Naval Medical Research Unit - Dayton
Wright-Patterson AFB, Ohio

Science Update

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NAMRU-D MISSION:

To maximize warfighter performance and survivability through premier aeromedical and environmental health research-delivering solutions to the field, the Fleet, and for the future.

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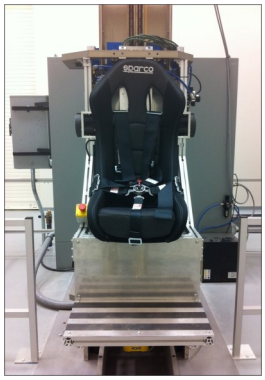
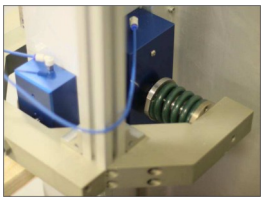
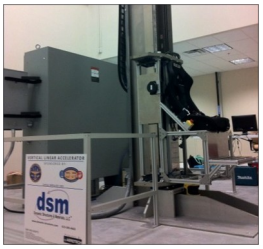
Vertical Linear Accelerator Device Provides Wide Range of Research Capabilities

Dr. Richard Arnold & Mr. Roy Dory







Adverse motion environments, such as those experienced during some shipboard and airborne operations, can present a variety of threats to warfighter health, safety, and mission effectiveness. Understanding specific effects of motion on health, safety, and performance enables researchers to develop better means to reduce negative consequences of such operational environments. A new research device housed at NAMRU-Dayton provides unique motion capabilities that will aid in research, and ultimately in mitigation of negative outcomes resulting from adverse motion environments.

The Vertical Linear Accelerator, or VLA, is capable of providing precisely controlled vertical acceleration forces to human research participants across a range of operationally relevant frequencies. For vestibular research on applications such as motion sickness, large amplitude accelerations in the range of 0-2 Hz are most effective. Oscillations in this range can be produced by VLA with accelerations of up to 1 G.

Although originally designed for such low frequency, high amplitude accelerations, the operating envelope of VLA far exceeds this range, providing a platform for research on the effects of higher frequency accelerations, such as those experienced by helicopter pilots and aircrew. Low amplitude vibrations produced by VLA in the range of 4-25 Hz mirror those produced by the main rotor blade passing frequencies of airframes currently flying in the DoD inventory. The device can produce even complex vibration profiles, simultaneously vibration reproducing waveforms generated by the main rotor, main rotor harmonics, and the tail rotor.

These capabilities, coupled with a reconfigurable subject seating platform affords great flexibility, for example allowing comparative testing of the vibration dampening characteristics of alternative rotary wing crew seating designs in a high fidelity testbed. This unique new device shows outstanding promise to help solve some of the most difficult aeromedical challenges experienced by US military pilots and aircrew.

UAS Workshop Held at NAMRU-Dayton

LT Stephen Eggan

On 8-9 November 2011 NAMRU-D hosted a workshop on Unmanned Aircraft Systems/Remotely Piloted Aircraft (UAS/RPA) Human Factors and Human Systems Integration (HF and HSI) research. The purpose of the workshop was to identify and address science and technology (S&T) research gaps related to a range of UAS/RPA HF/HSI research topics. To do this, the workshop brought together UAS subject matter experts from across the Navy, Air Force, and Army. Ten speakers presented overviews of past, present, and future UAS/RPA research efforts and introduced a broad spectrum of issues currently facing the UAS/RPA community.

Dr. Henry Williams from NAMRU-D and LtCol Anthony Tvaryanas from USAF 711 HPW provided broad overviews of current unmanned operations in the Navy and Air Force. CDR Joseph Cohn from ONR described new Navy S&T investments in unmanned systems. UAS personnel selection issues were addressed by several presenters, with Dr. Tom Carretta providing an Air Force perspective on the topic, and Drs. Rick Arnold and Phil Mangos discussing Navy perspectives. Recent Army research on mounted operator performance was presented by Mr. Jeremy Athey from US Army Aeromedical Research Lab. Training, particularly, embedded training was another issue that was identified as a significant challenge. Perspectives on training challenges were presented by LCDR Brent Olde and Ms. Melissa Walwanis from NAVAIR, and by Dr. Wink Bennett from USAF 711 HPW, who also provided attendees a tour of his RPA training research laboratory.

The workshop alternated presentations with discussion and working sessions. The 35 tri-service workshop attendees focused on identifying significant S&T gaps and challenges across a range of HF and HSI domains. A workshop proceedings report is being prepared by NAMRU-D that will capture the essence of the various presentations and discussions, generate a list of the identified S&T gaps, and provide recommendations for research to address the gaps. Specific topics that are addressed include: UAS selection, training, control station design, manpower and scheduling, manned/unmanned teaming, and motion sickness. The goal of the tri-service proceedings report is to provide a mechanism for information exchange, to enhance government agency coordination, and to provide guidance for future UAS human factors related research.

Dr. Henry Williams discussing UAS Human Factors issues.

Neuro-Otologic Test Center: NAMRU-D's Newest Capability

Mr. Roy Dory

Among NAMRU-D's most recent acquisitions is a Neuro-Otologic Test Center (NOTC), built by Neuro Kinetics, Inc., Pittsburgh, PA. The NOTC consists of a rotating barany chair capable of accommodating both dynamic off-vertical and off-axis rotations. The chair is located in a light-tight cylindrical enclosure onto which various visual stimuli can be projected and synchronized with the chair's motion. In addition to providing assessments of vestibular function, the NOTC affords NAMRU-D researchers the ability to investigate and isolate physiological mechanisms that contribute to fleet aeromedical problems, including motion sickness and associated interventions, and sensory interactions related to spatial orientation.

NAMRU-D Acquires JBAIDS Capabilities

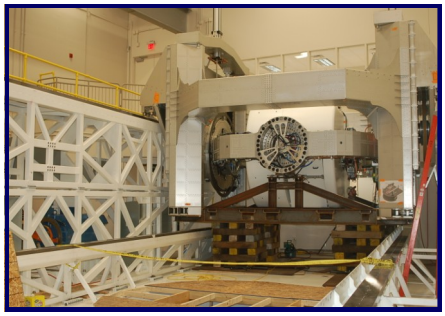
LT Andre Ntamack, MSC, USN

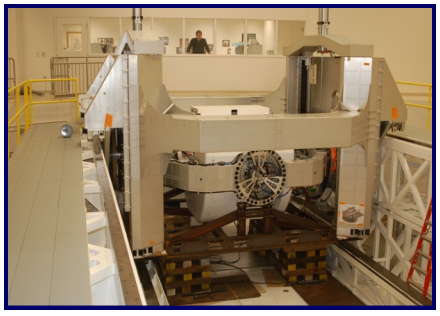
In May 2011 NAMRU-D acquired the Joint Biological Agent Identification and Diagnostic System (JBAIDS). JBAIDS is a reusable, portable, modifiable identification and diagnostic system that employs polymerase chain reaction (PCR) technology, capable of simultaneous, reliable identification of multiple biological threat agents of medical and operational significance. PCR is a technique that amplifies specific regions of DNA in order to produce enough DNA to be adequately tested. Specific DNA sequences are used as indicators of the presence of biological threats. The system enhances force health protection by providing the capability to determine appropriate treatment, risk and prevention measures in response to the presence of biological agents. JBAIDS is configured to support reliable and rapid identification of biological agents from various sources including clinical, environmental (e.g. air, water, food, entomology, veterinary), and forensic samples. Since biological threat agents (e.g. pathogens and toxins) can be intentionally or accidentally delivered to target areas anywhere in the theater(s) of operation affecting military readiness and effectiveness, JBAIDS provides rapid evaluation to protect military and civilian personnel.

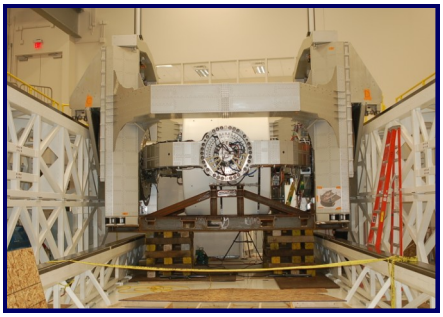
NAMRU-D is actively involved in research and operational endeavors involving the JBAIDS system. Dr. Karen Mumy, a microbiologist at NAMRU-D, has teamed with U.S. Air Force School of Aerospace Medicine (USAFSAM) researchers to validate the Food Analysis Transport System (FATS) sampling methodology developed to identify select agents that cause foodborne illness. Additionally, the 88th AMDS/SGPB Bioenvironmental Engineering Group has asked NAMRU-D to collaborate in generating exercise scenarios to test biological threat consequence management capabilities at Wright-Patterson Air Force Base.

Source: Idaho Technology Inc.: JBAIDS is composed of: 1) a thermocycler capable of automatically analyzing samples for the presence of targeted DNA sequences; 2) a rugged laptop preloaded with the easy-to-use JBAIDS instrument run and analysis software that will automatically collect, interpret data, and report the results.

Disorientation Research Device in its Final Construction Phase







DRD capsule and horizontal sled assembly, shown resting on the 50ft long main arm structure.

NAMRU-D participates in Pulmonary Health Workgroup

LT Pedro A. Ortiz

The 2nd Annual Military Operational Medicine Research Program (MOMRP) /Joint Program Committee for Military Operational Medicine (JPC5) In Progress Research Review (IPR) and Pulmonary Workgroup was held in Fort Detrick, Maryland 1-2 December 2011. The working group was attended by invited representatives and scientific researchers from the Army, Navy, Air Force, Department of Veterans Affairs (VA), National Institute for Occupational Safety and Health (NIOSH) and academia. The goal of the IPR/Workgroup was to address pulmonary health threats for deployed service members and prioritize future studies to target knowledge gaps and research solutions for pulmonary exposure to particulate matter and dust. Topics of discussion included "Assessment of Pulmonary Effects of Exposure to Southwest Asian Dusts" (Dr. Michael Morris, Brooke Army Medical Center and Dr. John Lewis, US Army Center for Environmental Health Research); "Biomarkers for Pulmonary Injury Following Deployment" (Dr. Richard Gelinas, Pacific North West National Laboratory); "Respiratory Symptoms and Conditions among Military Personnel Deployed to Iraq and Afghanistan: Findings from the Millennium Cohort Study" (Dr. Nancy Crum-Cianflone, Naval Health Research Center, Millennium Cohort); and "Computational Modeling Approach for Diagnosis of Pulmonary Disease" (Dr. Bora Sul, US Army Telemedicine and Advance Technology Research Center).

Al Asad, Iraq (April 27, 2005) - A massive sandstorm cloud rolls over Al Asad, Iraq just before nightfall. A sandstorm is strong dry wind blowing over the desert that raises and carries clouds of sand or dust often so dense as to obscure the sun and reduce visibility almost to zero. U.S. Marine Corps photo by Cpl. Alicia M. Garcia (RELEASED)

CDR Daniel Hardt of NAMRU-D provided a well-received presentation entitled "Compositional Analysis and Toxicology of a Simulated Burn Pit Plume", in which he presented data to prove the principle that characteristic smoke generated from the open burning of mixed solid waste can be transferred into animal exposure chambers with a high degree of efficiency. This important first step was necessary to proceed with future toxicological studies involving animals (this work was featured in NAMRU-D Fall 2011 Science Update). Overall, this meeting provided an opportunity for attendees to offer feedback about current Pulmonary Health research and identified the areas that will need to be addressed next.

NAMRU-D Scientists Play Central Role in F-22 Hypoxia Investigation

Dr. Jeffrey Phillips

NAMRU-Dayton continues to develop ties with its local Air Force partners in the MGen Harry G. Armstrong Complex. Recently the NAMRU-D hypoxia research group was invited to join the USAF Physiological Data Analysis Center (PDAC), composed mostly of scientists from the 711 Human Performance Wing (711 HPW). The PDAC was established by the Air Force Safety Investigation Board (SIB) to address the recent spate of hypoxia-like incidents in the F-22 Raptor community.

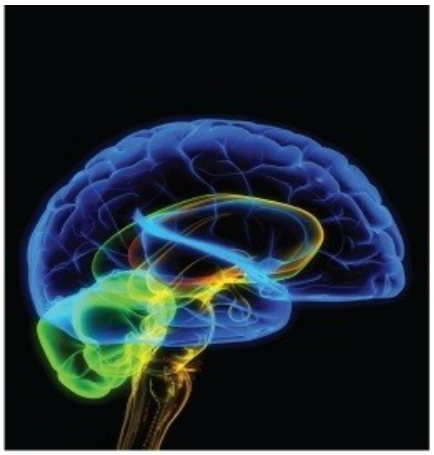
With aviation safety data indicating that hypoxia continues to be one of the top aeromedical risk factors, NAMRU-D scientists have increased their efforts related to in-cockpit hypoxia detection and mitigation over the past decade. NAMRU-D scientists bring unique expertise regarding the response of pulse oximetry to hypoxic hypoxia (low pressure/lack of oxygen) and have developed analytic methods to determine whether observed blood O_2 desaturation events are the result of hypoxic hypoxia, stagnant hypoxia (Gz forces), or other influences. Differentiation between types of hypoxia through pulse oximetry required analysis of human performance research where participants were subjected to a simulated hypoxic event using the Reduced Oxygen Breathing Device (ROBD) and simulated G-forces. This work will support the identification of a non-intrusive sensor durable enough for a flight environment. Future research will investigate cognitive and physiological effects under hypoxic conditions in an effort to allow for quick and accurate physiological detection of a pilot's compromised cognitive state. These and related issues are now being addressed across the services in a coordinated manner as a result of this new partnership.

F-22 Raptor in flight.

This work will benefit the Naval services as well, as knowledge and technologies developed in this effort can address similar problems that have been identified in aircraft such as the F/A-18. This collaboration between Navy and Air Force scientists represents the unique benefit of the BRAC-created Joint Center for Aeromedical Research, Education, and Training at Wright-Patterson.

Investigation of Potential Biomarkers of mTBI

Dr. Palur Gunasekar



Traumatic brain injury has been indentified as a significant health issue among military populations. Experts agree that proper management immediately following injury is a key to recovery. The injuries range from mild to moderate to severe. Ironically, it is the mild TBI (mTBI), or concussion, that is often the greatest culprit as it can easily go undetected. An important medical concern of the war is the potential long-term effects of mTBI, particularly from blast explosions, which represent the largest cause of military TBI during Operation Iraqi Freedom. Though body armor and protective equipment in combination with extraordinary performance of medical first responders have saved soldiers' lives, severe and mild forms of TBI can cause neurological problems with long-lasting symptoms,

Those who survive high pressure forces from blast explosions, such as this, may suffer from long lasting neurological problems

including memory loss and behavioral changes. The underlying cause of these types of injuries is not well defined. There may be a connection between brain injury and neuronal cell death. The lack of appropriate research models and insufficient experimental data has impeded understanding the pathophysiology of blast injury for diagnostics and mitigation purposes. NAMRU-D is conducting research to identify key biomarkers (i.e., specific molecules reflecting a biological response to injury) associated with blast injury. In a project funded by the Directed Medical Research and Development Program, researchers from NAMRU-Dayton is investigating an animal model where rats are exposed to a "blast" wave using air-driven pressure to mimic battlefield scenarios. The goal was to examine potential cognitive deficits, pathological effects and potential biomarkers of blast injury. In many pathological conditions, biomarkers have been proven to be a useful diagnostic tool. The study is nearing completion and researchers are hopeful a successful outcome will lead to other studies, including investigating the use of combination therapies as a mitigation strategy.

NAMRU-D Presentations & Products

Arnold, R. D. (2011, November). *Crew selection testing for naval unmanned aircraft systems.* Presentation given at the UAS/RPA Human Factors & Human Systems Integration Research Workshop, Dayton, OH.

Eggan, S. M. (2011, November). UAS workshop held at NAMRU-Dayton. *Call Signs: United States Naval Aerospace Experimental Psychology Society, 2*(3), 14-15.

Hardt, D. J., James, R. A., Gut, Jr., C. P., & Gargas, M. L. (2011). *Health risk assessment of women in submarines: Reproductive and developmental toxicity evaluation of major submarine atmosphere components (CO, CO_2 and O_2) in rats (Rattus norvegicus) – Phase I (Range finding study)* (Report No. ADA550977). Retrieved from http://handle.dtic.mil/100.2/ADA550977

Hardt, D. J., James, R. A., Gut, Jr., C. P., McInturf, S. M., & Gargas, M. L. (2011). *Health risk assessment of women in submarines: Reproductive and developmental toxicity evaluation of major submarine atmosphere components (CO, CO_2, and O_2) in rats (Rattus norvegicus) – Phase II (Neurological and reproductive performance study)* (Report No. NAMRU-D-12-03).

Mumy, K. L. (2011, Novmeber). *In vitro toxicology methods: Evaluation of the occupational risks from jet fuel*. Presentation given at Toxicology Perspectives on Aviation Turbine Fuel from Alternative Feedstocks, Dayton, OH.

Phillips, J. B., Chernyshenko, O. S., Stark, S., Drasgow, F., Phillips, H. L. (2011). Development of scoring procedures for the performance based measurement (PBM) test: Psychometric and criterion validity investigation (Technical Report No. NAMRU-D-12-10).

Phillips, H., Foster, C., Arnold, R. (2011, November). UAS operator selection: A case for change. *Call Signs: United States Naval Aerospace Experimental Psychology Society, 2*(3), 5-8.

Williams, H. P. (2011, November). Some general UAS human factors issues. Presentation given at the UAS/RPA Human Factors & Human Systems Integration Research Workshop, Dayton, OH.

Commanding Officer's Corner

Captain Keith Syring, USN
Commanding Officer

By CAPT Keith Syring

For the past few years much of the NAMRU-D staff have necessarily kept one eye on BRAC relocation and realignment issues, and the other on sustainment of our research mission, a balancing act they've managed remarkably well. Now with BRAC concluded, our full attention and effort can be focused on the advancement of the research mission. This is being accomplished with a renewed focus on capability development, both through internal growth and external collaboration.

Our researchers are currently pursuing a range of inter-agency and inter-service partnerships. For example, researchers from the Aeromedical Research Directorate recently visited the Ames Research Center to meet with NASA colleagues on such topics of mutual interest as fatigue countermeasures, vision research, and the effects of high-G stress and whole body vibration. Likewise, the Environmental Health Effects Research Directorate is preparing for collaborative efforts with the Army to study the toxic effects of munitions, and will also be continuing current research with the Air Force regarding the combined effects of jet fuel and sound exposure. Additional advancement of inter-service collaboration was made in November when NAMRU-D hosted a UAS / RPA Human Systems Integration Workshop where representatives from the Navy, Air Force, and Army addressed cross-service issues of concern for UAS human factors-related research.

In addition to developing external collaborations, NAMRU-D's in-house research capabilities continue to advance. Recent upgrades to the Vertical Linear Accelerator (VLA), acquisition of the Joint Biological Agent Identification and Diagnostic System (JBAIDS) and the Off-Vertical Rotating Chair (OVR), and the long-awaited delivery of the capsule for the new Disorientation Research Device (DRD) all serve to improve our in-house research capabilities. These improved capabilities will ultimately strengthen NAMRU-D's standing as a leader in aeromedical and environmental health effects research, and, more importantly, enhance our ability to effectively accomplish our mission in support of the operational forces.

None of these advancements and opportunities would have been possible without the exceptional commitment of the NAMRU-D staff to the success of this new command, and I am extremely impressed and proud of their accomplishments as our first full year as a command concludes. I have every confidence that the next year will be even more impressive.

Taking the Helm of Navy Medicine's Aeromedical & Environmental Health Research

NAMRU - Dayton

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