Department of the Navy SBIR/STTR Transition Program

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MCSC-PRR-5048

Topic # N20A-T001
Optimized Energy-Attenuating Seat Design for Ground Vehicles
Corvid Technologies, LLC

WHO

SYSCOM: MCSC

Sponsoring Program: PM Amphibious Combat Vehicle (ACV), Advanced Amphibious Assault (AAA)

Transition Target: Vehicle program offices across the U.S. Marine Corps

TPOC: sbir.admin@usmc.mil

Other Transition Opportunities: Vehicle program offices within the U.S. Army and U.S. Air Force would also benefit from the use of the developed injury prediction tools to improve vehicle energy attenuation seat safety.

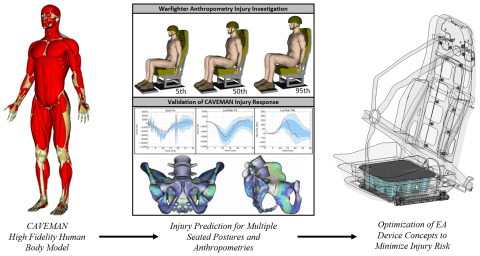

Image courtesy of Corvid Technologies, 2023.

Notes: The Computational Anthropomorphic Virtual Experiment Man (CAVEMAN) model is currently available for use by the DoD, industry, or academia for injury prediction simulations. The high-fidelity human body model can be licensed for direct use or applied injury analyses can be conducted by Corvid Technologies for interested organizations.

WHAT

Operational Need and Improvement: Many warfighters sustained pelvis and lumbar spine injuries from ground vehicle underbody blast events that occurred during Operation Iraqi Freedom and Operation Enduring Freedom. As a result, many ground vehicle programs have incorporated blast-mitigation technologies within their vehicles to protect warfighters against such injuries. However, current blast mitigation technologies are typically only tested for a 50th percentile male occupant. To improve safety for all warfighters, an underbody blast tool capable of quantifying differences of injury risk due to variation in warfighter seated posture, gender, and gender-relative size is needed.

Specifications Required: During this effort, investigation into how anthropometric variability, gender, and seated posture affect injury risk will lead to the development of a capability to accurately predict pelvis injury, lumbar spine injury, femur fracture, and soft tissue injury for warfighters exposed to underbody blast. This injury prediction tool will be used to demonstrate improvement to the design of an energy attenuating device to further safety for occupants falling outside of the standard 50th percentile male classification.

Technology Developed: The Computational Anthropomorphic Virtual Experiment Man (CAVEMAN) model, a family of high-fidelity virtual human body models, is being leveraged to develop and deliver a tool for the USMC to accurately predict pelvis and lumbar spine injuries for warfighters to improve energy attenuating (EA) seat design and performance. The CAVEMAN system provides a means for injury prediction with the virtual underbody blast environment for male warfighters across the 5th-95th percentile anthropometry range in any seated posture. Parallel efforts are underway to add equivalent injury assessment capabilities for female warfighters with additional virtual human body models based on female-specific anatomy.

Warfighter Value: Use of the CAVEMAN model provides a pathway for virtual energy attenuating (EA) seat safety analysis creating the means for quicker and more extensive seat development and testing capabilities for the USMC. The final family of CAVEMAN models will improve safety for warfighters by including variation in body size, gender, and posture in the vehicle safety assessment promoting protection for all warfighters.

WHEN

Contract Number: M67854-22-C-6505 **Ending on:** Jul 11, 2024

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Investigate how anthropometric variability and changes in seated posture affect pelvis and lumbar spine injury.	Low	Complete laboratory testing	3	1st QTR FY22
Develop pelvis, lumbar spine, femur, and soft-tissues injury prediction tool.	Medium	Compare tool to laboratory testing.	6	3rd QTR FY24
Demonstrate energy attenuating device improvement using the warfighter injury prediction tool.	Medium	Evaluation of injury risk to all warfighters.	7	4th QTR FY24
Further investigation into gender influence on injury risk in the underbody blast environment.	Medium	Completion of laboratory testing and tool validation.	8	4th QTR FY25

HOW

Projected Business Model: The CAVEMAN model is available for license by the government, industry, or academia. The model can be setup to run on the DoD High Performance Computing Center (HPC), a private HPC, or on Corvid's HPC. Access to the CAVEMAN model and supporting documentation is available via a demo license. Included within the demo are step-by-step tutorials to learn the basics required for CAVEMAN injury prediction simulations.

Company Objectives: The CAVEMAN model has been developed to enhance the U.S. Military's capabilities to accurately predict warfighter injury risk during underbody blast events. Extensive validation in military load scenarios has shown the utility in the tool for military applications. The tool is ready to be utilized to improve the understanding of current safety system protections levels and work toward improved capabilities for warfighters of any size and gender.

Potential Commercial Applications: In addition to underbody blast, the CAVEMAN virtual human body model has been used for less-than-lethal munitions testing, aircraft crash safety, aircraft ejection and high-G maneuvers, personal protective equipment design, and human-robot interaction safety. It is well suited for human body injury prediction in high-rate dynamic environments or the starting point for accelerated model development for additional injury biomechanics research.

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