Topic: N172-120

Skyward, Ltd.

Mitigation of Helmet Vibration

Individual warfighter cognitive performance and situational awareness are critical components of pilot and crew member mission effectiveness. Noise and vibration issues, such as those associated with the E-2D Advanced Hawkeye HGU-68/P flight helmet in operational environments, can result in extreme fatigue and decreased pilot performance. Skyward has developed tailored noise attenuation and vibration suppression solutions to improve the vibro-acoustic response of the HGU-68/P helmet by leveraging in-house reverse engineering, finite element analysis expertise, and strategic test facility partners to implement multi-disciplinary design optimization to solve this issue. Skyward's tailored vibro-acoustic suppression solutions give them a competitive advantage and uniquely positions them for strategic partnerships with the NAVAIR E-2/C-2 Airborne Command and Control Systems Program Office (PMA-231) and other government and commercial entities.

Technology Category Alignment:

Air Platforms
Human Systems
Human Systems

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SYSCOM: NAVAIR
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Corporate Brochure: https://navystp.com/vtm/open_file?type=brochure&id=N68335-19-C-0268

Department of the Navy SBIR/STTR Transition Program

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NAVAIR 2020-837

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Mitigation of Helmet Vibration

Skyward, Ltd.

WHO

SYSCOM: NAVAIR

Sponsoring Program: E-2/C-2 Airborne Command and Control Systems Program Office (PMA-231)

Transition Target: E-2D Advanced Hawkeye (AHE)

TPOC:
(301)342-9213

Other transition opportunities: The E-2D Advanced Hawkeye (AHE) aircraft managed through the PMA-231 Program Office is the primary transition opportunity. NAVAIR's Aircrew Systems Program Office (PMA-202) is also monitoring the development of this SBIR and is an alternative transition opportunity. PMA-202 and the Naval Air Warfare Center Aircraft Division (NAWCAD) Human Systems Engineering Department is the lead for this SBIR and could assist in identifying other aircraft platform transition opportunities to which Skyward's optimized solution could be tailored. Upon successful flight test of Skyward's tailored vibro-acoustic attenuation device solution(s), Skyward intends to seek transition within PMA-231, PMA-202, and other Program Offices within the DoD. Skyward also plans to seek transition within the private sector in the arenas of commercial aviation and other vehicle protective helmets with similar issues.

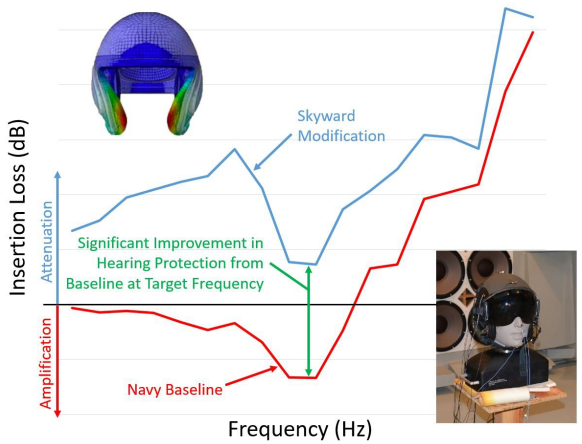


Image Courtesy of Skyward, Ltd. (2020)

WHAT

Operational Need and Improvement: Individual warfighter cognitive performance and situational awareness are critical components of pilot and crew member mission effectiveness. Noise and vibration issues, such as those associated with the blade pass frequency (BPF) of the E-2D AHE HGU-68/P flight helmet in operational environments, can result in increased workload and decreased pilot performance during flights, missed radio communications, and extreme fatigue. In an effort to mitigate the helment vibro-acoustic problem during flight, the Navy solicited small businesses to perform experimentally validated Finite Element Analysis (FEA) on the HGU-68/P E-2D flight helmet and leverage this analysis to develop an optimized solution.

Specifications Required: Demonstrate a multi-objective optimized solution to mitigate helmet vibrations by leveraging a high-fidelity, experimentally validated FEA process.

Technology Developed: To increase the mission effectiveness of pilots and aircrew, Skyward developed tailored vibro-acoustic attenuation solutions for the E-2D AHE HGU-68/P flight helmet, which not only eliminates vibration/noise amplification issues currently plaguing the pilots and aircrew, but also provides vibration/noise attenuation capability. Skyward developed tailored noise attenuation and vibration suppression solutions to improve the vibro-acoustic response of the HGU-68/P helmet by leveraging in-house reverse engineering, FEA expertise, and strategic test facility and transition partners to implement multi-disciplinary design optimization to solve this issue. As a result, Skyward developed a uniquely designed composite additive manufactured retrofit solution and an innovative production helmet shell redesign solution, which are specifically tailored to the E-2D AHE HGU-68/P flight helmet. Both these solutions are applicable to all sizes of the HGU-68/P and can be tailored to other helmet systems or platforms with similar issues.

Warfighter Value: Skyward's tailored solutions will improve cognitive performance, increase situational awareness, decrease the potential for missed radio communications, and decrease the workload and fatigue of the E-2D pilots and aircrew. The solutions will also decrease long-term hearing loss disorders associated with aviation noise for warfighters. This translates to a decrease in long-term Veteran's Affairs benefits required to treat warfighters with aviation noise-induced hearing loss disorders and a long-term net savings for the U.S. Navy in treating disabled warfighters.

WHEN

Contract Number: N68335-19-C-0268 **Ending on:** July 31, 2020

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Develop Validated high-fidelity 3D FEA of HGU-68/P Helmet and Acoustic Environment	Med	Complete FEA Development	2	March 2018
Develop Conceptual Design Solutions to Mitigate Vibro-acoustic Issues	Med	Analytical proof of concept for Conceptual Design Solutions	3	January 2019
Manufacture/Test Additively Manufactured Prototype Retrofit Solution in Simulated Operational Environment	Med	Prototype Successfully Mitigates Vibration	6	July 2020
If Option 1 Exercised, Manufacture/Test Prototype Helmet Shell Redesign Solution in Simulated Operational Environment	Med	Prototype Successfully Mitigates Vibration	6	March 2021
If Option 2 Exercised, Perform MIL STD Impact/Penetration Tests of Prototype Designs	Med	Prototype Passes Impact/Penetration Tests	6	June 2021
If Option 2 Exercised, Impact and Flight Testing of Prototype Helmet Modifications	Med	Modifications Pass Flight Tests	7/8	December 2021

HOW

Projected Business Model: Skyward's HGU-68/P retrofit and helmet redesign will each be demonstrated in the E-2D Advanced Hawkeye through flight testing. Phase III efforts will ensure transition. With NAWCAD Human Systems and PMA-202 support, Skyward will arrange commercial sales to the Navy through PMA-231. The retrofit will occur with existing E-2D aircrew helmets. The helmet shell redesign will be sold as a new E-2D helmet in future helmet procurements. Additional military and commercial platforms experiencing vibro-acoustic issues with impact/penetration requirements, particularly rotary wing, multi-rotor, and turboprop fixed wing, will be sought to apply Skyward's design process to new retrofit and helmet redesign applications.

Company Objectives: Skyward has established a local additive manufacturer for the initial retrofit production, but is studying options, including internal manufacturing, to meet long-term production demand and lower cost. Skyward will utilize its existing relationship with a major helmet manufacturer and license the helmet redesign to accomplish production of new helmets. These accomplishments will further Skyward strategic paths, increasing technical capabilities in 3D scanning and reverse engineering and high-fidelity finite element analysis, while creating sustainable IP and commercialized products. Skyward will examine spin-off opportunities if it decides to manufacture retrofits.

Potential Commercial Applications: Skyward will target other military platform opportunities such as the V-22 aircraft, using contacts established through licensing of its patented fire protection product. Skyward's relationship with an OEM helmet manufacturer and AFWERX will continue to be leveraged for new design opportunities for the Air Force Next Generation Fixed Wing Helmet. Commercial applications will be sought taking advantage of the model/test/design optimization process developed by Skyward for reducing vibro-acoustic issues, which may include protective helmets used in other applications, but will not be limited to helmets alone. The process can be applied to other components or structures with variations in the test requirements.

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