Photo courtesy of Environmental Tectonics Corporation

THE KRAKEN GOES TO BATTLE AGAINST SPATIAL DISORIENTATION

By Capt. Rich Folga, USN

WITH MULTIAXIS MOTION CONTROL TO INVESTIGATE SPATIAL DISORIENTATION COUNTERMEASURES, NAVAL MEDICAL RESEARCH UNIT-DAYTON HOUSES THE DISORIENTATION RESEARCH DEVICE—ALSO KNOWN AS THE KRAKEN.

The Disorientation Research Device (DRD), otherwise known by its official Navy-branded moniker, the KrakenTM, is the Navy's newest weapon in the battle against a long-standing noncombat threat to aviators and aircrews: spatial disorientation (SD). The DRD was created to provide unprecedented research capability to address this persistent threat. By replicating acceleration forces experienced in flight and integrating high-fidelity flight or other vehicular displays, the DRD can produce dynamic conditions under sustained G forces (up to 3G) with man-in-the-loop control of motion with authentic sensory stimulation. During these conditions, researchers can measure actual sensory spatial reflexes and monitor subject physiologic parameters. Other research applications for the DRD include study of all forms of motion sickness, human systems integration validation of helmet mounted displays, specify areas of neural activation during dynamic motion, developmental life support equipment test and evaluation, recreation of aircraft mishaps and dynamic effects of hypoxia on performance.

As the program manager for the Kraken, I am charged with developing this unique capability into an SD research and countermeasure test bed, targeting the most persistent aeromedical cause of fatal aircraft mishaps, one that strikes across platforms and services. The Kraken is housed and operated in the Naval Aerospace Medical Research Lab (NAMRL) at Naval Medical Research Unit-Dayton.

After accepting the $19-million device from the contractor in October 2016, our team of engineers, mathematicians, and technicians is pulling together to complete a long list of crucial tasks for development of this long-awaited, one-of-a-kind multiaxis acceleration research platform. No other research capability like the Kraken exists in the United States.

While primarily designed as a basic research tool, the Kraken was given a special feature called external motion control (EMC) mode, which allows for some advanced applied research exploration. We are very focused on developing the EMC mode, our man-in-the-loop mode where subjects can control the device from inside the capsule. This is of utmost interest for our team and the SD research program when it comes to the study of actual in-flight aviation SD. The device requires significant development effort because of the complexity of multi-axis motion control. The vehicle model must mesh without significant artifacts affecting subject perception. Working toward this goal, my team continues to demonstrate several advancements in algorithm development, system architecture, and communication with the Kraken's nerve center using the EMC mode.

Since completing staff maintenance and operator training in December 2016, the DRD team has switched to preoperational readiness and research preparation. To get the Kraken to initial operational capability, we will refine the organic maintenance program, complete an internal command safety assessment, man-rate the device, continue developing all axis motion washout algorithms, upgrade facilities, and work through various flight model integration and validation steps.

One of our key priorities is the maturation and preservation of the multidisciplinary core DRD team who function as the operators, developers, and maintainers. The current transition from Kraken caretakers to research device operators requires refinement of the operational model and training for specific device positions.

The author is strapped in prior to a test of a man-in-the-loop mode where subjects can control the device from inside the capsule. Photo by Megan Mudersbach

The Kraken team is working through various flight model integration and validation steps at Naval Medical Research Unit-Dayton. Photo by Megan Mudersbach

As a supplement to a small initial cadre of maintenance and engineering staff appointed to tame the Kraken, we have enlisted the help of the Office of Naval Research reserve engineering support program. This select group of seasoned naval aviators with engineering backgrounds provides valuable support in the areas of preoperational program development, preplanned product improvement prioritization, subsystem life cycle management, standard operating procedures development, and job qualification requirements program authorship.

What research is on deck for the Kraken? Naval Medical Research Unit-Dayton is partnering with two other organizations on three separate planned research efforts for fiscal year 2018 and beyond. The first project is a NASA-led study of the loss of aircraft state awareness in commercial aviation. The second and third projects are Defense Health Agency-funded, Joint Program Commision-5 (Aviation Mishap Prevention Working Group)-sponsored SD research studies. Dr. Henry Williams, senior research psychologist at Naval Medical Research Unit-Dayton, is the lead on both of the latter projects. Williams investigates pilot SD modeling and will be looking at the effects of helmet-mounted display format and spatial audio cueing on pilot performance and SD prevention.

About the author:

Capt. Folga is the Disorientation Research Device program manager and currently serves as the engineering and technical services department head at the Naval Medical Research Unit-Dayton.