculty Researcher Award

During 2021, Athlete Engineering's own Dr. Reuben Burch was awarded the New Faculty Researcher Award by the Southeast Section of the American Society for Engineering Education (ASEE) for his outstanding initiative and performance in both teaching and research. Dr. Burch is an Associate Professor of Industrial and Systems Engineering at Mississippi State University (MSU) and is the Associate Director of the Center for Advanced Vehicular Systems (CAVS).

Through the integration of Dr. Burch's former college athletic history as a member of the MSU football team, his industry experience, and his return to academic scholarship, the Athlete Engineering program at MSU was created in 2017. With the mission to improve the human athlete through data science and technology, this interdisciplinary team of staff, faculty, and student researchers spans numerous departments on campus such as engineering, athletics, kinesiology, textiles, and sociology. This program is housed within CAVS and also partners with researchers from the National Strategic Planning and Analysis Research Center (NSPARC).

With goals to maximize human performance and ingenuity by (1) advancing knowledge and educating the next generation of scientists and entrepreneurs, (2) transforming research and applied innovation, and (3) creating and nurturing economic development based on entrepreneurship and research commercialization, Athlete Engineering researchers at MSU are rising to the forefront of athletic research specialists.

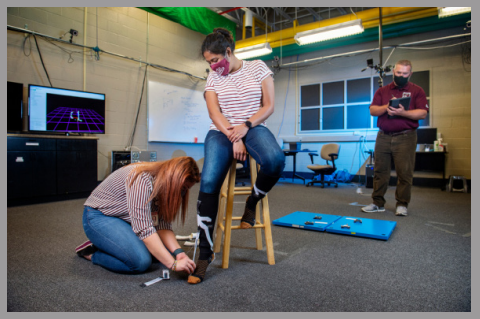
As a program that investigates all types of wearable devices, Athlete Engineering projects range from sports-related studies to investigating the effectiveness of various fabric face masks used to protect against COVID-19. Research projects such as these help to build a mutually beneficial relationship between Athlete Engineering and other organizations both on and off campus. Athlete Engineering is proud to collaborate with other human performance professionals from a wide range of athletic sectors including strength and conditioning coaches from the NFL and NBA, along with wearable technology and sports science companies such as STRIVE™ and Gear Sports. As this collaborative research team continues to grow, Athlete Engineering is looking to improve the safety and performance of all human athletes, including the tactical, industrial, and at-risk athlete personas, with the help of our partners. These collaborations have opened the door to innovative research initiatives which are helping to shape the field of sports science and wearable technology research.

Dr. Burch with an early prototype of the Smart Sock
- Photo by Megan Bean/Mississippi State University

Data science in Mississippi

Athlete Engineering was proud to be recognized by Mississippi Public Universities for our advancements in the field of sports science technology. Thanks to our dedicated team of MSU staff, faculty, and student researchers our program was recognized for using the Human Performance Lab at CAVS to test, research, and validate various aspects of wearable technology and other sports technologies. The success of these studies heavily depends on our partnerships with the MSU Athletics department including Men's and Women's Basketball, Football, and the Baseball and Softball teams. Alongside testing and validating technology, our team is also proud of our initiatives to design and create innovative pieces of wearable technology to further benefit the human athlete by collecting millions of data points that practitioners can utilize to understand more about enhancing performance and safety.

Athlete Engineering would like to congratulate all the other Mississippi schools in our collective push to become leaders in data analytics.



Students working on a prototype in the Human Performance Lab at CAVS
- Photo by Megan Bean/Mississippi State University

Tactical Athlete Summit at Auburn University

Four of our Athlete Engineering researchers had the opportunity to present at the Tactical Athlete Summit at Auburn University in October. The two faculty members and two graduate student researchers each presented various aspects of research or involvement in the Athlete Engineering program.

Dr. Burch shared a program and research overview to highlight various aspects such as the wide range of university departments which come together to make up our multidisciplinary team of researchers. He was also able to showcase Athlete Engineering's extensive partnership network with local and state entities, athletic professionals, and sports performance organizations which create mutually beneficial research collaborations.

Dr. Harish Chander, an associate professor of kinesiology and co-director of the Neuromechanics Laboratory, presented his research on military footwear type and load carriage impact on human performance. The main goal of this research is to help prevent injuries, promote safety, and enhance the performance of tactical athletes. This study in particular focuses on analyzing and evaluating the impact of two military footwear and a load carrying military type workload on the biomechanics and physiology of human performance. Extrinsic and intrinsic factors in the military are more pronounced and impact the postural control and locomotor system significantly.

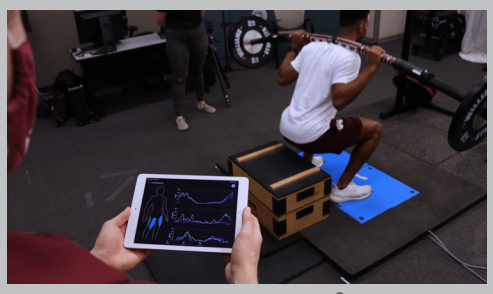
The findings from this research will offer helpful insight in footwear design and with scheduling work-rest intervals, to avoid postural control decrements in the military that can potentially lead to falls and fall related injuries, so that military personnel can perform operations with less fatigue and less slip incidences and lower muscular exertions.

Graduate student researcher Sam Osborne shared insights from several research projects. During 2020 through 2021, Osborne was the graduate lead for the Report Automation Task Force and is currently finishing his master's degree in Industrial Engineering — Human Factors and Ergonomics. One study included in his presentation focused on the Tsunami Bar®, a flexible barbell comprised of polypropylene and fiberglass. The Tsunami Bar® has the potential to augment strength training by means of the oscillatory motion that naturally occurs when lifting the flexible barbell. However, the efficacy of this alternative has been largely unexplored. An investigation of the effects on the squat exercise was conducted with both the Tsunami Bar® and traditional barbell, where force plate, motion capture, and surface electromyography data are collected at the lower limb segments. Ground reaction forces, limb segment torques, barbell end positions, and muscle activation data are collected and analyzed to determine if any significant differences exist between both barbell types. This initial study will lay the foundation for deeper research examining the efficacy of the Tsunami Bar® when incorporated

The larger goal of this and future Tsunami Bar® studies is to teach human factors students how to use laboratory gold standard equipment to validate human performance technology and make health and safety recommendations to real-world customers.

Lastly, graduate student researcher Erin Parker presented her work with the Smart Sock project. Parker is pursuing a graduate degree in Industrial Engineering. During the Spring of 2021, Parker was awarded the Office of Research and Economic Development Bagley College Undergraduate Research Award and was inducted into the Bagley College of Engineering Hall of Fame. The sock prototype utilizes soft sensor technology to capture data in response to body movements. A primary goal throughout this ongoing project is to not only create properly functioning pieces of wearable technology, but to also design and package the product in a way that is both comfortable and effective. Parker's undergraduate experience with computer engineering and fashion design have helped her to develop the sock from both an engineering and textile perspective. While the functionality of the sock is essential to the overall purpose of the product, the sock is being designed with the intention of one day being used by the average person. Comfort and ease of use are both important factors for Parker and other Athlete Engineering researchers to consider throughout the development of the prototype. Our team of researchers works diligently to design pieces to further enhance our knowledge of human and technical performance.

A comparison of military footwear


Data collection from the Tsunami Bar® experiment


The Smart Sock prototype

The Report Automation Task Force

While research exploring the validity and reliability of wearables is of upmost importance in the sports sphere, the software systems and data analysis programs are equally important. This is where the students on the Athlete Engineering Report Automation Task Force performs an important role. This team is composed of both graduate and undergraduate student research assistants who help to analyze and report performance data gathered from wearables.

For one of our many projects this year, our student Athlete Engineering researchers collaborated with the MSU Softball Team and Assistant Coach, Josh Johnson, to complete an individualized report system for the team. This system allows the coaching staff to personalize workouts for each player, resulting in more effective training and better performance on the field. Coach Johnson worked with our student researchers to pair technology with human performance in the Human Performance Lab at CAVS. A system of motion capture cameras and wearables collected data on the way the athletes moved and the force they produced when pitching. By combining Coach Johnson's biomechanics expertise and Athlete Engineering's innovation with data collection gold standard tools, the MSU Softball Team now has access to an individualized report systems that allows both coaches and players to visualize performance data and create training standards.

Data collection for the individualized report system - Photo courtesy of Mississippi State University Athletcis

Markerless motion capture systems

A recent collaboration between Athlete Engineering's research partner, NSPARC, and Gears Sports, an industry leader in providing high-end sports optical motion capture systems to golf and sports centers of excellence, has hailed a new investigation of developing a markerless motion capture app. Together, NSPARC and Gear Sports are creating the Golf Rapid Intelligence Diagnostic (GRID) System, which is a cost-effective and accurate 3D motion capture and analysis system using a monocular mobile device. NSPARC's own Dr. Tony Luczak and Patrick Nelsen have been working on this project to help future coaches and athletes. By designing an affordable 3D kinematic analysis tool, a new training paradigm will equip golf coaches, instructors, and golfers who do not have access to the high-cost, gold-standard performance measurement tools of a laboratory.

Benefits of a markerless system include quantifying movements outside of the lab during training and actual games that can help provide insight about altered biomechanics due to fatigue and modifying techniques to improve performance or mitigate injury.

Athlete Engineering is grateful for our continued partnership with NSPARC to combine human factors data with an increased ability to integrate software and hardware development.

Data collection for the marker-less motion caption system

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