ATHLETE ENGINEERING AT MSU™

MISSISSIPPI STATE UNIVERSITY
CENTER FOR ADVANCED VEHICULAR SYSTEMS

# Football

## Athlete Engineering at the Industry's Core

Athlete Engineering
Mississippi State University
Vol. 1, Issue 2
October 2021

## A Journey to STRIVE™

Mississippi State University (MSU) Alumnus Zach Shelly, is currently employed with STRIVE™ as a Sports Scientist. STRIVE™ is a data analysis platform and wearable technology company which provides muscle data to athletes so that they may compete at peak performance.

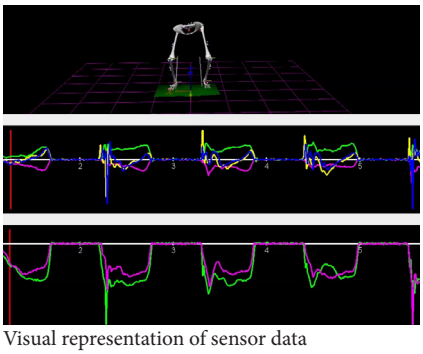
Shelly educates athletic trainers, physical therapists, strength and conditioning coaches, sports scientists, and other athletic practitioners on muscle data and how to use STRIVE™'s technology to better enhance their training regimens.

During his time at MSU, Shelly worked with the football team to collect student-athlete performance data, specifically how much the players moved during practices in order to more accurately gauge their workload. Shelly's work also included establishing a database with athlete reports for the coaching staff to utilize during practices so that the 1.2 million rows of data collected per training session was quickly accessible.

"My role was presenting and displaying data and then collaborating with the practitioners to be able to leverage that data into something that was useful," said Shelly. "Now, how do we use this to inform our decisions and our decision-making process?"

Individualizing the training process is one of the most important aspects of improving performance. When the needs of high-performance athletes are met during workouts based on a regimen created from their individualized data-sets, performance outside of practice and as a member of an integrated team increases.

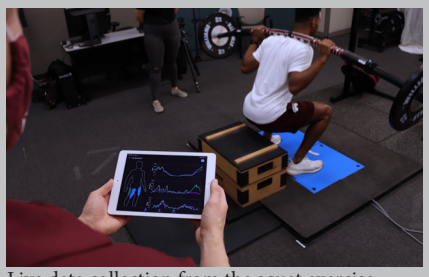
Athlete Engineering and STRIVE™ share collaborative research efforts which span outside the realm of athletics. There is a current research project focusing on enterprise spaces and industrial athletes who, through their shift work, are engaging in repetitive motion tasks. This project aims to inform managers of any risk to the employee based on the work being performed. The data collected will allow managers to shift tasks and workloads appropriately, reducing the injury risk to the employee.



Visual representation of sensor data

## Sensor Testing

The data analysis platform and wearable technology company, STRIVE™, partnered with Athlete Engineering at MSU to conduct a study which tested the STRIVE™ Sense3 performance monitoring system against a research-grade system, Noraxon™, in measuring activity during the back squat exercise. For this study, 17 participants performed three total trials of the squat exercise with a progressive load for individual trials equal to 30%, 60%, and 80% of their estimated one-repetition maximum. Both systems were used to capture surface electromyography (sEMG) measurements from the rectus femoris muscle. Researchers calculated values from each trial to assess concurrent validity and interrater reliability of the STRIVE™ Sense3 device. Researchers found several outliers which indicated the need for coaches to lubricate sensors and ensure proper fit to collect accurate data. However, examining results alongside practitioner feedback indicate the STRIVE™ Sense3 system is capable of tracking sEMG activity in comparison to a research-grade system.



Live data collection from the squat exercise

# Athlete Engineering Partners with NFL Strength Coach

Anthony Piroli, the Head Strength and Conditioning Coach for the 2021 Super Bowl champions, the Tampa Bay Buccaneers, is a long-standing partner of Athlete Engineering at MSU. Coach Piroli worked with the MSU football team on two occasions, first as an Assistant Strength and Conditioning Coach in 2014 then returning to MSU in 2017 to fulfill the roles of Head Strength and Conditioning Coach and Director of Performance.

"We were bringing in some technology and were tracking both the athletes on the field and in the weight room, and bridging the gap between the two," said Piroli.

Coach Piroli emphasizes the importance of properly profiling athletes and catering to individual's training needs to produce the most efficient performance.

"I talk about trying to not rewrite the script on what we do but find ways to monitor appropriately the things we're already doing," said Piroli. "To streamline the process to make sure that the things we are doing, the things that we are monitoring, make sense for what we're trying to achieve."

Coach Piroli and Athlete Engineering researched the validity of different technologies, such as force plates and wearable sensors, used by the MSU football team.

This technology plays a critical role in day-to-day training for athletes. It is important for athletic practitioners to have confidence that the data and statistics they receive from wearable sensors are valid, reliable, and repeatable to best improve athletic performance.

"Having no data is better than having bad data," said Piroli. "We shouldn't be investing resources into anything to measure our athletes if it's not giving us real, proven, and actionable information."

After joining the Tampa Bay Buccaneers in 2018, Coach Piroli has continued to invest in research initiatives with MSU Athlete Engineering. Athlete Engineering is grateful to call Coach Piroli a partner and we look forward to the next research project and publication with him.

Wearable sensor and data monitoring system
Photo by Megan Bean/Mississippi State University

# Football Helmet Prototypes and Response Times

There is no shortage of research being conducted on athletic safety equipment and how these devices can be improved to further benefit the wearer during competition. Although safety is a primary concern in protective equipment design, certain design considerations can impact a player's ability to react or respond to a stimulus. This is called response time and it is critical in the sport of football. In 2019, Athlete Engineering conducted a study to evaluate a helmet prototype with modifications to improve peripheral view compared to the Riddell SpeedFlex™ helmet worn by MSU football athletes. This study also provided insight on how a player's field of vision effects an athlete's response time.

To complete this study, 18 NCAA Division 1 football student-athletes were selected to complete a response test task and questionnaire. Each athlete performed the response test three times using the FITLIGHT™ Trainer system, once with the prototype helmet, once with the Riddell SpeedFlex™ helmet, and once with no helmet. The users also completed balance tests while wearing each of the two helmets. The results of this study showed that the athletes response times were significantly affected when wearing the SpeedFlex™ helmet compared to wearing no helmet. Also, responses from the questionnaire showed that the student athletes perceived that their field of vision was increased while wearing the modified helmet prototype during tasks.

However, there was no significant difference when comparing the SpeedFlex™ helmet and the modified helmet in terms of response times or balance. These results are extremely important to the athletics industry because of the importance of response time in football as a key performance indicator and modifiable injury risk factor.

A potential future study would be to get more data from a larger pool of participants allowing researchers to assess different experiences and skillsets as they pertain to perceived peripheral view and the positions played in football.

# Bully Car: Where Innovation and Design Meet for the Mascot

Michael Gibson is a Research Engineer at the Center for Advanced Vehicular Systems (CAVS) at MSU and is a critical partner in the development, production, and upkeep of the famous Bully Car which transports the MSU mascot, Bully, onto Scott Field at Davis Wade Stadium during the beginning of each home game.

Before the installment of the Bully Car, MSU's Bully mascot was towed onto the field in a man-powered wagon. However, it did not take long for the innovative student and faculty minds in the Bagley College of Engineering as well as the Research Engineers at CAVS to begin turning the idea of an engine powered Bully Car into a reality.

"We have resources at CAVS, we have engine research, we have all these different things and we're pulling Bully out by hand? We should have a remote control or someone driving him. Something much more than just a wagon," said Gibson.

The original idea for the Bully Car was presented to an Automotive Engineering class and was intended to serve as a class project for the semester. Students generated ideas not only regarding the Bully Car's mechanics, but also cosmetic elements such as lighting and a $CO_2$ smoke effect.

The inner structure of the Bully Car

After discussions with the MSU Athletics Department, a design was agreed upon and the team got to work.

Expanding far beyond a one semester class project, the Bully Car made its debut during the football season of Fall 2019. The body of the Bully Car was composed of a 4-seat go-kart which gave the team a longer platform to work with over the standard 2-seat go-kart. This design is known as Bully Car 1.0.

However, Gibson and other partners at CAVS believed that this Bully Car was only a prototype and that there was still room for improvement.

Today, Bully Car 2.0 escorts Bully onto the field and is dressed in major mechanical and cosmetic modifications which improved its overall appearance, efficiency, and durability.

Athlete Engineering and the Bully Car team appreciate the continued support and funding provided by MSU's CAVS as well as the support from the Athletics Department for allowing us to utilize all students, athletes and non-athletes alike, to continue to blur the lines between our engineering creativity and our competitive success in sports.


Bully Car carrying Bully onto the field

MISSISSIPPI STATE UNIVERSITY™
CENTER FOR ADVANCED VEHICULAR SYSTEMS

# STRIVE™ Smart Shorts

STRIVE™ and Athlete Engineering continue to engage in joint research initiatives. A collaborative article was published in August of 2021 regarding external load and muscle activation monitoring using the STRIVE™ Sense3 smart compression shorts. Sixteen external load and muscle load variables were measured from 15 National Collegiate Athletic Association (NCAA) Division I men's basketball players with 1137 session records.

The findings suggest that each position in basketball has its own unique external load and muscle activity profile, and that training regimens can be adapted to match these demands in competition. Training can be adjusted for the specific demands each playing position requires based on what was observed during games, rather than keeping demands similar for all positions during training. The analysis of muscle activation provides an additional layer of information in which playing positions can be differentiated during games, giving coach practitioners another perspective that can be used to better optimize training for their athletes. This novel wearable has potential to bring a new layer of baselining performance that can be used by coach practitioners to better prepare, train, and rehabilitate their athletes.

Strive™ Sense3 smart compression shorts

# Stay connected with us!

*msuathleteengineering*

*msu_AthleteEng*

*MSU Athlete Engineering*

*AthleteEngineeringMSU*

MISSISSIPPI STATE UNIVERSITY
CENTER FOR ADVANCED VEHICULAR SYSTEMS

ATHLETE ENGINEERING

MISSISSIPPI STATE UNIVERSITY
JAMES WORTH BAGLEY COLLEGE OF ENGINEERING