SAFE
Association

2018 SAFE SYMPOSIUM

TECHNICAL PROGRAM

October 15 – October 17

Grand Sierra Resort, Reno, NV

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SAFE 2018 PROGRAM SCHEDULE

Monday

Time	EVENT
6:45 - 7:30	Refreshment Break
Location	Grand Salon
7:30 - 8:00	Welcome
8:00 - 8:45	Guest #1 (Brigadier General Edward L. Vaughan)
8:45 - 9:15	Guest #2 (Colonel Samantha Weeks)
9:15 - 9:45	Awards
Location	Reno Ballroom
Moderator	Dr. Demelza Poe/Mr. Edgar A Poe III
9:45 - 10:15	Refreshment Break
Location	Grand Salon
10:15 - 11:00	Guest #3 - Dare To Dream (Mr. Mike Lightner)
11:00 - 11:45	Guest #4 - Mr. Doug Downey - The Next level of Safety - Survivors Story
Location	Reno Ballroom
Moderator	Dr. Demelza Poe/Mr. Edgar A Poe III
11:45 - 1:00	Lunch/Exhibit Time
Location	Exhibit Hall
1:00 - 2:00	Safety Centers Brief - Air Force (Mr. Ruddell) / Navy (CDR Littel)
2:00 - 3:00	Q&A Panel - Female PFE Challenges (CMSgt Capaldi / Maj Tevebaugh / LT Alford)
Location	Reno Ballroom
Moderator	Dr. Demelza Poe/Mr. Edgar A Poe III
3:00 - 3:30	Refreshment Break
Location	Exhibit Hall
3:30 - 5:00	Tri-Service Science & Technology Panel
Location	Reno Ballroom
Moderator	Mr. Glenn Paskoff
5:15 - 5:45	Author/Moderator Briefing
Location	Tahoe
Moderator	Mr. Glenn Paskoff
5:00 - 7:00	End of Day Reception/Exhibit Time
Location	Exhibit Hall
Sponsor	East/West Industries

Tuesday

Time	EVENT			
7:30 - 8:15	Coffee/General Membership			
Location	Tahoe			
Moderator	Mr. Edgar A Poe III			
8:15 - 8:30	Coffee			
Location	Grand Salon			
8:30 - 10:00	ALSS (Hydration)	Biomechanics (Crashworthy)	Hearing Protection	Anthropometry 1
Location	Carson 1/2	Carson 3/4	Crystal 1/2	Crystal 3/4
Moderator	Mike Jaffee	Nathan Wright	Joe Essex	Lori Brattin-Basham
10:00 - 10:30	Coffee - Break in Exhibit Area			
Location	Exhibit Hall			
10:30 - 12:00	Oxygen	Biomechanics (Injury 1)	Mishap Investigation	Anthropometry 2
Location	Carson 1/2	Carson 3/4	Crystal 1/2	Crystal 3/4
Moderator	Rachael Ryan	John Buhrman	Keith King	Joseph Parham
12:00 - 1:30	Lunch			
Location	Exhibit Hall			
1:30 - 3:00	Oxygen	Biomechanics (Modeling)	ALSS (Parachutes)	Anthropometry 3
Location	Carson 1/2	Carson 3/4	Crystal 1/2	Crystal 3/4
Moderator	Steve Kim	Joseph Pellettiere	Wally Simmons	Dan Mountjoy
3:00 - 3:30	Coffee - Break in Exhibit Area			
Location	Exhibit Hall			
3:30 - 5:00	ALSS (Survival)	Biomechanics (Rotary)	CAD/PAD	Anthropometry 4
Location	Carson 1/2	Carson 3/4	Crystal 1/2	Crystal 3/4
Moderator	Sarah Day	Lindley Bark	Bob Hastings	Jennifer Whitestone
5:00 - 6:45	End of Day Reception/Exhibit Time			
Location	Exhibit Hall			

Wednesday

Time	EVENT			
7:00 - 7:45	Coffee			
Location	Grand Salon			
7:45 - 9:15	In-Flight Physiologic Challenges	Biomechanics	ALSS	Training
Location	Carson 1/2	Carson 3/4	Crystal 1/2	Crystal 3/4
Moderator	Lloyd Tripp	William Glass	Charlie Dixon	Mitch Tindall
9:15 - 9:30	Coffee			
Location	Grand Salon			
9:30 - 11:00	Oxygen	Biomechanics (Injury 2)	ALSS (Clothing)	Safety/Injury
Location	Carson 1/2	Carson 3/4	Crystal 1/2	Crystal 3/4
Moderator	Christine Brown	Adrienne Madison	Dana Anton	John Plaga
11:00 - 11:15	Break			
Location	Exhibit Hall			
11:15 - 12:15	ALSS (Solutions - Head to Toe)	U.S. Air Force Rapid Acquisition Initiatives	Technology Integration	Systems Approach to Engineering
Location	Carson 1/2	Carson 3/4	Crystal 1/2	Crystal 3/4
Moderator	Mike Jaffee	Jennifer Farrell	Fillip Behrman	Eric Schwartz
12:15 - 1:15	Lunch/Exhibit Time			
Location	Exhibit Hall			
1:15 - 2:15	NAVAIR Systems Engineering Transformation (Mr. Jaime Guerrero)			
Location	Reno Ballroom			
Moderator	Ms. Maria Thorpe			
2:15 - 2:30	Break			
	Grand Salon			
2:30 - 3:00	Acquisition PM Brief (USAF) - Mr. Varcarcel			
3:00 - 3:30	Acquisition PM Brief (USN) - CAPT David Padula			
Location	Reno Ballroom			
Moderator	Mr. Edgar A Poe III			
3:30 - 3:45	Closing/Award			
Location	Reno Ballroom			
Moderator	Mr. Edgar A Poe III			
4:00 - 7:00	Industry Day			
Location	(varies)			

For the most up-to-date session information, download the new SAFE Symposium app!

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MONDAY: 7:30 A.M. – 9:45 A.M.
WELCOME/GUEST #1/GUEST #2/AWARDS
LOCATION: GRAND SALON
MODERATOR: Dr. Demelza Poe / Mr. Edgar A. Poe III

BRIGADIER GENERAL EDWARD L. VAUGHAN, UNITED STATES AIR FORCE

Brig. Gen. Edward L. Vaughan is the Air National Guard Assistant to the Director of Training and Readiness, Deputy Chief of Staff for Operations, Headquarters U.S. Air Force, Washington, D.C. The directorate, encompassing seven divisions and the Air Force Agency for Modeling and Simulation, is responsible for policy, guidance and oversight of Air Force operations. General Vaughan also serves as the Air Force lead the Air Force Physiological Episodes Action Team.

General Vaughan completed Reserve Officer Training Corps at Rensselaer Polytechnic Institute and received his commission as honor graduate from ANG's Academy of Military Science. He previously served in leadership roles at the squadron, group, wing and higher headquarters levels in both the mobility and combat air forces. General Vaughan commanded the 156th Airlift Wing, Puerto Rico, and Detachment 1 of the 13th Air Expeditionary Group (formerly the 13th Expeditionary Support Squadron), Antarctica.

In addition to his military work, General Vaughan has extensive private sector management and technical experience, including manufacturing and test engineering, program management, marketing, and small business operations. General Vaughan is a command pilot and prior navigator with more than 2,700 flying hours in fighter and mobility aircraft and over 200 combat hours. His contingency experience includes Operations Iraqi Freedom, Tomodachi, Southern Watch, Coronet Oak, Enduring Freedom, Uphold Democracy, Katrina, Deep Freeze and Maria Relief Puerto Rico. General Vaughan is a frequent speaker on leadership, aviation safety, disruptive innovation and Airpower. He holds life-memberships in the Air Force Association, Red River Valley Fighter Pilots Association, Old Antarctic Explorers Association and Order of Daedalians.

EDUCATION

1991 Bachelor of Science degree in mechanical engineering, Rensselaer Polytechnic Institute, Troy, NY
1997 Squadron Officers School, Distinguished Graduate, Maxwell Air Force Base, Ala.
2002 Air Command and Staff College, by correspondence
2003 Joint Air Commanders Course, Air Warfare Center, Nellis AFB, Nev.
2009 Master's degree in strategic studies, Academic Distinction, Air War College, Maxwell AFB, Ala.
2010 Joint Air Operations Planning Course, LeMay Center for Doctrine, Maxwell AFB, Ala.
2012 Joint Faculty Development Course, Air War College, Maxwell AFB, Ala.
2012 Joint Faculty Development Course, Joint Forces Staff College, Norfolk Naval Air Station, Va.
2015 National Security Studies Program, George Washington University, Washington, D.C.
2017 Director of Mobility Forces Course, USAF Expeditionary Operations School, Hurlbut AFB, Fla.
2017 Joint Task Force Commander Training Course, USNORTHCOM, Peterson AFB, Colo.

ASSIGNMENTS

1. April 1992–February 1993, specialized undergraduate navigator training, Mather Air Force Base, CA
2. February 1993–April 1993, student navigator, C-130 Replacement Training Unit, Little Rock AFB, AK
3. May 1993 – August 1995, Tactical Navigator, LC/C-130, 139th Airlift Squadron, Stratton Air National Guard Base, NY
4. August 1995 – August 1996, undergraduate pilot training, Columbus AFB, Miss.
5. August 1996 – December 1996, student pilot, C-130 Replacement Training Unit, Little Rock AFB, AK
6. December 1996 – March 1998, Airlift Pilot, LC/C-130, 139th Airlift Squadron, Flying Executive Officer, C-130H Tactical Airdrop Pilot, 109th Operations Group, Stratton ANGB, Scotia, N.Y.
7. April 1998 – July 1999, Fighter Pilot Upgrade, F-16 Replacement Training Unit, Luke AFB, Ariz.
8. July 1999 – December 2000, F-16 Fighter Pilot, Squadron Scheduler; Bomb Range Control Officer; Squadron Training Officer, 138th Fighter Squadron, Hancock Field, Syracuse, N.Y.

9. December 2000 – March 2002, F-16 Instructor Fighter Pilot, Wing Plans Officer; Standardization-Evaluation Liaison Officer, 163rd Fighter Squadron, Fort Wayne International Airport, Ind.
10. March 2002 – February 2005, Chief of Wing Safety, Instructor Fighter Pilot, 122nd Fighter Wing, Fort Wayne IAP, Ind.
11. February 2005 – July 2008, Division Chief, Aviation Safety/Deputy Director, Safety, National Guard Bureau, Arlington, Va.
12. July 2008 – October 2009, student, Air War College, then Deputy Director, USAF Blue Horizons, Center for Strategy and Technology, Maxwell AFB, Ala.
13. October 2009 – September 2011, Chief, Joint Operations and Plans; Joint Task Force–Support Forces Antarctica, U.S. Pacific Command, JB Pearl Harbor-Hickam, Hawaii.
14. October 2009 – September 2011, Commander, Forward and Garrison, Detachment 1, (formerly 13th Expeditionary Support Squadron), 13th Air Expeditionary Group, JTF-Support Forces Antarctica, McMurdo Station, Antarctica
15. September 2011 – October 2013, ANG Advisor to the Commander and President, Air University, Maxwell AFB, Ala.
16. November 2013 – October 2015, National Director of Safety, National Guard Bureau, Headquarters USAF, the Pentagon, Washington, D.C.
17. October 2015 – June 2017, Commander, 156th Airlift Wing, Muñiz ANGB, Carolina, Puerto Rico
18. June 2017 – July 2018, Director for Integration – Air National Guard, Office of Reserve Integration, Office of the Secretary of Defense, the Pentagon, Washington, D.C.
19. August 2018 – present, ANG Assistant to the Director for Readiness and Training and Lead for the Air Force Physiological Episodes Action Team, Headquarters USAF, the Pentagon, Washington, D.C.

SUMMARY OF JOINT ASSIGNMENTS
1. October 2009 – September 2011, Chief, Joint Operations and Plans; Joint Task Force–Support Forces Antarctica, United States Pacific Command, JB Pearl Harbor-Hickam, Hawaii, as a lieutenant colonel
2. June 2017 – July 2018, Director for Integration, Office of Reserve Integration, Office of the Secretary of Defense, the Pentagon, Washington, D.C. as a colonel

FLIGHT INFORMATION
Ratings: command pilot
Flight Hours: more than 2,700, including over 200 combat hours
Aircraft Flown: A-10C, F-16B/C/D/F, C-130E/H1/H2/H3, WC-130, LC-130, AT-38, T-38, T-37, T-43, T-3A

MAJOR AWARDS AND DECORATIONS
Legion of Merit
Defense Meritorious Service Medal
Meritorious Service Medal with two oak leaf clusters
Air Medal
Aerial Achievement Medal with two oak leaf clusters
Joint Service Commendation Medal
Air Force Commendation Medal with oak leaf cluster
Antarctica Service Medal
Iraq Campaign Medal with service star

OTHER ACHIEVEMENTS
Chief of Staff of the Air Force Individual Safety Trophy (USAF level), 2007
Inductee to the Air Force Safety Hall of Fame (USAF level), 2008
Co-inventor, "USAF method/apparatus for mitigating aircrew fatigue", Patent #US20110071873A1, 2011

EFFECTIVE DATES OF PROMOTION
Second Lieutenant April 9, 1992
First Lieutenant April 15, 1994
Captain April 15, 1996
Major April 13, 2001
Lieutenant Colonel May 4, 2005
Colonel, May 24, 2012
Brigadier General, Aug. 1, 2018

(Current as of August 2018)

COLONEL SAMANTHA WEEKS, UNITED STATES AIR FORCE

Colonel Samantha Weeks is the Commander, 14th Flying Training Wing, Columbus Air Force Base, Mississippi. The 14th FTW conducts Specialized Undergraduate Pilot Training for U.S. Air Force and allied officers, as well as tactical training for Afghan and Lebanese pilots and aircraft maintainers in the A-29 Super Tucano at Moody AFB, Georgia. The wing is composed of 244 aircraft flying more than 55,000 sorties and 77,000 hours per year while training over 400 pilots and combat system operators annually. Colonel Weeks manages an operations and maintenance budget of $106 million with capital assets exceeding $2.3 billion.

Colonel Weeks received her commission from the United States Air Force Academy in 1997. After graduating from Specialized Undergraduate Pilot Training, she flew the F-15C where she supported Operations Northern and Southern Watch. She was assigned as an Air Force Fellow to the Secretary of the Air Force's Office of Legislative Liaison, Washington D.C., and was chosen for a Lorenz Fellowship in Colorado Springs. She was also a demonstration pilot in the United States Air Force Aerial Demonstration Squadron, the Thunderbirds. Prior to this assignment, she was the Commander, 57th Adversary Tactics Group, Nellis AFB, Nevada.

Colonel Weeks is a command pilot with more than 2,200 flying hours including 105 combat hours in support of Operations Northern Watch and Southern Watch, and has flown in support of Operation Noble Eagle.

EDUCATION
1997 Bachelor of Science degree in Biology, U.S. Air Force Academy, Colorado Springs, Colo.
2002 Squadron Officer School, Maxwell AFB, Ala.
2005 Masters in Human Relations, University of Oklahoma
2008 Air Command and Staff College, by correspondence
2009 Air Force Fellows, Strategic Policy Intern Program, Washington, D.C.
2010 Master of Philosophy, Military Strategy, School of Advanced Air and Space Studies, Maxwell AFB, Ala.
2014 Air War College, by correspondence
2016 Doctoral dissertation on leader and leadership preparation, Stephen R. Lorenz Fellowship

ASSIGNMENTS
1. August 1997–November 1997, Athletic Instructor, Athletic Department, U.S. Air Force Academy, Colo.
2. November 1997–October 1998, Student Pilot, Specialized Undergraduate Pilot Training, Laughlin AFB, Texas
3. April 1999–October 1999, Student Pilot, F-15C initial training, Tyndall AFB, Fla.
4. October 1999–March 2003, F-15C pilot, 4-ship flight lead, Mission Commander, 94th Fighter Squadron, 1st Fighter Wing, Langley AFB, Va.
5. May 2003–May 2004, Joint Terminal Attack Controller and Assistant Director of Operations, 607th Air Support Operations Group, Osan Air Base, South Korea
6. July 2004–July 2006, Flight Commander and Instructor Pilot, 12th Fighter Squadron, 3rd Wing, Elmendorf AFB, Alaska
7. October 2006–November 2008, #6: Opposing Solo, #5: Lead Solo, F-16 Instructor Pilot, Chief of Training, Aircrew Flight Equipment Officer, and Budget Officer, U.S. Air Force Aerial Demonstration Squadron, the Thunderbirds, Nellis AFB, Nev.
8. November 2008–July 2009, Chief of Staff, United States Air Force Warfare Center, Nellis AFB, Nev.
9. August 2009–July 2010, Air Force Fellows-Strategic Policy Intern, Washington, D.C.
10. July 2010–June 2011, Student, School of Advanced Air and Space Studies, Maxwell AFB, Ala.
11. September 2011–May 2012, Chief of Safety, 8th Fighter Wing, Kunsan Air Base, South Korea

12. May 2012–June 2013, Commander, 8th Operations Support Squadron, Kunsan Air Base, South Korea
13. June 2013–July 2015, Deputy Executive Assistant and Executive Assistant to the Commander, North American Aerospace Defense Command and U. S. Northern Command, Colorado Springs, Colo.
14. July 2015–August 2016, Air Force Fellow-Lorenz Fellowship, Colorado Springs, Colo.
15. August 2016–August 2018, Commander, 57th Adversary Tactics Group, Nellis AFB, Nev.
16. August 2018–present, Commander, 14th Flying Training Wing, Columbus AFB, Miss.

FLIGHT INFORMATION
Rating: Command Pilot
Total Flight Hours: 2,200 with 105 Combat Hours
Aircraft Flown: F-16, F-15C, T-38C

MAJOR AWARDS AND DECORATIONS
Defense Superior Service Medal
Air Force Meritorious Service Medal with two oak leaf clusters
Aerial Achievement Medal
Air Force Commendation Medal with oak leaf cluster
Joint Meritorious Unit Award with oak leaf cluster
Air Force Outstanding Unit Award with silver and bronze oak leaf clusters
Air Force Organizational Excellence Award
Combat Readiness Medal with two oak leaf clusters

EFFECTIVE DATES OF PROMOTION
Second Lieutenant - May 28, 1997
First Lieutenant - May 28, 1999
Captain - May 28, 2001
Major - Dec. 1, 2006
Lieutenant Colonel - Dec. 1, 2011
Colonel - June 1, 2016

(Current as of August 2018)

MONDAY: 10:15 A.M. – 11:00 A.M.
GUEST #3 – DARE TO DREAM (MR. MIKE LIGHTNER)
LOCATION: RENO BALLROOM
MODERATOR: Dr. Demelza Poe / Mr. Edgar A. Poe III

As a Chief Master Sergeant in the United States Air Force, with over 30 years of service, Mike Lightner led and managed over 5,000 people stationed all around the globe. It was during this period, he discovered his passion for the growth and development of others. He also discovered there were certain things that successful leaders did that other leaders did not do. Now retired, Mike has dedicated his life to helping others grow and develop so they can reach their full potential. As an author, he published the book LEAD BOLD ~ LEAD STRONG ~ LEAD WELL: 9 Proven Leadership Secrets Anyone Can Learn and Apply, where he shares many of the success lessons he learned while serving in the military. As a John Maxwell Certified Coach, Teacher and Speaker, he offers workshops, seminars, keynote speaking, and coaching, aiding with personal and professional growth through study and practical application of John's proven leadership methods.

MONDAY: 11:00 A.M. – 11:45 A.M.
GUEST #4 – THE NEXT LEVEL OF SAFETY (A SURVIVOR'S STORY)
LOCATION: RENO BALLROOM
MODERATOR: Dr. Demelza Poe / Mr. Edgar A. Poe III

INTRODUCTION: Taking safety to the next step is similar to the scientific leap of taking manned space exploration well beyond the reaches of the moon. The variables involved with both initiatives have long been hypothesized as manageable and yet neither has occurred this far into the 21st century. Systems, technology, training, and automation have nearly eliminated all platform (pick one) catastrophic failures this side of the machine with the human operator involved. Redundancy in the aforementioned staples of high risk environments make most failures a simple afterthought with the completion of a respective checklist – if the failure meets the threshold of notifying the human operator at all.

So, what is left to perfect in the application of safety in high risk environments? The simple answer is the human operator – not just at the controls of the machine, but at every touchpoint in the machine's lifecycle. The more difficult answer is the "why" at the individual level of performance – good or bad. Traditionally, the "why" is associated with root cause analysis. However, the "why" we're going to uncover is the link in the safety chain that few have taken the time to look at closely through the human factor lens. Because ultimately, only the individual has the ability to look introspectively and answer that ultimate question.

Mr. Doug Downey, President, Convergent Performance, LLC and Mr. E. Poe, III, Tedgar Consulting, Inc.

Doug Downey is a graduate of the U.S. Air Force Academy and served over 24 years as a college instructor, Combat Logistician, Commander, and as a Fighter Pilot qualified in the F-16 Viper and F-117 Stealth. He served as an instructor pilot, functional check pilot, and air show demonstration pilot. He is a career Safety Officer qualified in Crew Resource Management, Safety Management Systems, Root Cause Analysis and accident investigations with experience as an Investigator, Analyst, Chief of Safety, and Aircraft Mishap Board President. He also served as an Advance Agent for Air Force One and President G.W. Bush for five years, and later as a Diplomat to Pakistan. In Pakistan he directly consulted the Government on the redesign of F-16 tactical operations, national airspace use, and safety program management and enterprise risk management for the entire Pakistani Air Force.

Doug joined the Convergent Performance team in 2014, and brought with him a breadth of experience in leadership, training, risk mitigation, safety management systems, and process improvement. He has a Bachelor's Degree from the U.S. Air Force Academy and a Master's Degree in Business Administration with an emphasis in Aviation from Embry-Riddle Aeronautical University. In addition to instructing cadets how to fly T-52s (Diamond) and T-53s (Cirrus), he was the Deputy Director of Cadet Training & Education responsible for all curriculum development and strategic planning of assessment and tactical training of over 4,000 cadets.

Doug is recognized as an industry expert in Risk Management, Safety Management Systems, Safety Program Management, and Aviation Accident and Mishap Investigations. He is a successful author of industry research studies and periodical columns. He also is certified by the International Society of Safety Professionals (ISSP) as a Registered Safety Professional.

MONDAY: 1:00 P.M. – 2:00 P.M.
U.S. AIR FORCE AND U.S. NAVY SAFETY CENTERS
LOCATION: RENO BALLROOM
MODERATOR: Dr. Demelza Poe / Mr. Edgar A. Poe III

INTRODUCTION: This panel provides an update from the Air Force and Navy Safety Centers on current trends in aviation mishaps and projections for future strategies to protect the aviator.

A question and answer session will follow after each Service presentation.

Presenters include:

UNITED STATES AIR FORCE – MR. MARK RUDDELL, U.S. Air Force Safety Center

Mr. Ruddell has worked for 13 years as an Aerospace Engineer at the Headquarters, Air Force Safety Center, investigating mishaps for all types of aircraft flown by the US Air Force. Mark focuses in the areas of structures and mechanical systems, with special emphasis on escape systems, crashworthiness, and survivability.

Prior to working for the Air Force, Mark worked for 17 years for the US Navy providing engineering support for Depot level aircraft maintenance and sustainment. Mr. Ruddell holds a B.S. degree in Aircraft Maintenance Engineering from Parks College of St. Louis University.

UNITED STATES NAVY – CDR MSC COREY LITTEL, U.S. Navy Safety Center

CDR Corey Littel graduated from Keene State College with a BS is Sports Medicine in 1994, and from Old Dominion University with a MS Ed in Sports Medicine in 1996. He was accepted into the Navy's Medical Service Corps as a Lieutenant Junior Grade in November of 1998. Following Officer Indoctrination School in Newport, RI, he was assigned to Naval Aerospace Medicine Institute under instruction. He completed both the Aerospace Medicine academic and flight training curriculum requirements in July 1999, and was designed Naval Aerospace Physiologist #240.

His assignments include:

Instructor, Aviation Survival Training Center, MCAS Cherry Point, NC
Aeromedical Safety Officer, Fighter/Strike Fighter Wing Atlantic
Crew Systems Department Head, Air Test & Evaluation Squadron Two-Zero
Branch Head, Life Support Systems, Naval Air Warfare Center-Aircraft Division
Director, Aviation Survival Training Center, Patuxent River MD
Chief of Staff, Naval Test Wing Atlantic
Program Director, Warfighter Performance, Navy Expeditionary Combat Command
Deputy Force Surgeon, Navy Expeditionary Combat Command & Aerospace & Operational Physiologist, Naval Safety Center

CDR Littel is a 2015 graduate of the Naval Postgraduate School's Executive Master of Business Administration program, 2011 graduate of Naval War College's Joint Professional Military Education program and 2000 graduate of the School of Aviation Safety's Aviation Safety Officer course. He is board certified in Aerospace Physiology by the Aerospace Medical Association. He was screened and selected into the Defense Acquisition Corps in 2007 and holds Level II DAWIA certification in Program Management, Systems Engineering and Test & Evaluation. He also holds secondary subspecialty codes in Financial Management – Defense Focused (3100) and Human Systems Integration (4600).

He was selected as the Naval Aerospace Physiologist of the Year in 2002 by BUMED and the Naval Aerospace Physiology Program Planning Committee, and as the SAFE Association General Spruance

Award recipient in 2005 and again in 2012 for outstanding contributions to safety through education. His personal decorations include Meritorious Service Medal (three awards), Navy and Marine Corps Commendation Medal (four awards), Navy Achievement Medal and multiple campaign and unit awards.

He currently resides in Chesapeake, VA with his wife Kimberly and daughters Gabrielle, Jessica and Adelynn.

MONDAY: 2:00 P.M. – 3:00 P.M.
Q & A PANEL – FEMALE PILOT FLIGHT EQUIPMENT (PFE) CHALLENGES
LOCATION: RENO BALLROOM
MODERATOR: Dr. Demelza Poe / Mr. Edgar A. Poe III

INTRODUCTION: Pilot Flight Equipment (PFE) has historically been designed solely for male aircrew. While the impact with regard to flight suits for female aircrew may only result in unflattering attire, when it comes to certain clothing and equipment the consequences can result in degraded performance of the aircrew (e.g. fatigue, G-tolerance), decreased performance of the equipment (e.g. O_2 mask, helmet), and potentially life-threatening conditions such as an ill-fitting torso harness. This panel will discuss some of the challenges that female aircrew have faced in addressing this issue and what additional progress needs to be made.

PANELISTS:

U.S. AIR FORCE - Dana L. Capaldi, CMSgt, 514 Air Mobility Wing Command Chief, Functional Manager, Aircrew Flight Equipment

Chief Master Sergeant Dana L. Capaldi is currently assigned to the 514th Air Mobility Wing, Joint Base McGuire-Dix-Lakehurst, New Jersey where she serves as the Command Chief Master Sergeant. In this capacity, she is the Senior Enlisted Leader for approximately 2,000 enlisted personnel assigned to the wing. Chief Capaldi advises the 514th Air Mobility Wing Commander and senior staff on matters of health, welfare and morale of the Airmen.

Previously, Chief Master Sergeant Dana L. Capaldi served as the A3 Chief Enlisted Manager responsible for over 5000 Airman across AFRC. Chief Capaldi also was the Headquarters Air Force Reserve Command Aircrew Flight Equipment Functional Manager, responsible for managing Aircrew Flight Equipment resources, long-range programming and procurement, equipment maintenance, and program sustainment processes. Chief Capaldi determined current and future Aircrew Flight Equipment manning requirements for flying units at wing, group, and squadron locations throughout the command meeting combat objectives. She established and evaluated appropriate skill qualifications for both war and peacetime standards. She also forecasted annual Aircrew Flight Equipment operations and maintenance, aircrew chemical defense budget requirements, further analyzed funding support rates and execution trends and the annual AFE cost per flying hour target rates.

Chief Capaldi is a native of Centralia, Illinois; she graduated from Centralia High School in 1990 and entered the United States Air Force in August 1990. Capaldi has deployed numerous times in support of Operations DESERT STORM, DENY FLIGHT, IRAQI FREEDOM, and ENDURING FREEDOM. Chief Capaldi served as NCOIC, and superintendent at both the squadron, group, and MAJCOM level before becoming the Headquarters, AFRC Aircrew Flight Equipment Functional Manager and CEM.

EDUCATION
1995 Airman Leadership School, Resident, McConnell AFB, KS
1998 Associates Degree from Community College of the Air Force, Survival and Rescue

1998 Associates Degree from Butler County Community College, Eldorado, KS, Cum Laude
2001 Non-commissioned Officer Academy, Resident, McGee Tyson ANG, TN
2006 Bachelor of Arts, Southwestern University, Winfield, Kansas, Magna Cum Laude
2010 USAF Senior Noncommissioned Officer Academy, Resident, Maxwell/Gunter AFB, AL
2011 Senior Enlisted Joint Professional Military Education Course, by correspondence
2016 Reserve Components National Security Course, Washington, D.C
2017 Contingency Wartime Planners Course, Maxwell AFB, AL
2018 Chief Leadership Course, Maxwell/Gunter AFB, AL

ASSIGNMENTS

1. Aug 1990-Sept 1990, trainee, Basic Military Training, Lackland AFB, TX
2. Sept 1990-Oct 1990, student, Aircrew Life Support, Chanute AFB, Illinois
3. Oct 1990-July 1993, Aircrew Life Support, 305th Air Refueling Wing, Grissom AFB, IN
4. July 1993-Aug 1994, Aircrew Life Support, 380th Air Refueling Wing, Plattsburgh AFB, NY
5. Aug 1994-Dec 1995, Assistant NCOIC, Aircrew Life Support, 22d Air Refueling Wing, McConnell AFB, KS
6. Dec 1995-Oct 2001, Lead Trainer, Aircrew Life Support, 184th Bomb Wing, McConnell AFB, Kansas
7. Oct 2001-Dec 2003, Aircrew Life Support, 126th Air Refueling Wing, Scott AFB, Illinois
8. Dec 2003- Sept 2007, NCOIC Aircrew Life Support, 931st Air Refueling Group, McConnell AFB, KS
9. Sept 2007- Oct 2010, Superintendent, Aircrew Flight Equipment, 916th Air Refueling Wing, Seymour Johnson AFB, NC
10. Oct 2010 – May 2016, Superintendent, Aircrew Flight Equipment, 413th Flight Test Group, Robins AFB, GA
11. May 2016- February 2018; Superintendent, Aircrew Flight Equipment; Headquarters Air Force Reserve Command, Robins AFB, GA
12. February 2018-Present, CEM and Functional Manager, Aircrew Flight Equipment; Headquarters Air Force Reserve Command, Robins AFB, GA

MAJOR AWARDS AND DECORATIONS

Meritorious Service Medal with four oak leaf clusters
Commendation Medal with two oak leaf clusters
Achievement Medal with oak leaf cluster and silver oak leaf cluster
Air Reserve Forces Meritorious Service Medal with one silver oak leaf cluster and one oak leaf cluster
Air Force Recognition Ribbon with oak leaf cluster
National Defense Service Medal with bronze star
Southwest Asia Service Medal with bronze star
Global War on Terrorism Expeditionary Medal
Global War on Terrorism Service Medal
Armed Forces Service Medal
Nuclear Deterrence Operations Service Medal with four oak leaf clusters
Air Force Expeditionary Service Ribbon with Gold Border
Armed Forces Reserve medal with three M devices and silver hourglass
Kuwait Liberation Medal Kingdom of Saudi Arabia
Kuwait Liberation Medal Government of Kuwait

OTHER ACHIEVEMENTS

2004 Air Force Reserve Command Aircrew Life Support Senior Non-Commissioned Officer of the Year
2004 Fourth Air Force Aircrew Life Support Senior Non-Commissioned Officer of the Year
2008 916 Air Refueling Wing Senior Non-Commissioned Officer of the Year
2008 Superintendent of Fourth Air Force and AFRC Aircrew Flight Equipment Program of the Year
2009 HQ Air Force Air Reserve Component Aircrew Flight Equipment SNCO of the Year
2009 Air Force Reserve Command Aircrew Life Support Senior Non-Commissioned Officer of the Year
2009 Fourth Air Force Aircrew Life Support Senior Non-Commissioned Officer of the Year
2010 Superintendent of 4th Air Force and AFRC Aircrew Flight Equipment Program of the Year
2011 Twenty Second Air Force Aircrew Flight Equipment SNCO of the Year
2014 HQ Air Force Air Reserve Component Aircrew Flight Equipment SNCO of the Year
2014 Air Force Reserve Command Aircrew Flight Equipment Senior Non-Commissioned Officer of the Year

EFFECTIVE DATE OF PROMOTION
Chief Master Sergeant – July 2016
(Current as of June 2018)

U.S. AIR FORCE - Heather M. Tevebaugh, Maj, BSC, Air Force Safety Center

Major Heather M. Tevebaugh is the senior Aerospace and Operational Physiologist assigned at the Air Force Safety Center, Kirtland Air Force Base in New Mexico, as the Human Factors Investigations Branch Chief and Aerospace Physiology Fellowship Director. She is a key consultant to the Air Force Chief of Safety and coordinates all Air Force Safety Center physiological and human factors investigative functions. Major Tevebaugh is the Air Force Safety Center's point of contact for all critical aviation and ground safety human performance investigation issues and oversees Safety Investigation Board support and Message of Final Evaluation reviews. She is a formal safety course instructor and subject matter expert. Additionally, Major Tevebaugh leads human factors mishap data collection, analysis, and reporting. She analyzes and identifies aircraft system hazards for Air Force Safety programs and develops Air Force safety strategy. Finally, Major Tevebaugh directs SAF and Headquarters Air Force staff taskers and Department of Defense human factors plans.

Major Tevebaugh enlisted in the Air Force in March 1994 and graduated from Aerospace Physiology technical training in June 1994. Over her fourteen year enlisted career she traveled to four assignments and held numerous positions which included Non-Commissioned Officer-in-Charge of Hyperbarics, Kadena Air Base, Japan. While still enlisted and on Active Duty, Major Tevebaugh earned both her Bachelor of Science and Master of Education degrees garnering her a direct commission as an Aerospace and Operational Physiologist. Again, she has held numerous positions over four assignments which included the Deputy Consultant to the United States Air Forces Europe Surgeon General and Chief of Safety for Aerospace and Operational Physiology. Prior to her current position, the Major was the Director of Aerospace and Operational Physiological Training, 23 Aerospace Medicine Squadron, Moody Air Force Base, Georgia.

EDUCATION
2000 Airman Leadership School, Offutt Air Force Base, Omaha, Neb.
2007 Non-Commissioned Officer Academy, Keesler AFB, Miss.
2006 Bachelor of Science, Health Educator, Trident University International, Cypress, Calif.
2007 Master of Education, Instruction and Learning, Trident University International, Cypress, Calif.
2012 Squadron Officer School, Maxwell AFB, Ala., by correspondence
2015 Squadron Officer School, Maxwell AFB, Ala. in residence
2018 Air Command and Staff College, Maxwell AFB, Ala.
2018 Master of Military Operational Art and Science, Joint Warfare, Air Command and Staff College, Online Masters Program, Maxwell AFB, Ala.

ASSIGNMENTS
March 1994 – May 1994, Student, Basic Training, Lackland Air Force Base, Texas
May 1994 – June 1994, Student, Aerospace Physiology Technical Training, Brooks AFB, Texas
July 1994 – September 1998, Aerospace Physiology Journeyman, Laughlin AFB, Texas
October 1998 – October 2001, Standardization and Evaluation Element Chief, Offutt AFB, Neb.
October 2001 – December 2004, Non-Commissioned Officer-in-Charge Aerospace Physiology, Kadena Air Base, Japan
December 2004 – May 2008, Non-Commissioned Officer-in-Charge Aerospace Physiology, Grand Forks AFB, ND
May 2008 – June 2008, Student, Commissioned Officer Training, Maxwell AFB, Ala.
June 2008 – July 2008, Student, Aerospace Physiology Officer Training, Brooks AFB, Texas
July 2008 – July 2011, Aerospace and Operational Physiology Operations Officer, Laughlin AFB, Texas
July 2011 – August 2014, Aerospace and Operational Physiology Flight Commander, Ramstein AB, Germany

August 2014–August 2017, Director of Aerospace and Operational Physiological Training, Moody AFB, GA
August 2017 – Present, Air Force Safety Center Human Factors Investigations Branch Chief, Kirtland AFB, NM

MAJOR AWARDS AND DECORATIONS
Aerospace Medical Association Aerospace Physiology Society - 2018 Fred A. Hitchcock Award
Air Force Aerospace Physiology Non-Commissioned Officer of the Year 2006
Meritorious Service Medal with oak leaf cluster
Air Force Commendation Medal with three oak leaf clusters
Air Force Achievement Medal with oak leaf cluster

EFFECTIVE DATES OF PROMOTION
Second Lieutenant April 20, 2008
First Lieutenant April, 20, 2010
Captain April 20, 2012
Major January 01, 2017

U.S. NAVY - Rebekah M. Alford, LT, Naval Aviation Warfighting Development Center

Lieutenant Rebekah M. Alford is an MH-60S pilot at the Naval Aviation Warfighting Development Center in Fallon, Nevada. She is responsible for training and preparing deploying squadrons during Air Wing Fallon Exercises as well as teaching the Seahawk Weapons and Tactics Instructor Course. Core mission sets include Close Air Support, Combat Search and Rescue, Special Operations Support, and Maritime Strike. LT Alford is the MH-60S community's subject matter expert for Airborne Mine Countermeasures, MQ-8 Fire Scout, and Counter-Unmanned Aircraft Systems.

LT Alford joined the Navy in May 2011 and graduated from Officer Candidate School in August 2011. She has completed two deployments aboard USS Bonhomme Richard (LHD 6), serving as the Assistant Officer in Charge, and has deployed to Iwakuni and Atsugi, Japan. She has flown seven lifesaving Medical Evacuations and Search and Rescues. Prior to her current position, LT Alford was an Instructor Pilot and Quality Assurance Officer at Helicopter Sea Combat Squadron TWO FIVE (HSC-25) at Andersen AFB, Guam.

EDUCATION
2007 Newcastle University, School of Biomedical Sciences, Newcastle, England
2010 Bachelor of Science, Forensic Chemistry, Towson University, Towson, Maryland
2010 Bachelor of Science, Molecular Biology, Biochemistry, and Bioinformatics, Towson University, Towson, Maryland
2017 Seahawk Weapons and Tactics Instructor (SWTI) Course

ASSIGNMENTS
May 2011 – August 2011, Student, Officer Candidate School, Naval Station Newport, Rhode Island
August 2011 – December 2011, Student, Aviation Pre-Flight Indoctrination, Naval Air Station Pensacola, Florida
January 2012 – July 2012, Student, Primary Training Squadron, VT-27, NAS Corpus Christi, Texas
July 2012 – February 2013, Student, Helicopter Training Squadron, HT-18, NAS Whiting Field, Florida
February 2013 – November 2013, Student, Fleet Replacement Squadron, HSC-2, NS Norfolk, Virginia
November 2013 – November 2016, Pilot, Helicopter Sea Combat Squadron TWO-FIVE (HSC-25) Andersen AFB, Guam

November 2016 – Present, Instructor Pilot, Naval Aviation Warfighting Development Center (NAWDC), NAS Fallon, Nevada

MAJOR AWARDS AND DECORATIONS
Navy and Marine Corps Achievement Medal
National Defense Service Medal
Global War on Terrorism Service Medal
Sea Service Deployment Ribbon
Navy and Marine Corps Overseas Service Ribbon
Sikorsky Rescue Award

EFFECTIVE DATES OF PROMOTION
Ensign August 5, 2011
Lieutenant Junior Grade August, 5, 2013
Lieutenant September 1, 2015

MONDAY: 3:30 PM – 5:00 PM
TRI-SERVICE SCIENCE & TECHNOLOGY PANEL
LOCATION: RENO BALLROOM
MODERATOR: Mr. Glenn Paskoff, NAVAIR

INTRODUCTION: This panel provides an overview of Human Performance and Protection science and technology efforts and focus areas in the United States Air Force, Navy, and Army.

A question and answer session will follow after each Service presentation.

Presenters include:

UNITED STATES AIR FORCE - Lloyd Tripp, Ph.D.

Current Position: Program Manager, Aerospace Physiology & Toxicology
Area of Expertise: Aerospace Physiology & Human Factors Psychology

Education*:*
Ph.D. Human Factors Experimental Psychology, University of Cincinnati, Cincinnati, OH - 2007
M.A. Human Factors Psychology, University of Cincinnati, Cincinnati, OH - 2004
B.A. Psychology, Capital University, Columbus OH - 1998
A.A.S. Allied Health Science, Community College of the Air Force – 1986

Significant Accomplishments*:* Total Number of: Publications Patents
- One hundred publications, Three book chapters, five patents
- Developed and operationally fielded helmet mounted pulse oximetry to monitor inflight hypoxia for F-22 pilots
- Developed lower Body Negative Pressure negative G protection system
- Developed the method for collecting 2-D echocardiography in a high-G environment
- Directed the development of a strategic integrated research plan for the Biosciences and Performance Division

Current Focus areas:

Unexplained Physiological Events - serving as an Aerospace Physiology Subject Matter Expert for the F-35, F-16, A-10, T-6, Navy F-18 and T-45

Developing in-flight pilot physiological monitoring capabilities. Developing Smart Digital Breathing Regulator System

Managing the program area for the next generation on-board oxygen generating system

Most Significant Publications or Patents*:*

Tripp, L.D., Warm, J.S., Matthews, G., Chiu, P., Werchan, P., Deaton, J.E. (2006) +Gz Acceleration Loss of Consciousness: Time Course of Performance Deficits with Repeated Experience. Human Factors and Ergonomics. 48, 109-120.

Tripp, L.D., Chelette, T, Savul, S.A. (1998). Female exposure to high-G: Effects of simulated combat sorties on cerebral and arterial O2 Saturation. *Aviat. Space and Environ. Med* 69(9):869-874.

Tripp, L., Jennings, T., Seaworth, J., Howell, L., Goodyear, C. (1994). The Effect of Long Duration +Gz Acceleration on Cardiac Volumes Determined by Two-Dimensional Echocardiography. Journal of Clinical Pharmacology 34:484-488

Flexible LBNP Trousers for -Gz Acceleration Protection, U.S. Patent # 4,959,047, 14 February 1991

Ear Canal Pulse/Oxygen Saturation Measuring Device, Air Force Invention # 18,609, 27 July 1992, Patent 25 May 1993 # 5,213,099

Significant Awards/Honors:

Harry G. Armstrong Award for Scientific Excellence, 1988

Aerospace Medical Association, Space Medicine Branch, Young Investigator Award, 1988

Aerospace Medicine Association, Life Sciences Biomedical Engineering Branch's, Research Innovation Award, 1999

Aerospace Medical Association, Eric Liljencrantz Award, 2002

Aerospace Physiologist Society, Paul Bert Award, 2007

711HPW, James W. Brinkley Leadership Award, 2010

Jerome H. Ely Human Factors Award for the best paper of the year, 2007 Aerospace human Factors Association, Henry L. Taylor Award, 2013

Memberships with Professional/Technical Societies:

Aerospace Medical Association, 1988 – Present (Fellow)

Aerospace Human Factors Association (Past President), 1988 – Present (Fellow) Life Science & Biomedical Engineering Branch (Past President), 1989 – Present SAFE-Wright-Brothers Chapter (Past President), 1984 – Present

Society of Aerospace Physiologists, 1989 – Present

(Current as of 28 June 2018)

UNITED STATES NAVY – Barry S. Shender, Ph.D., SSTM

Barry S. Shender, Ph.D., SSTM, is the Lead Technologist for the Naval Air Systems Command (NAVAIR) Human Systems Department (AIR 4.6) in Patuxent River, MD, USA. As a Senior Scientific Technical Manager, Dr. Shender oversees and provides mentorship for all of the science and technology (S&T) efforts in AIR 4.6, including warfighter performance, training, survivability, and safety. He has worked for NAVAIR as a civilian human research scientist since 1987, starting out as an acceleration research engineer at the Naval Air Development Center in Warminster, PA, USA. He is a NAVAIR Esteemed Fellow, a Fellow of the Aerospace Medical Association (AsMA), a Senior Member of the Institute of Electrical and Electronic Engineers, and a Life Member of the SAFE Association. Dr. Shender has held technical leadership positions in a number of professional and international organizations, including Chair of The Technical Cooperation Program (TTCP) Human Resources and Performance Group (HUM) Human Systems Performance - Air Technical Panel, Chair of the S&T Committees of AsMA and SAFE, Technical Program Chair of the AsMA Annual Scientific Meeting (2016 and 2018), and US Navy member of three NATO Human Factors in Medicine Research Technical Groups ("Long Term Effects of Sustained High G on the Cervical Spine," "Medical Aspects of Military Operations in High Mountainous Environments," and "Aircrew Neck Pain"). He has authored or co-authored 43 journal articles, 20 technical reports, and over 150 technical conference abstracts / presentations.

He actively conducts human research, ranging from basic to advanced, quantifying the physiologic and cognitive response to exposures to operational environmental stresses, including maneuvering and impact acceleration loading, extreme temperatures, and high altitude. Throughout his career, Dr. Shender has strived to provide practical solutions to support warfighters during both normal and emergency operations. This involves filling basic knowledge gaps, developing tools to predict response, and creating mitigation technologies and procedures. But, he has not done this alone. This work involves fostering collaborations and coordinating and leading diverse multidisciplinary technical teams within NAVAIR, among DoD services, and internationally.

UNITED STATES ARMY – Dr. John S. Crowley MD, MPH

Dr. John S. Crowley is the Science Program Director for the U.S. Army Aeromedical Research Laboratory, Fort Rucker, Alabama, USA.

Dr. Crowley obtained his Bachelor of Arts and Medical Doctor degrees from the University of Missouri at Kansas City in 1980 and 1982, respectively. He received a Master's Degree in Public Health from the Harvard School of Public Health in 1987, and completed the USAF Residency in Aerospace Medicine the following year. In 1991, he completed the Medical Research Fellowship Program at the Walter Reed Army Institute of Research.

As a US Army Medical Corps Officer, Dr. Crowley served in several scientific and leadership positions at the US Army Aeromedical Research Laboratory (USAARL) at Fort Rucker; and as an Exchange Officer to the United Kingdom. In 2004, Dr. Crowley retired from the US Army at the rank of Colonel, and took the position of Science Program Director at USAARL.

Dr. Crowley is board-certified in Aerospace Medicine and is a Master Army Flight Surgeon. He has authored over 50 scientific reports (25 as first author), over a wide range of applied aeromedical topics. Dr. Crowley served as Vice-Chair for Aerospace Medicine on the American Board of Preventive Medicine from 2004-2010; he is a Fellow of the Aerospace Medical Association, is the immediate Past-President of the US Army Aviation Medical Association, and is the Scientific Committee Chair for the International Academy of Aviation and Space Medicine.

MONDAY: 5:15 P.M. – 5:45 P.M.
AUTHOR/MODERATOR GUIDELINES BRIEFING
LOCATION: TAHOE
MODERATOR: Glenn Paskoff

INTRODUCTION: The purpose of this meeting is for the SAFE Science & Technology Chair to provide guidelines to all Technical Session presenters and moderators. Following the briefing there will be an opportunity for questions.

TUESDAY: 8:30 AM – 10:00 AM
ALSS (HYDRATION)
LOCATION: CARSON 1/2
MODERATOR: Mr. Mike Jaffee, NAVAIR

BRIEFING: **Hydration Considerations for Military Aircrew –** Ms. Jennifer L. Farrell, Maj. Benjamin F. Schumacher, Dr. Mohamed A. Mughal, and Maj. Joseph R. Speakman; Air Force Life Cycle Management Center (AFLCMC), Human Systems Program Office, Wright-Patterson Air Force Base, OH

INTRODUCTION: This presentation addresses the aircrew physiological and material concerns associated with equipping Air Force aircrew with a standard, safe-to-fly, hydration solution. Industry, the military services, and the SAFE community have long grappled with how best to hydrate aircrew in flight. Failure to consume a minimum of 1 quart per hour under standard conditions and up to 1 gallon in dry, high-altitude, and high-exertion conditions can result in reduced physical and mental performance. Often, aircrew are left to choose whether to "tactically dehydrate" themselves by not drinking, or bring a mix of non-standard water bottles or canteens. These non-standard solutions are not currently evaluated for cockpit Foreign Object Damage risk, physical burden, nor officially recommended as safe-to-fly. The problem is especially important for tactical fighter aircraft due to space and operational constraints such as ejection seat capability and high-G flight maneuvers. The Chemical, Biological, Radiological, and Nuclear (CBRN) Individual Protection Programs also have a requirement to hydrate personnel when they don their individual protective ensembles. For most aircrew, the ensemble includes a full face mask with a drink tube. There are few currently fielded options other than the one-quart M1961 plastic canteen with M1 drink cap. These legacy canteens have poor fluid flow and limited quantities of water available. Protective limitations of legacy hydration methods drove the U.S. Army to develop the Multi-purpose Personal Hydration System (MPHS) to integrate with their Land Warrior and Air Warrior standard configuration Modular Lightweight Load-carrying Equipment (MOLLE) hydration carriers. Through this presentation, the SAFE community will learn about what the Air Force is considering and seek feedback from industry, Aircrew Flight Equipment, Bio-Environmental, Flight Physiology, and fellow military services on what solutions are available or challenges to consider as the Air Force looks to determine future requirements.

BRIEFING: Stealthy, Supersonic In-Flight Urination for Immersion Suit Wearers – Ms. Wendy Todd[1], Mr. Mark Harvie[2]; Mr. Roger Croft[3], Mr. Neil Fairgreaves[4]; [1]Naval Air Warfare Center, Patuxent River, MD; [2]Omni Medical Systems, Milton, VT; [3]Defence Science and Technology Laboratory, Salisbury, UK; [4]Crew Systems, Lightning Project Team, Ministry of Defence, Abbey Wood, UK

INTRODUCTION: Aviators require an in-flight relief capability that allows them to fully control the aircraft without contaminating the cockpit. Immersion suits force many to avoid urination during flight. Trials showed that using the suit's urination zipper resulted in an unsealed immersion suit. In particular, the F-35 G-suit and 5-point harness obstruct access to the suit's urination zipper, forcing those pilots to completely unstrap which leaves them at increased risk of injury, especially during ejection.
A potential solution is "Through Suit Connector (TSC)", an accessory of the already-approved AMXDmax® urine relief system. This presentation describes the efforts conducted by the manufacturer, the US DOD, and the UK MOD to qualify the TSC for the F-35 Lightning.

METHODS: Analysis was used to assess the safety of the lithium battery for aircraft and shipboard use. Testing was used to assess the TSC's durability to routine stresses such as laundering, whilst ability to withstand ejection were verified by windblast and parachute opening shock simulation. Burn testing was used to characterize the TSC's flame resistance. Rescue swimmer demonstration assessed the TSC's compatibility with and durability to water survival activities. Demonstration was also used to assess pilot and cockpit compatibility, and the validity of installation, inspection, and maintenance procedures.

RESULTS AND DISCUSSION: The TSC was found to remain watertight after exposure to routine stresses such as laundering, and emergency stresses such as high-speed windblast, parachute-opening shock, and water survival activities. The TSC was found to exhibit satisfactory flame resistance. The AMXD® lithium battery was certified as safe for use aboard ships and aircraft. The installation procedures were validated and converted to F-35 documentation. A Risk Hazard Analysis found that identified hazards were catastrophic in consequence but extremely unlikely in likelihood. The TSC was authorized and cleared for use in all F-35 variants in June 2018.

BRIEFING: **To Hydrate or Dehydrate: That is the Question –** LT Virginia DeBons, LCDR Amanda Lippert, CDR Sean McCarthy; Naval Aviation Warfare Center – Aircraft Division, Patuxent River, MD

INTRODUCTION: Optimum physical and physiological health is essential for optimal human performance in military aircraft. Appropriate hydration is a well-known factor in performance, however management of hydration in military aircrew has been a challenge for both male and female aircrew from the early days of military aviation. While hydrating in the aircraft is fairly easy, urine relief in the aircraft is quite complicated. Over the years, aircrew, human systems engineers, and medical personnel have tried a variety of procedures and products to manage in-flight urination with varied success. This brief will review the current procedures and products used by aircrew and open a discussion for future procedures and products.

METHODS: The current urine relief procedures and products used by Naval aircrew were identified and reviewed for assessment of best practices for human performance in flight.

RESULTS AND DISCUSSION: While most aircrew understand the significance of proper hydration for their mission performance, too many aircrew tend to fly at a level of dehydration due to a variety of factors. Anatomically and culturally, male aircrew have an easier time managing hydration in-flight. The history of products designed to support in flight urination for males is several decades long. In the past, aircraft have also been designed to support male urination. However, some newer tactical aircraft are making it difficult even for male aircrew to manage hydration through in-flight urination due to aircraft design. Urination products for female aircrew have never been designed for complete effective use in the flight environment. Another factor for hydration is the ability for aircraft to stay aloft for longer flights due to enhanced fuel capabilities and in-flight refueling. Taking these factors into consideration aircrew have come up with a procedure known as "tactical dehydration" to mitigate in-flight urination. The method is commonly used in ejection seat aircraft and rotary wing/tilt-rotor aircraft. Although most aircrew know that using this method to mitigate in-flight urination will reduce their mission performance and increase their risk of physiological injury, they find it to be the easiest method for management instead of using an aircraft or personal relief system. Several documented instances of urination accidents as well as a multitude of "off the record" instances of urination accidents are well known. A review and discussion of these instances has shown that aircrew need better education at the early stages of aircrew training about proper management of hydration and their options for in-flight urination. Additionally, the Naval Air Systems Command need to continue to work with industry to identify and develop safe and effective in-flight urination relief systems.

TUESDAY: 8:30 AM – 10:00 AM
BIOMECHANICS (CRASHWORTHY)
LOCATION: CARSON 3/4
MODERATOR: Mr. Nathan Wright, USAF / Mr. Brandon Hall, USN

PANEL: Rotorcraft Seating Systems: Survivability and Occupant Endurance

INTRODUCTION: The panel will include presentations of current research efforts related to rotorcraft crashworthy seating systems. In particular, the focus of the panel will be twofold:

(1) Performance of, and advances in, rotorcraft cabin seating systems
(2) Mitigating the potential negative physiological impacts of long-duration flights

Rotorcraft seating systems present unique design and development challenges. For example, rotorcraft seating systems are designed under significant mass constraints, must accommodate a wide range of occupant weights, and potentially be installed in multiple orientations. Additionally, occupant endurance is an increasingly prevalent concern among military aircrew. Fatigue and pain have been associated with the rotary wing flight environment.

PANEL CHAIRS:

Mr. Nathan Wright – Human Systems Integration Analyst; Human Systems Integration Directorate Air Force Research Laboratory, Wright-Patterson AFB, OH

Mr. Brandon Hall – Aerospace Engineer; Human Systems Department, Naval Air Warfare Center – Aircraft Division, Patuxent River, MD

PRESENTERS:

Dynamic Testing of Legacy Helicopter Troop Seats Using Contemporary Boarding Masses and Impact Scenarios - Paul Parker, QinetiQ, Farnborough, UK

INTRODUCTION: Energy Absorbing (EA) and non-EA seating in military aircraft are designed and qualified to defined limits based on a range of both static and dynamic methods. To the user, these limits are typically expressed in terms of maximum occupant mass. In the UK, it is known that aircrew and passenger boarding masses can exceed these limits. This increase in mass is due to general increases in the mass of the population and the equipment they carry.

QinetiQ, on behalf of the UK Ministry Of Defence, has undertaken a programme of work to physically test legacy tube and fabric troop seats of the type used in some UK in-service helicopters. The testing aims to establish the crash performance of this type of seating, and hence any potential injury risk to occupants, including those whose mass exceed the design specification of the seating.

METHODS: Testing was undertaken using the decelerator sled facility at Cranfield Impact Centre, Bedfordshire, UK. The testing utilized instrumented Hybrid III dummies fitted with additional clothing and equipment to replicate the range of occupant masses of crewman and infantry users of UK military aircraft. Testing was conducted at a range of impact severities (peak acceleration and velocity change) that a review of the literature had shown were credible and survivable in terms of occupiable cabin space post impact. Injury risk was assessed by consideration of standard Injury Assessment Risk Values.

RESULTS AND DISCUSSION: The presentation will highlight key results of the described testing. This will include how the tube and fabric seats designed against static load cases perform in a dynamic crash scenario and any associated occupant injury risk, and how these factors are influenced by different occupant boarding masses. The results of this assessment will be of interest to those working in the area of crash protection.

Please note at time of submission, testing has not been conducted, hence detailed results are unknown, and the abstract reflects this.

Characterization of Helo Hunch – Eric Anderson; Naval Air Warfare Center - Aircraft Division, Crashworthy and Escape Systems Branch, NAS Patuxent River, MD

Speaker will provide an overview of Navy efforts to characterize the seating posture known throughout the rotary wing community as "helo-hunch." The presenter conducted a study which collected quantitative data on the occurrence and severity of helo-hunch and self-reported pain. The intent of the study was to determine if seat occupant positional data could be quantitatively related to subjective pain levels reported by study participants. Seventeen subjects flew a helicopter simulator for a three-hour mission-representative flight, with pain ratings taken every 15 minutes. The simulator test seat was instrumented to record subject movement and posture throughout the duration of the simulated mission.

Evaluation of Supplemental Lumbar Supports – Brandon Hall; Naval Air Warfare Center - Aircraft Division, Crashworthy and Escape Systems Branch, NAS Patuxent River, MD

Speaker will provide an overview of Navy efforts to evaluate use of supplemental lumbar support systems. Supplemental lumbar supports were characterized by conducting 3-hour seated evaluations and recording participants' self-reported pain levels. Additionally, several supplemental lumbar support designs were evaluated dynamically on the horizontal accelerator at Naval Air Station Patuxent River. Resulting data from fully-instrumented manikins was analyzed to determine trends in occupant loading and dynamic excursion.

TUESDAY: 8:30 AM – 10:00 AM
HEARING PROTECTION
LOCATION: CRYSTAL 1/2
MODERATOR: Mr. Joe Essex, NAVAIR

BRIEFING: Evaluation of Custom Earplug Variation and Digital Ear Canal Scanning Technologies – Mr. Tyler Winningham, Ms. Kristen Semrud; Naval Air Warfare Center Aircraft Division (NAWCAD) 4.6 Human Systems Department, Patuxent River, MD

INTRODUCTION: The U.S. Navy currently uses the silicone impression method, an invasive procedure that carries a risk of ear injury such as a blow by or ear irritation, to obtain the ear canal geometry required for custom molded earplugs. This study is evaluating two different digital ear canal scanning technologies relative to the current physical impression method in order to qualify one of the digital devices as a replacement for the current method.

METHODS: Thirty volunteers have had impressions and digital scans taken. Each volunteer will complete personal attenuation rating (PAR) assessments for 15 sets of earplugs, five for each technique (physical impressions, eFit Scanner, and Aura 3D Scanner), using two different PAR measurement systems (VeriPro and FitCheck). The PAR measurements will be used to analyze variability within earplugs from a single ear canal geometry source, as well as compare the PAR measurements of the earplugs from source to source.

Digital overlays of a 3D scan of the physical impression with the direct digital scans of the ear canal from each ear canal scanning technology were used to highlight differences in ear canal geometry between the techniques.

BRIEFING: **An Examination of the ANSI S12.42 Standard for Evaluating the Performance of Hearing Protection Devices in U.S. Naval Aviation–** Brandon Dietrich, G. Alston Rush, Ph.D., Gunnar A. Eskeland, M.S.; Naval Air Warfare Center Aircraft Division, Patuxent River, MD

INTRODUCTION: Noise spectrum analysis and attenuation testing following the ANSI/ASA [American National Standards Institute/Acoustical Society of America] S12.6 Real Ear Attenuation at Threshold (REAT) standard are required to determine appropriate hearing protection solutions for a given platform. The hearing protection device (HPD) attenuation evaluation is costly and time consuming due to the need for human subject testing.

An alternative to human subject testing during preliminary performance and production lot acceptance testing is the use of acoustic test fixtures (ATFs), such as the G.R.A.S. 45CB, to determine the HPD insertion loss (IL) following the ANSI S12.42 Methods for the Measurement of Insertion Loss of Hearing Protection Devices in Continuous or Impulsive Noise Using Microphone-in-Real-Ear or Acoustic Test Fixture standard. The ANSI S12.42 standard requires a repeated-measures design consisting of two measures of each HPD condition (e.g., un-occluded and occluded ear) for each HPD sample. It also requires a waiting period of 120±5 seconds after final adjustment. The purpose of this effort was to contest the test methods of requiring an un-occluded - occluded sequence after every HPD condition as well as the waiting period of 120±5 seconds after final adjustment.

METHODS: Gentex ear seal with Comply™ Foam Technology were evaluated in four military flight helmets, HGU-84/P, HGU-68/P, HGU-56/P, and HGU-56/P rotary wing helmet (RWH), using a G.R.A.S. 45CB ATF and a modified ANSI S12.42 standard in the NAVAIR Auditory Performance Lab's reverberation chamber. Tests were performed for three sets of ear cup/ear seal combinations with four fits for each set resulting in twelve tests per configuration. An un-occluded measurement was conducted at the beginning and end of each set of a given ear cup/ear seal combination. Additional ear seal configurations were tested for the HGU-68/P. These included Gentex standard oval seals from the HGU-84/P helmet, Oregon Aero Softseal/Hushkit, and Pro Flight Gear Fully Articulating Air Bladder System. Data collection began when the fit was complete to capture the waiting period of 120±5 seconds allowing analysis of the ear seal recovery time. Data analysis was conducted by comparing at-ear sound pressure levels throughout the 120±5 seconds waiting period and after the two-minute waiting period.

Statistical analysis was piloted by cross-class analysis of variance (ANOVA) method using ear seal, ear cup, helmet, and sound pressure levels (SPL) as dependent variables and mean squared error.

BRIEFING: **Comparative Evaluation of Comply Ear Seals and Alternative Hearing Protection Devices in U.S. Navy Aircrew Helmets Using an Acoustic Test Fixture –** G. Alston Rush, Ph.D., Gunnar A. Eskeland, M.S., Brandon Dietrich; Naval Air Warfare Center Aircraft Division, Patuxent River, MD

INTRODUCTION: U.S. Naval Aviators and flight deck maintainers are generally exposed to extreme noise environments for extended durations, often requiring double hearing protection and leading to noise overexposure. Gentex Corporation, the manufacturer for most helmets used by Navy aircrew, has developed a "High Attenuation / High Comfort Ear seal" with the goal to provide "Improved hearing protection and clarity in communications via enhanced passive attenuation results in increased mission effectiveness." The purpose of this test is to evaluate the noise reduction performance of the Comply ear seals to verify the results provided by the Gentex Corporation, and evaluate baseline helmet and alternative Hearing Protection Devices (HPD) attenuation performance via comparative analysis.

METHODS: Comply ear seals were evaluated in four military flight helmets, HGU-84/P, HGU-68/P, HGU-56/P, and HGU-56/P Rotary Wing Helmet (RWH), using a G.R.A.S. 45CB Acoustic Test Fixture (ATF) (G.R.A.S. Sound & Vibration A/S, Holte, Denmark) and a modified American National Standards Institute (ANSI) S12.42 standard in the NAVAIR Auditory Performance Lab's reverberation chamber. Tests were performed for three sets of ear cup/ear seal combinations with four fits for each set, this accounted for twelve tests per configuration. Additional helmet configurations were tested for the HGU-68/P, utilizing 116 dB in-flight noise from a propeller-driven aircraft. Vibrations were measured using seven single-axis accelerometers; one placed at the rear, top, and ATF neck, and two each placed on the left and right sides of the helmet. Data analysis was conducted by comparing at-ear sound pressure levels and helmet shell vibration between ear seals, helmets, and noise profiles. Statistical analysis was piloted by cross-class Analysis of Variance (ANOVA) method using ear seal, ear cup, helmet, and noise type as classes, Sound Pressure Levels (SPL) and acceleration (G) as dependent variables and mean squared error. Insertion Loss, or the difference between occluded and unoccluded Sound Pressure Levels were utilized to evaluate the noise reduction performance of the Comply ear seals and alternative hearing protection devices, as compared to the baseline configuration for each helmet.

RESULTS AND DISCUSSION: The noise attenuation performance of Comply ear seals are presented by comparative analysis for HGU-84/P, HGU-68/P, HGU-56/P, and HGU-56/P RWH helmets. Attenuation results of alternative HPDs including Creare AHP ear cup, Pro Flight Gear ear cup and seal, and FAABS fitting pads were evaluated. Significant differences were observed in helmet shell vibration and at-ear attenuation results between aircraft representative noise and Pink noise.

TUESDAY: 8:30 AM – 10:00 AM
ANTHROPOMETRY
LOCATION: CRYSTAL 3/4
MODERATOR: Ms. Lori Brattin-Basham, NAVAIR

BRIEFING: Military Anthropometric Data for Design of Protective Equipment – Mr. Joseph L Parham, Dr. Hyeg Joo Choi, Dr. Todd N Garlie, Mr. Steven P Paquette; US Army Natick Soldier Research Development & Engineering Center, Natick, MA

INTRODUCTION: Accurate anthropometric data are critical for the proper design, fit, sizing, and tariffing of protective equipment and devices within the US military. To this end, each branch of the US military periodically collects body size and shape information from its uniformed personnel. These anthropometric databases are foundational to the development of all protective equipment utilized by the US armed forces.

The US Army Anthropometric Survey (ANSUR II) databases consist of data from 4,082 males and 1,986 females which represent the current US Army population. Each Soldier subject contributes: 93 directly-measured body dimensions, to include skeletal heights and breadths, as well as circumferences, and measurements of the head, hands, and feet; individual 3D scans of their whole body, head/neck, and right foot; detailed demographic data to ensure that the resultant databases are representative of the US Army with a sampling strategy based on age, race/ethnicity, and with males and females treated separately.

The ANSUR II and other service-specific anthropometric databases are extensively used throughout the Department of Defense to optimize the design of personal protective equipment as well as other life-saving protective devices. These data also serve to inform industrial and commercial design of human-centered products, and are a unique resource to a wide variety of researchers concerned with human variation. The databases, as well as Technical Reports describing the methods, summary statistics, and measurement techniques, are all publicly available. In order to validate the continued relevance of the ANSUR II databases, a surveillance study is underway. This study is collecting limited anthropometric data on a small sample of Soldiers in an effort to identify and quantify any population-level trends.

BRIEFING: Comparison of Military Anthropometric Databases Among Different Services –Dr. Hyeg Joo Choi, Mr. Joseph L Parham, Dr. Todd N Garlie, Mr. Steven P Paquette; US Army Natick Soldier Research Development & Engineering Center, Natick, MA

INTRODUCTION: Within the past 10 years, the US Air Force, US Marine Corps, US Army, and US Navy collected or statistically created anthropometric databases to represent their uniformed personnel. The USAF conducted the Aircrew Sizing Survey (ACSS) at five air force bases collecting 58 dimensions to complete a database with 700 aircrew (640 males and 60 females). Data collection for the USMC database (MC-ANSUR) was performed in conjunction with the US Army anthropometric survey (ANSUR II).

MC-ANSUR consists of 94 dimensions collected from 1,921 Marines (1,301 males and 620 females). ANSUR II collected data on 8,120 males and 3,841 females from 12 Army bases, for which 6,068 Soldiers (4,082 males and 1,986 females) were selected to create a working database representative of the current US Army population. The US Navy, however, collected a subset of dimensions comparable to ANSUR II, then statistically created a matching database by selecting candidate cases from the ANSUR II database to represent US Navy personnel.

This study compares military databases collected directly from its uniformed personnel that include ACSS, MC-ANSUR, and ANSUR II, along with ANSUR I as a baseline database, with two research questions. 1) Are the personnel in these three military services different in terms of body sizes? 2) Can the clothing and individual equipment (e.g., uniforms) be shared between different services? For the analysis on the first question, race and age were controlled as both can have a significant influence on overall body size, and different racial and age proportions exist in all three military databases. White subjects aged 20-39 were selected for this comparison. To answer the second question, the entire databases were compared to one another based on the assumption that ACSS, MC-ANSUR and ANSUR II represent their service populations. Detailed discussions along with visual representations will be presented.

BRIEFING: **Modernizing Anthropometric Accommodation Evaluations in Naval Aviation –** LT Miles Erwin, MSC, USN; Naval Aviation Schools Command, Pensacola, FL

INTRODUCTION: Naval Aviation Schools Command (NASC) is the designated Model Manager of the Naval Aviation Anthropometric Accommodation Program, responsible for evaluating and certifying all prospective officers that seek aeronautical designation and flight in Naval aircraft. Throughout the program, 13 locations evaluate a total of over 5,000 applicants and students annually. The significance of consistent and accurate anthropometric measurements relates to appropriately awarding student naval aviator and naval flight officer contracts to applicants and assigning student aviators to training pipelines resulting in the student being accurately matched with compatible fleet aircraft. Throughout the program, 12 locations serve as affiliate sites to predominately screen applicants prior to the aviation contract being awarded, and NASC evaluates all students once they have checked into Aviation Preflight Indoctrination. Within the affiliate sites, over 50 Hospital Corpsmen serve as measuring technicians to perform anthropometric evaluations utilizing handheld anthropometers and non-standardized stations. With the diversity of experience levels between measuring technicians, varying amounts of throughput of applicants between locations, and existence of human error while hand measuring applicants, standardization is paramount amongst the Naval Aviation Anthropometric Accommodation Program.

Recognizing the progress in development of optical and digital scanning technologies, machine learning, and seemingly limitless possibilities in computer programing, the opportunity to decrease human error in anthropometric evaluations is more possible than ever before. Therefore, any means to decrease variance between locations and measuring technicians is being investigated to increase overall safety in Naval aviation.

METHODS: The Naval Research and Development Establishment has been solicited for assistance to produce a new way forward in modernizing and standardizing Naval aviation anthropometric accommodation evaluations.

TUESDAY: 10:30 AM – 12:00 PM
OXYGEN
LOCATION: CARSON 1/2
MODERATOR: Ms. Rachael Ryan, NAVAIR

BRIEFING: Aircraft Cockpit Purge Measurements to Determine the Safety of Chemical/Biological Agent Protective Mask Removal in Flight - Jerry Jensen[1], William Greer[2]; [1]Leidos, Beavercreek, OH, [2]USAF/AFRL, Wright-Patterson Air Force Base, OH

INTRODUCTION: U.S. Air Force aircrew may be faced with the need to perform missions from an airfield contaminated with chemical or biological agents. Special aircrew protective equipment has been developed that enable aircrew to perform both ground and flight operations in a contaminated environment. Masks for use in high performance aircraft must also provide the ability to: perform Valsalva, interface with communication, oxygen, and various display systems, and survive high G maneuvers and possible ejection seat egress. These requirements result in a mask that is more encumbering than those used by ground personnel.

An alternate concept has been proposed whereby aircrew will use a simpler mask that can be removed once the aircraft is airborne in clean air and has had time to purge the cockpit of contamination. The concept is supported by knowledge of cockpit ventilation systems and test data obtained in past purge measurement efforts. The goal is to demonstrate the feasibility of this concept by challenging a modern high performance aircraft with chemical agent simulant, measuring the simulant challenge level in the cockpit over time, and calculating the risk to a crewmember at various mask removal times as the cockpit contamination is purged with clean air.

METHODS: An F-22 aircraft was challenged with engines running and was then taxied to a clean location so that cockpit air originating from the engine compressor no longer contained chemical agent simulant vapor. Measuring equipment in the cockpit monitored simulant contamination levels over time. The measurements were used to verify the safety of the concept and possible operational CONOPS.

RESULTS AND DISCUSSION: The presentation discusses key assumptions, test methods, measurement results, and how these measurements were used to develop an operational CONOPS.

BRIEFING: Water Intrusion Testing on an OBOGS Concentrator – Dennis Gordge; RED-Inc, Lexington Park, MD

INTRODUCTION: Water intrusion into an On Board Oxygen Generating System (OBOGS) is a known system degrader. Moisture in the supply air to the OBOGS will eventually inactivate the system's molecular sieves resulting in reduced performance. It was suggested that the OBOGS may be exposed to large slugs of liquid water that could lead to transient reductions in oxygen concentration. The large water slugs could also foul the oxygen monitor causing it to be ineffective in recognizing the transient condition, thus failing to warn the aircrew of a hypoxia-inducing situation. This test exposed an OBOGS concentrator to 36 500-ml slugs of water over the course of 6 hours. The accuracy of the system's oxygen monitor and its capability to detect a transient condition were evaluated. Although the oxygen concentrator experienced a 95% loss in air separation performance, the warning system was unaffected by the water challenge. The results demonstrate the robustness of the aircraft's warning system to detect low oxygen concentrations even in an operating mode indicative of a complete oxygen concentrator failure. The results have been used to dispel concerns over the aircraft's warning system and its ability to detect hypoxia-inducing situations caused by large slugs of free water in the bleed air supply system.

BRIEFING: Addressing Analytical Artifacts in USN Pilot Breathing Air Monitoring Efforts – Dr. Leah Eller; Naval Air Warfare Center Aircraft Division, Patuxent River, MD

INTRODUCTION: The breathing air on three USN aircraft platforms were monitored using pilot mounted assemblies. Parts-per-billion (ppb) levels of organic compounds were initially reported in the fleet monitoring effort. Through subsequent testing, the majority of compounds were determined to arise from analytical artifacts. The sources of these artifacts are discussed along with the impacts to fleet monitoring efforts.

TUESDAY: 10:30 AM – 12:00 PM
BIOMECHANICS (INJURY 1)
LOCATION: CARSON 3/4
MODERATOR: Mr. John Buhrman, Wright-Patterson AFB

BRIEFING: Comparison of Hybrid III and Postmortem Human Subject Responses in Underbody Blast Loading Conditions - K. Ott[1], D. Drewry III[1], J. Andrist[1], R. Armiger[1], S. Bilodeau[2], C. Demetropoulos[1], C. Carneal[1]; [1]Johns Hopkins University Applied Physics Laboratory, Laurel, MD; [2]US Army Research Laboratory, Aberdeen, MD

INTRODUCTION: Crash injury research has predominantly focused on the effects of loads applied to human subjects during automotive impacts. The biomechanical response of postmortem human subjects (PMHS) during frontal collisions is well characterized in the literature. However, relatively little work exists to characterize human biomechanical response to under-body blast (UBB) events, or to assess the ability of existing Anthropometric Test Devices (ATDs) to accurately reproduce occupant response under these conditions.

METHODS: To address these gaps, six whole body PMHS tests were completed under two vertical loading conditions that compare to reported UBB exposure. Additionally, a series of 50th percentile Hybrid III ATD tests were conducted under the same exposure conditions to assess the ATD's ability to assess vertical loading conditions. PMHS and Hybrid III sensor responses at analogous anatomical locations were compared.

RESULTS AND DISCUSSION: Tibial accelerations for the PMHS and Hybrid III were comparable in both response shape and magnitude. Posttest inspection of the Hybrid III revealed that damage of the ATD pelvis foam and skin resulted in large variations in sensor response due to altered load transmission through the pelvis. Based on comparable sensor responses at analogous locations, the ability of the Hybrid III to model PMHS response was evaluated. While both PMHS and Hybrid III accelerative responses demonstrate sensitivity to magnitude and duration of loading under most conditions, Hybrid III response was not typically representative of PMHS response. Findings serve to characterize human biomechanical response and Hybrid III biofidelity during UBB loading events.

BRIEFING: PMHS Lumbar Spine Combined Loading Test Device – John Humm[1], Klaus Driesslein[1], Frank Pintar[1], John DeRosia[1], Joseph Avila[1], Narayan Yoganandan[1], Justine Treuden[1], David Moorcroft[2], Richard DeWeese[2], Amanda Taylor[2]; [1]Medical College of Wisconsin, Milwaukee, WI; [2]Civil Aerospace Medical Institute, Oklahoma City, OK

INTRODUCTION: Safety standards for commercial aircraft specify that passenger seats must protect occupants from serious injury during emergency landing conditions. While epidemiology-based field injury data do not exist for airplane crashes, distraction-type injuries were observed in whole-body tests with occupants in obliquely mounted and front row seats; however, injury criteria under these modes have not been researched. This study was designed to develop a device that can be used to test isolated sacrolumbar spines, which can reproduce these injuries, and determine the axial tension and moment loads. Injury tolerances in this mode can assist developing standards to provide equivalent level of safety for occupants in obliquely oriented and front row seats as forward-facing seats.

METHODS: Tests were conducted using a PMHS (post-mortem human subject) isolated lumbar spine isolated from T12 to sacrum. The superior and inferior ends were potted in polymethyl-methacrylate (PMMA) such that the T12/L1 and Sacrum-L5 discs were unconstrained. Six-axis load cells were placed above and below the PMMA. The superior end was attached to an electro-hydraulic piston which applied the tensile load. The inferior end was fixed to custom apparatus which placed the sacrum in varying positions of flexion relative to T12-L1 disc. Each specimen was tested in several positions beginning with its natural curvature to a maximally flexed position. Pre-test sagittal x-rays were obtained. Tensile loads were applied at 1 m/s with 10 mm displacement for the biofidelity tests, while the failure test was run at 1 m/s with 50 mm displacement. Three retroreflective targets were placed at each level to measure the three-dimensional kinematics using a six-camera motion capture system at 1 kHz. Piston displacement and the six-axis load cells were recorded at 20 kHz.

RESULTS AND DISCUSSION: Distraction injuries at L5-S1, including bilateral facet dislocation, disc disruption, and posterior ligament disruption were observed in the isolated tests which are consistent with the injuries reported in whole-body sled tests. Generally, higher tension forces and moments were recorded as the sacrum was positioned into a more flexed posture relative to T12 for the same displacement. This test methodology helps delineate the effect of combined loading for lumbar spine injuries.

TUESDAY: 10:30 AM – 12:00 PM
MISHAP INVESTIGATION
LOCATION: CRYSTAL 1/2
MODERATOR: Mr. Keith King, NAVAIR

BRIEFING: **Mishap Investigation Support Team (MIST) Engineering Investigation Support in the Laboratory –** LCDR Amanda Lippert; Naval Air Warfare Center Aircraft Division, Patuxent River, MD

INTRODUCTION: Following the conclusion of In-Field support for a mishap, all personal flight equipment is shipped to the MIST Lab, along with other potential Aircrew Escape Systems (AES) components. The flight gear is catalogued and stored within the Lab. In the event that the Aviation Mishap Board (AMB) requests further analysis be performed by means of engineering investigation, the gear is transferred to the appropriate Lab for examination and/or testing. This brief will discuss the various processes applied to Aviation Life Support Systems (ALSS) in support of mishap investigations once the In-Field exploration is complete.

TUESDAY

BRIEFING: **Rotary Wing and Tilt Rotor Mishaps Lessons Learned -** Michael Knott; Naval Air Warfare Center Aircraft Division, Patuxent River, MD

INTRODUCTION: The presentation will cover the lessons learned regarding mishaps that were supported by the Mishap Investigation Support Team (MIST) from NAVAIR. Over the last 10 years, the MIST has provided support on over 20 class A mishaps. The MIST provides support on both fixed wing ejection, fixed wing non ejection, rotary wing, and tilt rotor aircraft. The rotary wing and tilt rotor section of MIST provides Subject Matter Expert (SME) support on crashworthy systems, restraints, and ALSS. The presentation will cover some lessons learned from recent mishaps.

METHODS: MIST provides in-field support in conducting mishap investigations. The MIST looks at all appropriate sub-systems to determine if they functioned properly or were causal to injuries during a mishap.

RESULTS AND DISCUSSION: The lessons learned have covered topics such as inadequate system design, improper maintenance instructions, improper use of a system, and exceeding system capabilities. The topic is relevant to SAFE due to the nature of the safety systems functions during mishaps.

BRIEFING: PMA-202 Mishap Investigation Support Team - Mitch Mackenzie[1], Nicholas Schombs[2]; [1]Naval Air Warfare Center Weapons Division, China Lake, CA; [2]Naval Surface Warfare Center IHEODTD, Indian Head, MD

INTRODUCTION: The presentation will provide a summary of the Mishap Investigation Support Team (MIST) and its involvement with fixed wing ejection mishaps from start to finish, to include engineering investigations and reporting process for USN and USMC. Status and key findings will be reported.

TUESDAY: 10:30 AM – 12:00 PM
ANTHROPOMETRY
LOCATION: CRYSTAL 3/4
MODERATOR: Mr. Joseph Parham, U.S. Army-Natick

BRIEFING: Development of a Portable Torso Scanning System to Capture Encumbered Soldier Fit – Ms. Jennifer Whitestone[1], Mr. Max Grattan[1,2], Dr. Jeffrey A. Hudson[1,2], [1]Crew Accommodation Laboratory (AFMC AFLCMC/EZFC), Wright Patterson AFB, Dayton, OH, [2]Infoscitex, Dayton, OH

INTRODUCTION: The United States Air Force (USAF) Crew Accommodation Lab (CAL) was tasked to model the Soldier Protection System (SPS), the U.S. Army's new lightweight body armor ensemble which includes an armored combat shirt with a plate-carrier style vest. The CAL offered surface measurements used in concert with motion capture during a series of tactical movements meant to simulate anticipated physical tasks. Data from the sensor studies served a two-fold function: 1) to provide geometric representation of the SPS in terms of body coverage, and 2) to determine impact on mobility due to the added protective equipment.

A portable whole body scanning system was devised to capture soldiers in the field while being tested with the revised SPS. The handheld Artec EVA scanning system was employed to capture surface data of the soldiers with and without the SPS. The field-ready scanning system was constructed using unistrut framework and calibration cones to establish a consistent reference frame to which all surface scans were referenced. The 250 male and female subjects were scanned with only BDU pants (and a sports bra for women) and subsequently scanned with two configurations of SPS. Digital models of the armor plates were aligned to the body using surface scans to determine coverage and interrogate fit. Software used to analyze the image data include Artec Studio and Polyworks.

Development of the portable torso scanning system using a handheld surface scanner and a calibration frame was used to successfully establish a database of Army soldiers with and without their SPS. The SPS presents a new lower profile signature and may prove to improve mobility. While the Army is developing the improved body armor, it is expected that the USAF will adopt the SPS.

BRIEFING: 3D Scanning Applications in the Human Systems Domain - Andrew Koch; Naval Air Warfare Center Aircraft Division, Patuxent River, MD

INTRODUCTION: For over 20 years, the Aircrew Accommodation (AA) Laboratory at the NAWCAD Human Systems Department has been focused on providing high quality anthropometric accommodation and ergonomics support to the Naval Aviation community. Recently, the AA Lab has expanded its capabilities by developing a range of 3D scanning devices and modeling tools to provide additional support in anthropometric accommodation and ergonomics, human factors, system safety, and training system development.

METHODS: Equipment and software used in this scanning and modeling capability includes FaroArm laser line probes, Artec Eva scanners, Agisoft PhotoScan, Polyworks, and Ansys Spaceclaim. Work is underway in the AA Lab to develop in-house scanning mechanisms that would allow quick photogrammetric methods of scanning humans through inexpensive software and hardware.

DISCUSSION: Most recently, this burgeoning scanning and modeling capability has been used to support multiple high-profile projects through digital human modeling (DHM) techniques. Of particular note is the design of the prototype MH-60 Next Generation Gunner Seat, the development of an emergency oxygen system for the T-45, and an observer station for the HC-27J aircraft. AA Lab DHM and scanning support has allowed for early design analysis and substantially reduced development and testing for these projects, resulting in saved time and money for the government.

In addition to providing scans for input into DHM efforts, this scanning and modeling capability has been used to develop models for different applications, both inside and outside traditional human systems domains. Recent projects include the scanning of T-45 flight controls, an MH-60 pilot seat, an E-2D cockpit, assorted helmets and head forms, a C-130 wing, a V-22 heat exchanger and prop-rotor blade, and an H-53K flexbeam.

Future efforts in the AA Lab will focus on refining the techniques for scanning and post-processing, acquiring additional equipment, and training additional employees in current and future techniques.

BRIEFING: Predicting Standard Anthropometry from Standardized Three-Dimensional Body Surface Scans – Dr. Brian Corner; Marine Corps Systems Command, Quantico, VA

INTRODUCTION: Obtaining fast and accurate anthropometry from three-dimensional (3D) body surface scans is a primary application of scan technology. Approaches may be divided into two main methods. In *Scan Extraction*, a mesh is interrogated in an effort to reproduce as accurately as possible the manual measurement procedure for standard anthropometric dimensions. Automated techniques are available in which software takes advantage of scan geometry such as curvature to locate landmarks and levels. The second method is *Scan Prediction*, where template-matched standardized 3D meshes are related to standard anthropometry through principal components regression (PCAR). The PCAR method is the topic of this presentation and will be described through the analysis of a small sample of female torso forms created for a previous study.

The 713 JSF CAESAR scans and their anthropometry are from the Joint Strike Fighter (JSF) CAESAR dataset. Whole body scan meshes were standardized and the torsos segmented from the head and limbs. Scans were aligned on their centroid using ordinary least-squares (OLS) method. The torso scans were divided in half through random selection to make training and test samples. A quick comparison of test and training anthropometry found no statistical differences between the two samples. Statistics were run in R. The standardized and aligned torso meshes were run through principal components analysis (PCA) on the node coordinates using covariance and the Eigen data saved for the regression step.

TUESDAY

Results from PCA found seven components described a bit over 90% of the sample variation. A linear regression model was applied to predict standard anthropometry from the seven training PCA factors. Predicted anthropometry was calculated for the verification data set. The root mean square error (RMSE) showed a considerable range from 5.7 for weight (kg) to 96.9 for suprasternale height (mm) prediction. Torso breadths had RMSE in the 15-20 range. Detailed results will be provided, as will a discussion of improvements in the PCAR approach for predicting standard anthropometry from 3D scans.

TUESDAY: 1:30 PM – 3:00 PM
OXYGEN
LOCATION: CARSON 1/2
MODERATOR: Dr. Steve Kim, Wright-Patterson AFB

BRIEFING: Road to Recovery: Return to Flight for the T-45 Goshawk Aircraft – Rachael Ryan[1], Dennis Gordge[2]; [1]Naval Air Warfare Center Aircraft Division, Patuxent River, MD; [2]RED-Inc, Lexington Park, MD

INTRODUCTION: Lack of confidence in the Navy's primary jet training aircraft's (T-45 Goshawk) life support system led to a stand-down in flight operations in April, 2017. Over the next six months, NAVAIR executed numerous efforts to investigate the issues and modify the aircraft in order to restore confidence in the system. Efforts focused on understanding the current system, identifying performance gaps, verifying breathing gas quality, and modifying the aircraft to bring it up to today's standard in aviation oxygen systems. The resulting changes have resulted in a full return to normal flight operations and a significant reduction in physiological events reported by instructor and student aviators. This briefing provides insight into the broad range of engineering efforts that led to the successful return to flight for this critical training asset.

DISCUSSION: These data quantify how male dynamic response to impact varies with load vector and weight and provide a validation dataset for spinal musculoskeletal modeling. These responses also imply that care should be taken when comparing the responses to the same G vector based on occupant posture, upright versus supine.

BRIEFING: T-45 Oxygen Quality Testing: Results and Lessons Learned – Nicke Boyd; Naval Air Warfare Center Aircraft Division, Patuxent River, MD

INTRODUCTION: Unexplained Physiological Episodes (UPEs) in aircraft equipped with On Board Oxygen Generating Systems (OBOGS) has led to numerous efforts to assess the quality of the breathing oxygen for contaminants that could degrade the pilot's ability to fly the aircraft. The desire to monitor hundreds of aircraft over an extended period of time required man-mounted devices that could easily integrate with the pilot's survival equipment and detect a broad range of potential contaminants with high specificity and sensitivity creates a significant challenge. Thermal desorption tubes, as well as hydrocarbon detectors, were used to collect gas samples during thousands of flights and multiple locations both ashore and afloat. The results of the findings are presented along with some of the limitations, pitfalls, and lessons learned from using this technique.

BRIEFING: Adaptation of US Navy Aircrew Breathing Gas Quality Assessment Equipment for Use in USN and USAF T-6 – Christine Brown; Naval Air Warfare Center Aircraft Division, Patuxent River, MD

INTRODUCTION: The Navy used Commercial Off the Shelf sorbent tubes and hydrocarbon detectors to monitor the aviator's breathing gas quality in the T-45 and F/A-18 aircraft. The integration of the equipment into the existing aircrew equipment required a simple connection fitting between the oxygen regulator and the oxygen hose. Due to an uptick in Unexplained Physiological Episodes (UPEs) in the T-6 aircraft, it was requested that the Sorbent Tube Adapter and Hydrocarbon Detectors be modified for use with the aircraft mounted pressure regulator to collect samples for both US Navy and US Air Force aircrew. Design work was completed to identify changes required to the existing STA/HCD. The updated systems were then evaluated in the AIR 4.6 Human Systems Altitude Lab prior to finishing flight test and being flown under limited CNATRA flights for data collection. Integration work continues to allow for flights in US Air Force T-6 aircraft.

TUESDAY: 1:30 PM – 3:00 PM
BIOMECHANICS (MODELING)
LOCATION: CARSON 3/4
MODERATOR: Dr. Joseph Pellettiere, FAA

BRIEFING: **Effects of Sex Differences on Dynamic Response Index Model Parameters –** Somers, J.T.[1], Hayashi, D.[2], Wells, J[3]; [1]KBRwyle, Houston, TX; [2]LZ Technology, Houston, TX; [3]Leidos, Houston, TX

INTRODUCTION: The Dynamic Response Index has been used for decades to evaluate injury risk due to +Z (eyeballs down) transient accelerations. Stech and Payne developed model parameters based on male cadavers and volunteer subjects. Buhrman and Mosher reported updated model parameters based on men and women volunteers; however, their results showed little difference between men and women. In this analysis a newer, larger data set was selected for analysis.

METHODS: Human volunteer data were downloaded from the Air Force Collaborative Biomechanics Data Network from the study entitled "Investigation of Gender Differences in Vertebral Body Size and Lumbar Loading During +Gz Impact Acceleration." A total of 267 test cases from 28 men and 27 women were analyzed from vertical drops ranging from 6 to 10*g*. A dynamic response model was fit to the subject's chest acceleration to estimate both undamped natural frequency and damping coefficient. These results were then analyzed to assess the effects of sex differences, age, sitting height, and *g* level on model parameters.

RESULTS AND DISCUSSION: Significant differences in undamped natural frequency ($P < 0.005$) were shown between men and women; however, all of the other covariates were not statistically significant. The undamped, natural frequency was 83.9 ± 1.1 rad/s 79.7 ± 0.8 rad/s for men and women respectively. The damping coefficient was found to be 0.278 ± 0.003. The resulting natural frequencies are much higher than those reported previously for both men and women, even though the test configuration was identical to that used by Buhrman and Mosher. Additional analysis may be warranted to determine the cause of this difference.

BRIEFING: **Development of an Efficient Parametric Finite Element Human Body Model to Assess Protection for a Diverse Population/Phase 1: Baseline Mesh Generation and Parameterization -** Dr. Casey W. Pirnstill[1*], Mrs. Elyse Patrick[2], Mr. John Buhrman[1], Mr. Cong Chen[3], Mr. Abeselom Fanta[3], Dr. Matt Reed[3] and Dr. Jingwen Hu[3]; [1]711 HPW/RHCPT, WPAFB, Ohio; [2]Infoscitex Corporation, WPAFB, Ohio; [3]University of Michigan Transportation Research Institute (UMTRI), Ann Arbor, Michigan

INTRODUCTION: Rocket sled testing for USAF ejection seat and EGRESS PPE is often very costly (>$200k per test) and can contain a large series of tests per program (n>20) for airworthiness assessment. Through the utilization of accurate rigid body and finite element (FE) models predicting both seat performance and manikin loading, the number of rocket sled tests could be optimized and possibly reduced for future programs. Additionally, accurate FE models could help prioritize/determine optimal test configurations to evaluate performance in areas where the model predicts the most severe instances.

METHODS: We will present recent advances in the development of a rapidly scalable human body model. We developed an efficient parametric FE human body model considering the morphological and biomechanical variations among the population for assessing protection in aircraft ejections. In this first phase, an FE mesh for a baseline human model based on statistically predicted skeleton and external body surface geometries was constructed, and the baseline mesh was parametrized in such a way that it can be rapidly morphed into subjects with a wide range of human attributes. This study demonstrated the capability of the parametric human modeling concept.

RESULTS AND DISCUSSION: Results and discussion will cover the construction methodology and meshing performance of the described human body rapidly scalable models.

BRIEFING: CORA Analysis Comparison of Two Hybrid III 50th Aerospace Manikin Finite Element Models to Horizontal Impulse Accelerator (HIA) and Vertical Drop Tower (VDT) Manikin Tests – Mr. Anthony Ligouri, Elise Patrick; AFRL 711th HPW Wright Patterson AFB, Dayton, OH

INTRODUCTION: The ability to model the human and manikin dynamic response in the ejection environment is essential to understanding biomechanical response in environments that are too dangerous or impossible to test and to be able to make injury predictions in those environments. While a biofidelic human model in a full ejection environment remains the lofty goal of most of these modeling efforts, a necessary step and more feasible goal is to model a manikin under test conditions.

METHODS: The Aircrew Biodynamics and Protection (ABP) group of AFRL has developed two Hybrid III 50th Aerospace finite element (FE) models. One model, developed from a previously-modified LSTC Hybrid III 50th Automotive FE model, was created in conjunction with Temple University, and the other, based on AFRL GEBOD data, was developed in conjunction with engineering contractors ATA Engineering, Inc. and L3 Applied Technologies. Both models were evaluated in simulations of five HIA tests and five VDT tests with peak accelerations ranging from 6 to 15 G's where the boundary conditions driving the simulations were taken from physical tests conducted at AFRL.

RESULTS AND DISCUSSION: Sixteen biodymanic response measures were directly compared via CORA analysis between each model and the corresponding measures in the manikins from the matching test. CORA scores varied among the different measures and between the two models, but some trends were observed as peak acceleration increased. This analysis demonstrated the strengths and weaknesses of each model and highlighted areas needing further improvement.

TUESDAY: 1:30 PM – 3:00 PM
ALSS (PARACHUTES)
LOCATION: CRYSTAL 1/2
MODERATOR: Mr. Wally Simmons, NAVAIR FRC-East

BRIEFING: **Parachute Service Life Evaluation –** Warren Ingram, Michael Petersen, NAWCWD, China Lake, CA

INTRODUCTION: In an industry dominated by shrinking budgets and schedule delays, much emphasis is placed on continued use of existing assets. Textile components used in harnesses and parachutes, however, experience a highly variable reduction in strength over time in response to varying temperature, pressure, moisture, contaminants, and other environmental and usage factors. Often time is the only factor documented with any rigor. Determining current material strength therefore requires destructive testing of a handful of assets from a limited inventory. Similarly, determining the rate of strength degradation ideally would involve performing first article testing and periodic surveillance testing of fielded components. However, first-article testing is often waived and surveillance testing is usually not included in program plans. This paper documents ongoing efforts by the Egress, Deceleration, & Parachute Systems Branch of the Naval Air Warfare Center, Weapons Division, to evaluate the service life of textile components and quantify strength degradation with limited design documentation, limited surveillance data, and limited test assets.

METHODS: Build upon the existing body of knowledge (i.e. available first-article testing, surveillance testing, material degradation studies, and service life evaluations). The pros and cons of various statistical methods were evaluated.

RESULTS AND DISCUSSION: Extrapolations of strength degradation are possible with some risk. Some statistical methods provide limited or misleading representations of the family of fielded systems.

BRIEFING: **Analysis of Degradation of Strength and Elongation of Parachute Textiles –** Alyse Dannenberg, Michael Petersen; NAWCWD, China Lake, CA

INTRODUCTION: Predictions of loss of strength of parachute textiles include a variety of environmental and design factors. Many studies include repeat usage or other contamination from usage. Many emergency parachute systems, however, are only exposed to thermal fluctuations over time. This paper documents ongoing efforts by the Egress, Deceleration, & Parachute Systems Branch of the Naval Air Warfare Center, Weapons Division, to evaluate the degradation of parachute textile materials in a relevant thermal environment.

METHODS: In 2014, fifteen lots of commonly used parachute textile samples were installed in boxes with material characteristics similar to an ejection seat headbox. These boxes were then placed in full sunlight in the cockpit of a boneyard aircraft. Thermal sensors were placed to measure ambient air temperature, cockpit air temperature, and the temperature inside a test box. Thermal data is recorded annually. Test samples are removed semi-annually for destructive testing of strength and elongation.

RESULTS AND DISCUSSION: Lot 2 will be tested in Sept/October of 2018. Test results will be compared with previous sample lots.

BRIEFING: **Adapting Video Extensometer for Textile Materials to Provide Continuous Elongation Measurement –** Paul Runnells, Michael Petersen; NAWCWD, China Lake, CA

INTRODUCTION: Measuring the incremental elongation of textile materials is challenging. Current textile test specifications, such as PIA Test Method 6016, direct the tester to mark the material at 1% of the Minimum Break Strength (MBS) of the material and measure the elongation at 75% of the MBS. This method is sufficient as a standard for comparison for quality assurance acceptance, but severely limits engineering analysis. For one, it reinforces a linear approximation of elongation. It also interrupts quasi-static tests for variable duration, which can influence the geometric elongation and reorganization of carriers and increase data scatter.

METHODS: The author developed test methods and techniques to enable continuous measurement of elongation during tensile testing of textile materials.

RESULTS AND DISCUSSION: The test method met both the process and measurement requirements of the test specification, as well as provided continuous elongation measurements for all materials tested, with the exception of small diameter threads. It also dramatically reduces the time required to perform the test. Continuous elongation measurements clearly show the non-linear elongation of test materials. Test videos and elongation plots will be presented and discussed.

TUESDAY: 1:30 PM – 3:00 PM
ANTHROPOMETRY
LOCATION: CRYSTAL 3/4
MODERATOR: Dr. Daniel Mountjoy, Wright-Patterson AFB

BRIEFING: Combining Anthropometric Technologies for Confined Space Monitoring Modeling – Ms. Monique Brisson; 711th Human Performance Wing/RHXB, Wright-Patterson AFB, OH

INTRODUCTION: The Confined Space Monitoring (CSM) process is being redeveloped to meet the needs of the maintainer career field. Current protocol requires one attendant to have eyes on the

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maintainer at all times. The proposed CSM system strives to increase efficiency of the process and elevate safety of the maintainer through the integration of physiological and anthropometric sensors. The suggested system needs to ensure the monitoring capabilities do not present additional risk or burden during the execution of their tasks. To ensure that the system is functioning as designed and meeting these requirements, it is necessary to collect motion data to accurately characterize the movement of the individual in relation to the confined space and sensor system.

A FARO laser scan arm was used to record the hatch opening and much of the entrance, struts, floor, and top of the confined space for future use as CAD geometry to supplement modeling of CSM. The Nansense motion capture suit was donned with physio sensors to measure EKG, heart rate, and respiration. The subjects entered the hatch and crawled into the C-130 structure and simulated tasks within the wing. Subjects were also scanned with the Human Solutions VITUS whole body scanner to capture geometry and texture data. Future subjects will be representative of the maintainer population.

The Nansense motion capture suit and physio sensors were tested to determine if the wing material or obstructions would interfere with the wireless transmission. The motion capture suit performed well capturing and transmitting the subject's limb movement, driving the Nansense model in real-time to visualize the subject's mobility. Future project goals combine all of the mentioned technologies to produce a simulation of the subject moving within a confined space environment. Digital modeling and simulation of the confined space helps to identify hazards and provide new spatial monitoring capabilities.

BRIEFING: Ejection Seat Posture Modeling: Constructing Fidelity Profiles for Verified JPATS Manikins in the RAMSIS Digital Human Modeling System – Dr. Jeffrey A. Hudson[1,2], Jennifer Whitestone[1], Max Grattan[1,2], Christopher Lafferty[3], Lori Brattin[4], Andrew Koch[4]; [1]Crew Accommodation Laboratory (AFMC AFLCMC/EZFC), Wright Patterson AFB, Dayton, OH; [2]Infoscitex, Dayton, OH; [3]Engineered Anthro Services, LLC, Dayton, OH; [4]NAVAIR 4.6 Human Systems, Naval Air Station Patuxent River, MD

INTRODUCTION: During the digital design phase (or modification) of new aircraft, Digital Human Modeling (DHM) systems are very useful and cost-saving as "first-look" analytical tools in cockpit anthropometric accommodation assessments. With seated test participant data, properly collected and summarized, the fidelity of an anthropometrically verified DHM system can be increased by capturing and applying realistic initial position, posture and reach capability for a specific seat and associated flight equipment. Past efforts have characterized pilot accommodation requirements by generating multivariate boundary cases represented as tabled sets of body dimensions (e.g. JPATS and JSF Cases).

These dimensional lists of the Navy and Air Force multivariate boundary cases were transformed into 3D human figure models using the RAMSIS NextGen DHM system. The resulting 3D boundary manikins generated were anthropometrically verified through an iterative process of editing, measuring, and regenerating. To produce realistic positioning and posturing for these digital manikins in a seat, data were collected using a group of test participants, anthropometrically similar to these boundary cases. The participants were strapped into ejection seats, with and without full encumbering flight equipment and their positions and postures were recorded with 3D scanners while their reach capability was recorded with a coordinate measuring arm. Their collective position, posture and reach data were statistically summarized and used to properly position and place their counterpart RAMSIS DHM manikins in the seat.

After processing and summarizing the empirical test participant data associated for each boundary manikin, a resulting "fidelity profile" was applied, thereby capturing and representing real human performance and position given the interaction of a specific crew station seat, restraint system, and the appropriate Aircrew Flight Equipment (AFE). The anthropometrically verified DHM manikins can have dramatic increase in accuracy during evaluations of CAD cockpit design with the addition of fidelity profiles generated using test participant position and posture studies in the specific seat.

BRIEFING: Improving Fidelity of Digital Human Modeling Tools: Lessons Learned, Ongoing Research, and Program Applications - Lori Brattin Basham[1], Andrew Koch[1], Jeffrey A. Hudson[2,3], Jennifer Whitestone[2], Max Grattan[2,3]; [1]NAVAIR 4.6 Human Systems, Naval Air Station Patuxent River, MD, [2]Crew Accommodation Laboratory (AFMC AFLCMC/EZFC), Wright Patterson AFB, Dayton, OH, [3]Infoscitex, Dayton, OH

INTRODUCTION: There are many known advantages to utilizing Digital Human Modeling (DHM) software for early evaluation of cockpit design or upgrade. To date, however, none of the DHM software packages have been comprehensively verified and validated (V&V) for this purpose. A number of challenges stand in the way of this goal that force the user to rely on a significant amount of "engineering judgement" in their DHM design analysis. It is important that aircraft programs have a realistic understanding of DHM limitations and the risks that comes with these limitations.

In spite of this, there is the possibility of improving the analysis by collecting empirical data on human subjects and applying that to DHM manikins. This strategy has been used by NAVAIR on programs such as the USCG HC-27J and USN H-60S NexGen Gunner Seat. In these cases, however, either a prototype or production seat was provided for the collection of the human subject data. There is still the larger challenge of providing useful human subject data when the program involved doesn't have a physical seat to provide.

In several collaborative discussions and during a 30-day rotation of NAVAIR personnel to AFMC AFLCMC/EZFC, WPAFB, the concept of Seat Posture Modeling (SPM) for DHM use was discussed. The team agreed to a process for gathering human subject data with the FaroArm Coordinate Measuring Machine and various scanning technologies. During the rotation, data was collected on several ejection seats for utilization by the USAF in SPM efforts. NAVAIR efforts post-rotation include collection of data on several helicopter seats and comparisons to determine if generic, "seat family," or individual helicopter SPMs can be utilized to improve DHM fidelity, with differences in helicopter Pilot Flight Equipment (PFE) being taken into account as well. The SPM data has the potential to greatly improve DHM analysis and can be utilized for other modeling applications.

TUESDAY: 3:30 PM – 5:00 PM
ALSS (SURVIVAL)
LOCATION: CARSON 1/2
MODERATOR: Ms. Sarah Day, QinetiQ

BRIEFING: Iridium's Entry into Search and Rescue - Mr. Paul Steward; NAL Research Corporation, Manassas, VA

INTRODUCTION: COSPAS-SARSAT has long been the lead and very capable satellite alerting system for search and rescue (SAR) response. But a long overlooked capability has been the Iridium satellite system. This presentation will introduce the Iridium system, explain its benefits to SAR, and cover several SAR-related products.

CONCLUSIONS: The Iridium satellite system has significant capabilities beyond that of COSPAS-SARSAT for military entities and government agencies. These benefits include position accuracy, alert latency, operational security, tracking, and 2-way communications. Additional benefits also include both the size and weight of Iridium for use by military and government personnel.

BRIEFING: **Lighter Weight, Lower Bulk Materials for Inflatable Products –** Mark Weitz, Brock Sweckard; Kennon Products, Inc., Sheridan, WY

INTRODUCTION: Kennon Products, Inc. has been working with NAVAIR (PMA-202) and NASA to develop and design lighter, more compact, and more reliable emergency inflatables, namely life preserver units (LPUs) and rafts. Kennon is employing a new class of textiles that are 1/3 - 1/2 the

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weight density of traditional coated-woven materials for the same strength. With inflation and rigging hardware included, final product weights are about 1/2 the weight, and nearly 1/2 the packed volume.

METHODS: The principal challenge of working with these ultralight/thin materials has been that traditional seaming methods do not produce sufficient seam strengths. Kennon has developed proprietary seaming technologies that are providing strengths and burst pressures that meet or exceed those of incumbent models. Software tools allow for rapid changes in designs and the technology does not require traditional tooling, so designs can be readily scaled, and/or adapted to changing requirements and missions. Automated fabrication methods help reduce manufactured costs.

RESULTS AND DISCUSSION: Kennon is focusing on the development of the LPU-21 form factor, which also includes the inflation system, and a fabric "casing" that houses the bladders and inflation system. The casing also serves as the ergonomic interface to the wearer. The smaller volume of the packed bladders allows for a slimmer, more streamlined overall LPU package. Improvements in casing design provide better reliability, easier maintainability, and one-size-fits-most sizing. The fabrication technology is scalable, and once LPU-21 designs and testing are completed, plans are in place to develop survival rafts.

TUESDAY: 3:30 PM – 5:00 PM
BIOMECHANICS (ROTARY)
LOCATION: CARSON 3/4
MODERATOR: Mr. Lindley Bark, NAVAIR

BRIEFING: Seat Suspension Concept Effects on Rotary-Wing Operational Vibration Mitigation
- Suzanne D. Smith, PhD[1], Benjamin C. Steinhauer[1], William C. Glass[2], CDR Wilfred H. Wells[2]; [1]Air Force Research Laboratory, Wright-Patterson AFB, OH; [2]Naval Air Systems Command, Patuxent River NAS, MD

INTRODUCTION: Recent surveys aboard rotary-wing aircraft strongly suggest that aircrew are being exposed to operational vibration associated with the potential for health risk. The objective of this study was to evaluate the effectiveness of a seat suspension concept to mitigate vertical operational vibration and minimize health risk.

METHODS: A Blackhawk seat fitted with a magnetorheological damper system was mounted onto the Six-Degree-of-Freedom Motion Simulator (SIXMODE) located at the Air Force Research Laboratory (AFRL). Nine military volunteers were exposed to multi-axis flight vibration recreated in the SIXMODE. Seat system configurations included LOCKED (no damper), UNLOCKED ON (damper with variable viscosity), and UNLOCKED OFF (damper with constant viscosity). Triaxial accelerations collected at the seat interfaces and subject anatomical sites were used to estimate rms spectra. The ISO 2631-1: 1997 and MIL-STD 1472 were used as guidelines for health risk assessment.

RESULTS: The UNLOCKED ON and OFF configurations showed similar results; significant reductions ($P<0.05$) in the highest vertical acceleration peak associated with the blade passage frequency (~17 Hz), specifically at the seat/occupant interfaces, as compared to the LOCKED configuration. The weighted seat pan vibration total values (*VTVs*) were substantially reduced in the vertical direction; allowable daily exposures for minimal health risk increased from less than two hours to greater than three hours to around six hours.

DISCUSSION: Suspension seats can mitigate rotary-wing aircrew health risk. The specific effectiveness of variable viscosity dampers may depend on the vehicle vibration characteristics and the ability to tune the damper with respect to frequency. Additional improvement to aircrew performance may also require consideration of seat interface postural influences.

BRIEFING: EVALUATION OF MUSCLE ACTIVITY AND FATIGUE DURING PROLONGED EXPOSURE TO ROTARY-WING OPERATIONAL VIBRATION - Benjamin C. Steinhauer[1], Suzanne D. Smith, PhD[1], William C. Glass[2], CDR Wilfred H. Wells[2]; [1]Air Force Research Laboratory, Wright-Patterson AFB, OH; [2]Naval Air Systems Command, Patuxent River NAS, MD

INTRODUCTION: High levels of higher frequency vibration have been associated with tonic muscle reflex which may affect muscle fatigue during prolonged exposures. One objective of the study conducted to investigate military helicopter vibration mitigation focused on developing and testing methods for evaluating muscle electrical activity and fatigue coincident with prolonged operational vibration exposure.

METHODS: Nine military volunteers were exposed for one hour to Blackhawk multi-axis flight vibration recreated in the Six Degree-of-Freedom Motion Simulator (SIXMODE). Electromyography (EMG) data were collected every five minutes from EMG sensors located on the right and left thoracic erector spinae, right and left lumbar erector spinae, and the right gastrocnemius. Other physiological parameters collected during exposure included heart rate, breathing rate, and skin temperature. EMG data were also collected while subjects performed a back extension endurance test (Sorensen) before and after the one hour exposure. Tests were conducted for three seat configurations (suspension/no suspension).

RESULTS: All tests showed very low muscle activity with similar results in EMG median frequency and power spectral density (PSD) throughout the one-hour exposure. The results may have also been influenced by artifact. Heart rate and breathing rate remained constant while skin temperature rose slightly during the one-hour exposure. No significant differences were observed in the EMG median frequency during the extension tests conducted before and after exposure.

DISCUSSION: Alternative sensor technology and signal analysis techniques should be considered to effectively measure any tonic muscle reflex associated with operational vibration. The exposure time may need to be extended to elicit muscle fatigue behavior before, during, and after exposure. A true maximum voluntary contraction task may improve the comparison of maximum capability of muscle when determining fatigue. Understanding the physiological mechanisms and consequences of aircrew vibration exposure is imperative for developing effective mitigation concepts for minimizing the known health risk.

BRIEFING: Derivation and Analysis of a Vibrational Transfer Function for the Prototype 2 (PT2) Next Generation Gunner Seat – Adam E. Gohl, Gunnar A. Eskeland, Lindley W. Bark; Naval Air Warfare Center Aircraft Division, Patuxent River, MD

INTRODUCTION: The effects of back pain can be debilitating and are widespread among Navy helicopter pilots. According to a survey conducted by the Naval Postgraduate School, "631 pilots [of MH-60S] who responded to question 22 (Have you ever experienced back and/or neck pain during or immediately following a flight?), 556 pilots (88.1%) stated that they have experienced pain during or immediately following a flight" (Phillips, 2011). It should come as no surprise that vibrational exposure through the seat surface is understood to be a causal factor behind such back pain. The effects of back pain in naval aviators can result in diminished situational awareness, decreased combat readiness, and increased attrition rates. Although vibrational exposure is not the only variable contributing to back pain, better vibration characterization within the operational environment is a necessity for the design of enhanced seating systems.

METHODS: Two flight tests were conducted onboard an MH-60S aircraft equipped with an instrumented Prototype 2 (PT2) Next Generation Gunner Seat at Naval Air Station Patuxent River. The chosen instrumentation was a Svantek SV106 Human Vibration Meter and Analyzer in conjunction with two Larson Davis SEN027 triaxial accelerometers. The SV106 was a suitable choice due to its compact size and immediate availability. The meter has 6-channel parallel recording capabilities, allowing for one triaxial accelerometer to be hard-mounted to the floor of the gunner seat while the second was "soft-mounted" to the seat bottom. Data was collected for two flights using two data collection options provided by the SV106. The first collection method processed 1/3 octave vibration levels for every 100ms time step for the duration of the flight. This data along with recorded maneuver information allowed for exposure values to be calculated according to the standard ISO 2631-1 "Mechanical vibration and shock – Evaluation of human exposure to whole-body vibration – Part 1: General requirements." The second flight for which data was collected utilized the meter's WAV recording capability with the intention of recording pseudo raw time history levels for later processing and a more detailed analysis than is allowed by the 1/3 octave recording option.

RESULTS AND DISCUSSION: Vibration data was successfully captured in two formats for two MH-60S flights. A comparative evaluation of the two data collection methods is presented. A transfer function was derived and analyzed for the characterization of human body vibration in rotary wing aircraft.

REFERENCES:

Phillips, S, Andrea. (2011). The Scope of Back Pain in Navy Helicopter Pilots. Naval Postgraduate School. 25.

TUESDAY: 3:30 PM – 5:00 PM
CAD/PAD
LOCATION: CRYSTAL 1/2
MODERATOR: Mr. Bob Hastings, NSWC-IHEODTD

BRIEFING: Energetics Obsolescence – Alexander Woods; Naval Surface Warfare Center – IHEODTD, Indian Head, MD

INTRODUCTION: Energetics Sustainment has been identified as one of the key drivers of technology by the 2017 CAD/PAD Technology Roadmap. The CAD/PAD Propellant Obsolescence Team exists to anticipate problems to the supply of quality energetic components for the Cartridge Actuated and Propellant Actuated Devices used in the DoD, and to facilitate the implementation of solutions to those risks. This presentation will discuss implementation of best practices from SD-22 by the CAD/PAD team and specific initiatives being pursued by the team to address Roadmap objectives.

BRIEFING: CAD/PAD Conventional Ordnance Deficiency Reports and Engineering Investigations – Nicholas Schombs; Naval Surface Warfare Center – IHEODTD, Indian Head, MD

INTRODUCTION: This presentation will provide a summary of recent mishaps related to CAD/PAD, Conventional Ordnance Deficiency Reports (CODRs) and Engineering Investigations (EIs) that were supported for the U.S. Navy and U.S. Marine Corps. Status and key findings will be discussed.

BRIEFING: A-4 PAD Program: MK 16 and MK 82 Replacement – David Howe[1], Michael Cramer[2]; [1]Task Aerospace, Inc., Clearfield, UT; [2]Nammo Talley, Mesa, AZ

INTRODUCTION: The ESCAPAC Ejection Seat, used in the A-7, S-3, and A-4 aircraft, is equipped with the MK 16 Rocket Catapult and the MK 82 Seat Man Separator Rocket. In 2015 it was determined that the MK 16 and MK 82 could no longer be produced due to propellant materials obsolescence. Since the platforms operating the ESCAPAC seat had retired from DoD inventory, this impact was primarily felt by foreign militaries and commercial operators of the A-4 Skyhawk. Task Aerospace is working with Nammo Talley to consolidate requirements from all operators and develop a propellant replacement program using a commercial qualification process for Nammo Talley versions of these rocket motors. This paper will describe the program concept that is providing critical support for this important legacy egress system. It will also discuss the option for qualification that reduces dependency on valuable DoD resources by utilizing viable commercial resources.

TUESDAY: 3:30 PM – 5:00 PM
ANTHROPOMETRY
LOCATION: CRYSTAL 3/4
MODERATOR: Ms. Jennifer Whitestone, USAF AFMC AFLCMC/EZFC

Mobile 3D Head Scanning for Aircrew Helmet Sizing and Fitting - Dustin Levy[1], David ODell[2]; [1]Gentex Corporation; [2]NetVirta, Inc.

INTRODUCTION: Optimization of performance and protection of aircrew helmets requires proper sizing and fitting, which is often accomplished by technicians using a measuring tape, calipers, and "tricks of the trade," which makes the quality of the fit highly dependent on their experience. With the advancement of 3D scanning technologies, there's an opportunity to greatly reduce technician time and related costs of achieving a proper helmet fit.

Traditional 3D scanners are expensive, and fixed-site installations carry high set-up, training, and support costs. Portable scanners are available, but still with a relatively high price tag and training requirement. We'll demonstrate a mobile app that requires minimal set-up cost and training. In under a minute the app acquires an accurate (+/- 0.5 mm) and precise 3D head scan and processes it to identify the recommended helmet size. We'll also share results from our user evaluations and discuss future app enhancements to further improve sizing and fitting of aircrew helmets.

BRIEFING: Using 3D Surface Scanning in a Religious Accommodation of Personal Protective Equipment (PPE) Study – Ms. Rhoda Wilson; U.S. Army Research Laboratory, Aberdeen Proving Ground, MD

INTRODUCTION: Amid increasing diversity in the military, the contentious question of how best to accommodate religious practices without negatively affecting Soldier survivability and mission success has become critically important. In 2016, the Assistant Secretary of the Army (Manpower and Reserve Affairs), ASA (M&RA) put forth a directive to study the impact of religious practices on the effectiveness of Personal Protective Equipment (PPE).

Test participants were recruited for clean-shaven baseline and 4 faith-based concepts (hijabs, patkas with unshorn hair and beards, beards of varying lengths, and bulk hair [i.e. dreadlocks, cornrows, braids, or hair exceeding current Army bulk standards]). The participants donned 8 mask and helmet configurations: 4 protective mask conditions (M50, M52, M53, M53 with PAPR) were worn with and without the Advanced Combat Helmet (ACH) while performing a series of eight 1-minute long exercises in a protection factor chamber filled with corn oil simulant. Three-dimensional scans of the head, with and without helmet and masks, were obtained to quantify helmet/mask offset due to the faith-based concept characteristics.

Beards, hijabs, patkas and bulk hair degrade protection offered by negative pressure masks. However, Powered Air Purifying Respirators (PAPRs) (i.e., M53 with PAPR) met the Joint Service protection factor requirement across all faith-based concepts. Safety is one of the many factors of military necessity when high level decisions are made for the Army. In evaluating the impact of 4 faith-based artifact concepts on the operational effectiveness of PPE, Army leadership is provided technical guidance for handling certain requests for religious accommodation and technical data resulting in changes to Army policies and regulations. The current evaluation uniquely contributes to the advancement of engineering techniques used to improve the design of U.S. Army protective equipment and offers the opportunity to exchange technical information with the SAFE community.

BRIEFING: Female Calvaria Shape Digitization: Creating a Database of Scalp Shapes to be Used in Equipment Design – Ms. Casserly R. Mullenger[1], Mr. Jeffrey A. Hudson[1], Ms. Jennifer Whitestone[2,] [1]Infoscitex Corporation, Beavercreek, OH; [2]USAF AFMC AFLCMC/EZFC, Wright-Patterson AFB, OH

INTRODUCTION: The United States Air Force (USAF) Anthropometry Laboratory developed a head stabilization rig and 3D data collection method to collect point data, through hair, that could be used to represent the geometry of a scalp. This work was driven by the inadequacy of head scan data to capture scalp shape under hair. Previous methods of wearing a "bald cap" to compress hair mass during a 3D head scan led to inaccurate scalp anthropometry and increased head size estimates in female head scans due to hair length and volume.

3D point data on the scalp is collected with the FARO arm while the Artec Eva photogrammetric scanner produces a high resolution scan for the face and neck. Data from both steps are aligned using four landmarks and a software program developed by the Morphometrics Laboratory at Florida State University (FSU). The software uses the collected scalp point data to generate a smooth, polygonal mesh head form in proper relation to a 3D scan of each subject's face.

When quantifying accuracy above and below actual scalp scans (i.e. bald subjects), a standard deviation of 1.7mm was obtained. Generated scalp shapes were also compared for repeatability, resulting in surface deviations of not greater than +/-1mm as indicated on a color difference map. Given the ~15mm larger offsets of traditional head scans (with "bald caps" over hair), scalp representation is improved with this FARO arm method. This method will be used by three military services (US Marines, US Army, and US Air Force) with the resulting database being a much needed resource to improve helmet design.

WEDNESDAY: 7:45 AM – 9:15 AM
IN-FLIGHT PHYSIOLOGIC CHALLENGES
LOCATION: CARSON 1/2
MODERATOR: Dr. Lloyd Tripp, FAsMA, FAsHFA, USAF

BRIEFING: Determination of Degraded Physiologic State During Mild to Moderate Hypoxic Hypoxia Using the Holistic Modular Aircrew Physiologic Status (HMAPS) Monitoring System -
Barry S. Shender, PhD[1], Jessica Anderson[2], Phillip Whitley, PhD[3], Leon Hrebien, PhD[4], Jeremy Beer, PhD[5]; [1] Naval Air Warfare Center Aircraft Division, Patuxent River, MD; [2] Athena GTX, Johnston, IA; [3] Criterion Analysis, Inc., Miami, FL; [4] Drexel University, Philadelphia, PA; [5] KBRwyle Science & Space, Brooks City-Base, TX

BACKGROUND: To detect and predict the onset of an in-flight "physiological episode" (PE), the US Navy is developing the HMAPS, a physiologic monitoring/warning system that obtains real-time information about aircrew physiologic and cognitive status.

METHODS: HMAPS is an open-architecture, body-mounted, aircraft-independent system that directly measures pulse oximetry (SpO_2), pulse rate, ECG, skin temperature, acceleration, and ambient barometric pressure, temperature, humidity, and volatile organic compounds. It also derives respiration rate, pulse wave transit time, and heart rate complexity. HMAPS uses these data as inputs to three prediction-detection algorithms. A cognitive impairment index (CI) estimates cerebral cognitive reserve[2] and relates it to SpO_2 and multi-task performance[4]. A decision fusion algorithm[1] based on multiple SpO_2 sensor inputs predicts hypoxia severity (HS). A Summary State (SS) index fuses all the physiologic data to estimate overall status.

An improved HMAPS prototype was tested at the KBRwyle facility, Brooks City-Base, TX hypobaric chamber in the winter of 2017. Five male (182.5±7.8 cm; 93.0±5.4 kg) volunteers (Vs) gave their informed consent and were exposed to a stepped profile consisting of 10min at ground level (GL baseline), 10min at 10,000ft (10K), 10min at 14,000ft (14K), 20min at 17,500ft (17.5K), followed by 15min recovery at GL. Vs also wore a Masimo RAD-57 forehead SpO_2 and provided a subjective rating of symptoms (0(none) - 10(maximal)). Throughout the exposure, Vs performed the SynWyn multitask, which includes an addition, short term memory, and audio and visual vigilance tasks; computing composite (CS) and individual task scores and response timing every 20sec[3]. These indices have an arbitrary five point scale, with five as the maximum degraded state.

RESULTS: This discussion focuses on the most affected cognitive measure, math accuracy and response time. Only descriptive results are presented given the small dataset. Four of five Vs completed 20min at 17.5K. Mean SpO_2 and pulse rate (PR) differences between HMAPS and RAD-57 were very small (10K: 2.4±1.3% SpO_2; PR 0.5±0.4bpm; 14K: 1.1±0.9% SpO_2; PR 0.4±0.2bpm; 17.5K: 2.5±2.3% SpO_2; PR 0.9±0.4bpm). Mean change in math response time compared to GL ranged from -4.7±23.5sec (10K), 6.0±29.7sec (14K), to 49.9±46.2sec (17.5K), %correct fell by 8.6±26.0% (10K), 19.6±20.7% (14K), and 58.4±27.0% (17.5K). The corresponding SpO_2 values were 89.4±0.6% (10K), 82.0±1.8% (14K), and 72.9±4.8% (17.5K).

At 10K, HS predicted mild degradation after 40-140s at plateau in all five Vs and in three Vs by SS (after 1:20 to 8:20min); CI did not predict a decrease and no symptoms were reported (SpO_2=89.4±0.6%). At 14K, two Vs reported symptoms: one reported "noticeable" tingling at 20s and the other "mild" degraded concentration after 4:20min at plateau. For the latter, CI predicted onset of symptoms at 8min, with SS and HS indicating "*Decreased recent memory and calculations*"[1] (level 4). At 17.5K, individual subject differences increased, with four of five Vs reporting symptoms. CI fell to a moderate impairment level ranging from 20sec to 10min at plateau and as high as level 5 ("*Altered judgment, impaired coordination*"[1]) between 3 and 4:40min. For the three Vs reporting cognitive symptoms, first onsets were "mild" at 60s (SS=2.25, CI=3), or "moderate" at 4min (SS=2.5, CI=4 at 2:40min), or "no rating provided" at 8min (SS=3 and CI=5 at 4:40min).

While SpO_2 returns to baseline in less than 5min at recovery on air, CS was 19.0±15.9% lower than baseline after 15min at GL.

CONCLUSION: Subjects varied in their ability to report symptoms in a timely fashion while performing

SynWin, making it challenging to align subjective to objective data. However, the relative occurrence and magnitude of performance decline, physiologic responses, and changes in indices are encouraging. Further algorithm refinement will occur during 2018 using data from chamber, centrifuge, and in-flight testing.

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(2) Cammarota JP. 1988. IEEE Trans BME 45:1017
(3) Beer, et al. 2017. Aerosp Med Hum Perform 88(7):616-26
(4) Whitley PE, et al. 2016. Aerosp Med Hum Perform 87(3):289

BRIEFING: Advancement of Hypoxia Sensing Instrumentation: Detection via Automatic Speech Recognition Technology - Beth F. Wheeler Atkinson[1], Christopher T. Rarick[2*], Richard Simonson[2*], Brian Stensrud[3], CDR W. Tyler Scheeler[4], LCDR Daniel L. Immeker[5], LCDR David McEttrick[6], LCDR Lee Sciarini[7], LT Christopher Murr[7]; [1]Naval Air Warfare Center Training Systems Division (NAWCTSD), Orlando, FL; [2]Zenetex, Orlando, FL; [3]Soar Technology Inc., Orlando, FL; [4]Aviation Survival Training Center (ASTC), Pensacola, FL; [5]Chief of Naval Air Training (CNATRA), Corpus Christi, Texas; [6]Aviation Survival Training Center, Whidbey Island, WA; [7]Naval Survival Training Institute (NSTI), Pensacola, FL

INTRODUCTION: Physiological events continue to be relevant issues for Navy aviators considering the recent increase in the reporting of hypoxia-like symptoms across branches of the military (e.g., Hodge Seck, 2017; Mizokami, 2017). While common hypoxia symptoms include mild euphoria, cyanosis, nausea, visual difficulties, and speech distortion (Hawkins, 1964), observations during hypoxia training indicate large variability in individual experiences. Furthermore, there are questions whether this variability is due to true idiosyncratic differences or lack of reliability of instruments used to measure hypoxia (Milner & Matthews, 2012). For this reason, efforts are underway to advance sensor and alerting technologies (Cobham, 2015; Hodge Seck, 2016). Current initiatives focus predominately on physiological indicators; however, alternative mechanisms may be necessary additions. For example, Milivojevic, Milivojevic, and Brodic (2012) conducted a study in which they used speech analysis in order to determine the degree to which speech is distorted due to hypoxic conditions at different altitudes. This preliminary research suggests it is possible to use speech algorithms to identify the presentation of hypoxia, and possibly evaluate the degree of symptom severity. While this research provided a good foundation for the use of speech recognition technology in detecting hypoxia, questions remain regarding the utility, reliability, and validity of using such technology as part of a broader physiological events alerting system in aircraft. This presentation seeks to provide an overview of technological advances in recent years that could be leveraged to develop technology for alerting aviators to physiological or other stressors that could impact performance. Additionally, the presentation will outline the benefits of conducting research and development of this technology within a training environment due to instructional utility, as well as the ability to deliver a large sample of speech patterns that offer opportunities for harnessing the power of machine learning technologies for algorithm refinement and testing.

Author's Note: The views expressed herein are those of the authors and do not necessarily reflect the official position of the DoD or its components. This research is in support of efforts funded by sponsors including the Naval Air Systems Command (NAVAIR) PMA-205 Air Warfare Training Development (AWTD) program and PMA-273, the Small Business Innovative Research/Small Business Technology Transfer (SBIR/STTR) program, and the Naval Innovative Science and Engineering (NISE) program (Section 219).

[*]Mr. Christopher Rarick and Mr. Richard Simonson were employed by Zenetex at the time of this publication, participating in a paid internship in collaboration with Embry Riddle Aeronautics University.

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BRIEFING: **Real-Time Spatial Disorientation Identification: Can a Motion Perception Model Increase Aviation Safety? –** Jan Bos; AEOLUS/TNO, Soesterberg, The Netherlands

INTRODUCTION: Spatial Disorientation (SD) can trigger inappropriate control inputs that may lead to loss of control in-flight (LOC-I), or controlled flight into terrain (CFIT). Accident investigators who try to make sense of pilot actions during these events have limited capability to assess the contribution of SD. Hence, there is a need for a valid, accessible tool to analyze recordings of flight data for their potential to induce SD in pilots. In a collaborative research project, TNO and Boeing developed an "SD Investigation Tool." The SD tool is based on a human perception model consisting of mathematical transfer functions which represent the neural processing of vestibular inputs (semicircular canals and otoliths). We extended this model with an algorithm to identify vestibular illusions from the computed mismatch between the perceived and actual aircraft orientation. This mismatch is being visualized on the computer screen by animation of two aircraft images: one image showing the actual aircraft attitude, and another "ghost" image showing the attitude perceived by the pilot. The tool was validated with recordings of basic flight maneuvers, and also with data of actual airplane safety events. Already, the tool is being used in accident investigations. Apart from that, the tool's animation of SD seems to offer a powerful addition to SD education programs for pilots. In this presentation we will demonstrate the SD tool with different examples of in-flight safety events.

The next step will be combining the SD recognition in an online tool that also combines visual illusions and provides warnings real time in the relevant situations, especially during IMC landings of rotary wing aircraft.

WEDNESDAY: 7:45 AM – 9:15 AM
BIOMECHANICS
LOCATION: CARSON 3/4
MODERATOR: Mr. William Glass, NAVAIR

BRIEFING: Soyuz Landing Risk Characterization – Nathaniel J. Newby, Jacob B. Putnam, and Jeffrey T. Somers; KBRwyle, Houston, TX

INTRODUCTION: NASA has been returning U.S. astronauts to Earth aboard the Russian Soyuz vehicle since 2003. Forty-one Americans have returned to Earth from the International Space Station aboard 45 different Soyuz vehicles (some crewmembers have flown multiple missions), spanning 3 unique vehicle design designations (TMA, TMA-M, and MS). NASA has recently begun a systematic evaluation of crew injury outcomes during Soyuz landing.

METHODS: To date, 45 astronauts from NASA, ESA, JAXA, and CSA have consented to be part of this study. Medical data documenting landing injuries experienced by these crewmembers have been obtained from NASA's Lifetime Surveillance of Astronaut Health database. Additionally, health information about pre-existing conditions that may have contributed to or exacerbated a landing injury have been obtained. Most of these crewmembers have also met with the authors to discuss and document their Soyuz landing experience.

RESULTS AND DISCUSSION: Approximately one third of all crewmembers landing in the Soyuz experienced some type minor bruising or lacerations. Approximately 10% of crew in this study experienced an injury that required some level of medical follow up. These numbers are significantly higher than the Multi-Axis Dynamic Response Criterion (MDRC) model would predict from the drop test data. Possible explanations include: Soyuz landing impacts are harder than current estimates, spaceflight deconditioning makes crew more susceptible to impact injuries, the MDRC is not well adapted to the spaceflight environment, or some combination of these possibilities. Types and number of injuries documented will be presented along with a discussion of what is likely driving these outcomes.

BRIEFING: **Considerations in the Design of Future Crash-Protective Seating Systems –** Lindley W. Bark[1], Hadley M. Sulpizio[2]; [1]Naval Air Warfare Center Aircraft Division – Naval Air Station Patuxent River, Patuxent River, MD; [2]U. S. Navy Helicopter Sea Combat Wing, Atlantic, Naval Air Station Norfolk, Norfolk, VA

INTRODUCTION: Three primary knowledge voids limit design of advanced active crash-protective (CP) systems. First, crash pulses must be studied to assure crashes and non-crash events may be discriminated. Crash recorders are under development to record actual mishaps over time. Second, improved documentation of field injury and causative mechanisms is needed. Mishaps are investigated with primary focus on mishap cause and prevention. Human survival investigation focuses on what led to the outcomes for individual occupants. This information is often a lower priority and harder to obtain. Finally, the third void includes the long term chronic injury potential associated with accommodations provided to aircrew and countermeasures that may be employed to mitigate chronic injury problems.
DISCUSSION: The presentation will include a robust discussion about the three voids, action to date to address these voids and resolve injury issues with the minimal amount of existing anecdotal data, and will suggest strategies/programs to obtain actionable databases that will guide future hardware development.

BRIEFING: Aircrew Multi-Axis Vibration Exposure Aboard the UH-60L Blackhawk Helicopter - Suzanne D. Smith, PhD[1], Steven G. Chervak[2]; [1]Air Force Research Laboratory, Wright-Patterson AFB, OH; [2]Army Public Health Center, Aberdeen Proving Ground, MD

INTRODUCTION: Military aircrew continue to report back discomfort, pain, and injury associated with flying rotary-wing aircraft. The Army and Air Force have expanded their effort to characterize and assess aircrew vibration exposures during military flight operations. This presentation focuses on aircrew exposures aboard the UH-60L Blackhawk and compares to previously documented exposures on the HH-60M variant.

METHODS: Triaxial accelerations were collected at the seat interfaces to estimate the rms spectra at the pilot cockpit station, two crew chief mid-cabin stations, and two aircrew aft-cabin locations for typical flight test conditions. Comfort reaction and health risk were assessed in accordance with ISO 2631-1 and MIL-STD 1472.

RESULTS: A substantial acceleration peak was observed at ~17-17.5 Hz and associated with the Blackhawk aircraft blade passage frequency; the highest peak not necessarily occurring in the vertical direction. Comfort reactions primarily ranged from "a little uncomfortable" to "very uncomfortable". The majority of weighted seat pan vibration total values (pVTVs) during level flight were associated with the potential for health risk in less than 8 hours; the pilot and aft aircrew exposed to the potential for health risk in as little as 1-2 hours, and at risk for daily exposures lasting less than 8 hours.

DISCUSSION: Pilot level flight data aboard the UH-60L did show notably higher overall vertical rms accelerations (1-80 Hz) at the seat base, coincidental with higher weighted seat pan pVTVs for health risk, as compared to the HH-60M. Differences in the vibration suppression systems aboard the two variants most likely contributed but require more detailed analysis. Cushion material/condition and pilot posture may also have influenced the findings.

WEDNESDAY: 7:45 AM – 9:15 AM
ALSS
LOCATION: CRYSTAL 1/2
MODERATOR: Mr. Charlie Dixon, NAVAIR

BRIEFING: **Low Boom Flight Demonstrator Overview: Life Support and Crew Escape System Design Challenges –** Brett Pauer, NASA Armstrong Flight Research Center, Edwards, California

INTRODUCTION: NASA is currently designing and building the Low Boom Flight Demonstrator (LBFD) X-plane designated X-59 Quiet SuperSonic Technology (QueSST) that will demonstrate that aircraft can fly at supersonic speeds over land without producing loud sonic booms on the ground. The LBFD will be used to conduct community response studies to collect data on the acceptability of these lower sound levels and provide it to aircraft noise regulators. The LBFD is designed to be flown up to 60,000 feet and Mach 1.7. To save on cost and schedule, the LBFD is capitalizing on using flight proven hardware from other aircraft. NASA is designing and integrating the life support system, and providing a qualified ejection seat and canopy system previously flown on other aircraft. This presentation includes an overview of the LBFD aircraft and explains the challenges of integrating existing life support and crew escape systems into a newly designed aircraft flown at high altitudes.

METHODS: Developed requirements and conducted trade studies on potential flight proven systems leading to an integrated design.

RESULTS AND DISCUSSION: Led to the development of an integrated preliminary life support and crew escape system design. The considerations in the design development will benefit the SAFE community in understanding how to integrate existing equipment into new applications.

BRIEFING: **The FAILSAFE Team's Training for Aviation Life Support Systems in Tactical Aviation: A Return to Core Skills –** LCDR Amanda Lippert, PRC(Ret) Kyle Wood, LT Virginia DeBons, PRCS Stuart Gray, PRCS Todd Lepsch, PRCS Carl Smith, PRC Carlos Hunter, PRC Joshua Houser, PR1 Brian Wertz; NAVAIR, Patuxent River, MD

INTRODUCTION: In 2017, a trend of ill-fitting flight gear was identified as a potential contributing factor to Physiological Episodes in tactical aviation fleet and training squadrons throughout the U.S. Navy and Marine Corps. In an effort to increase the knowledge base and skillset of the maintainers who are responsible for the fit of this gear, the FAILSAFE Team developed and executed a plan to travel to every tactical aviation command in the Navy and Marine Corps to give hands-on training on fitting procedures and troubleshooting unique fitting cases.

METHODS: The newly revised curriculum targets aviation life support equipment that is specific to tactical aviation platforms. The Team consulted resident Subject Matter Experts within NAVAIR for each piece of gear in question, as well as the integration of the entire ensemble together. Subjective data was gathered from key individuals within the PEAT (Physiological Episode Action Team) and the Naval Safety Center, based on several months of observation during site visits to each command. The Team was then tasked to develop a plan to train maintainers at each command. While completing this training task in 2018 and continuing in 2019, the FAILSAFE Tiger Team will modify the curriculum as needed, so that it will remain relevant – essentially becoming a "living document" that will evolve with time and gain fidelity throughout the cumulative training period. Upon completion of the training task, the curriculum will remain available for maintainers and Aeromedical Safety Officers to reference as new maintenance personnel are brought in to tactical aviation commands.

RESULTS AND DISCUSSION: The FAILSAFE Team has revised curriculum, and taken on a new task of training maintainers in tactical aviation squadrons, with the goal of decreasing ill-fitting flight gear for aircrew, and potentially reducing the risk of Physiological Episodes. This training will have a direct impact on future maintenance practices, as well as the potential to save lives and prevent injuries during an aviation mishap, when we rely on aviation life support systems to work flawlessly.

BRIEFING: AirCrew Readiness Center of the RNLAF Takes Technology from R&D to Warfighter Readiness – LtCol Ted Meeuwsen, PhD; Center for Man in Aviation RNLAF, AEOLUS Human Performance Innovation, Soesterberg, The Netherlands

INTRODUCTION: With the arrival of the next generation airframes like the F-35, the operational effectiveness and flight safety of the 5th generation is highly dependent on the overall pilot readiness, performance and protection. There is a professional need and growing interest for training, sustainment and enhancement related to human performance. The need for affordability & commonality is felt by several countries. An integrated solution with a fundamentally game-changing approach is required, driven by aircrew and system needs, rather than commercial objectives and competition.

The Center for Man in Aviation (CML) of the Royal Netherlands Air Force (RNLAF) and several partners will therefore establish an AirCrew Readiness Center based upon Human Performance and Protection. This center will 1) incorporate a F-35 pilot fit facility NL (Pilot Flight Equipment above and below the neck, i.e. helmet and flight safety equipment), 2) have specific training and dynamic testing as an added value (like immersive simulation), and 3) have a joint innovation platform "AEOLUS" as a driver for research, technology development and product improvement to accelerate the innovation cycle.

This coordinated setup will stimulate leveraging knowledge and unique density of training facilities and research assets by means of creating a level playing field collaborative plant of contributing partners in Soesterberg, the Netherlands. A one-stop-shop will be established, enabling operators like F-35 pilots to perform PFE-(re) fitting-refurbishments, -training and -sustainment with a strong connection to research and innovation.

The AEOLUS joint innovation center should ensure serendipity and unreserved problem-solving capacity and knowledge flow to the related parties. Based on applied science and hands-on experience, the opportunity is given to solve common problems in the shortest cycle possible.

WEDNESDAY: 7:45 AM – 9:15 AM
TRAINING
LOCATION: CRYSTAL 3/4
MODERATOR: Mr. Mitchell Tindall, NAWCTSD

BRIEFING: **Virtual Reality to Enhance Training and Safety –** Miles Frampton[1], William Harris[2]; [1]NAWCWD, Point Mugu, CA, [2]NAWCAD, Patauxent River, MD

INTRODUCTION: Virtual Reality and Augmented Reality are cutting-edge and underutilized technologies that can be used to augment training through visualization, immersion, and repetition with very low costs. Our project, CRAGR-VR (Collaborative Route Adjustment and Gaming Rehearsal System – Virtual Reality), is working to bring these technologies forward to enhance training and safety.

METHODS: AVATAR, Advanced Virtual and Augmented-reality Technologies Arsenal, is utilizing commercial-off-the-self (COTS) virtual reality (VR) and augmented reality (AR) headsets and software to create an immersive experience for training. Our current version will be capable of assisting Navy Pilots in an immersive battlespace environment using a desktop computer.

RESULTS AND DISCUSSION: Evaluation of CRAGR-VR is scheduled to begin July of 2018. VR and AR have been pushed throughout the DOD as a means for cost-effective training and practice. Safety training and practice can also be enhanced using VR and AR.

BRIEFING: **Verification of Physiological Stress Levels in Firefighting Training -** James A. Pharmer, PhD; Naval Air Warfare Center Training Systems Division, Orlando, FL

INTRODUCTION: This presentation focuses on the challenges and lessons learned about data collection in extreme environments. More specifically, as part of the development of an advanced firefighting course, Surface Warfare Officers School (SWOS) funded the Naval Air Warfare Center Training Systems Division on an effort to use physiological data to verify whether trainees were sufficiently stressed during live firefighting scenarios at SWOS Mayport. Individual variability, the sensitivity of physiological sensors, and interpretation of data from multiple sensors can be challenging even in highly controlled laboratory conditions. Utilizing physiological indices to determine stress levels in a high heat (up to 180 degrees Fahrenheit) and high activity environment while wearing the personal protective equipment (PPE) associated with firefighting offers some unique challenges, especially with respect to currently accepted physiological stress indicators.

METHODS: Physiological data including heart rate, heart rate variability, respiration rate, galvanic skin response (electrodermal activity), and motion/activity data were collected and analyzed from a total of 10 trainees (4 novice and 6 advanced) in firefighting and damage control courses which incorporated scenario based firefighting training into the curricula. The data were collected during activities prior to and during firefighting exercises, which allowed the data analysis team to establish individual baseline for comparison to verify the stressfulness of the exercises.

RESULTS AND DISCUSSION: Results verified that both novice and advanced trainees do indeed demonstrate increased stress levels, especially anticipatory stress, during firefighting training scenarios. The approach used to collect physiological stress data in extreme conditions) during high workload firefighting activities has direct relevance to the SAFE community. Implications for the use of physiological data to support adaptive training in the firefighting domain will also be discussed.

BRIEFING: **Capabilities Based Acquisition for Training Systems –** Ms. Tiffany Parrish, Mr. Matthew Everson, Mr. John Owen; Naval Air Warfare Center Training Systems Division, Orlando, FL

INTRODUCTION: This presentation focuses on the application of capabilities based acquisition to training systems. During the acquisition lifecycle, activities ranging from front end analyses, design & development, and testing are all impacted by a capabilities centered approach. Guided by the science of learning, training acquisition professionals can ensure that training systems are acquired based on true capability needs for learning and transfer of training to occur (vice potentially unnecessary requirements being levied or the discovery during validation testing that capability requirements are not met).

In this brief, attendees will hear how the Naval Air Warfare Center Training Systems Division is approaching this paradigm shift. From the development of training needs analyses, the transition from analysis to design documentation focused on capabilities, and the test and evaluation of training systems based on capability requirements, the authors will cover lessons learned from recent and current programs. The identification and incorporation of training centered capabilities, to include appropriate instructional techniques, as applied to safety training has direct relevance to the SAFE community with respect to training and simulation and transfer of training to the work environment.

WEDNESDAY: 9:30 AM – 11:00 AM
OXYGEN
LOCATION: CARSON 1/2
MODERATOR: Ms. Christine Brown, NAVAIR

BRIEFING: **Sensor Development for Continuous Monitoring of Isopropyl Alcohol Air Contaminants –** Steve S. Kim,[1] Yen H. Ngo,[1,2] Michael Brothers,[1,2] Ahmad Islam,[2,3] Benji Maruyama,[3] Jennifer A. Martin,[1] Claude C. Grigsby,[1] Rajesh R. Naik,[1] and Steve S. Kim[1]; [1]711th Human Performance Wing, Air Force Research Laboratory, Wright-Patterson AFB, OH, [2]UES, Inc., Beavercreek, OH, [3]Materials & Manufacturing Directorate, Air Force Research Laboratory, Wright-Patterson AFB, OH

INTRODUCTION: Isopropyl alcohol (IPA), a main component of de-icer spray for commercial/non-commercial flights, has to be selectively detected due to its potential to contaminate flight breathing air from occasional accumulation/evaporation in the airplane structure during or pre/post flights. Moreover, IPA has been shown to act as an anesthetic and central nervous system depressant, resulting in symptoms that can deter the cognitive ability of the individual. Thus it is imperative to be able to monitor IPA content and accumulative exposure level.

METHODS: Previous attempts to detect solvents in a portable, potentially reusable, low cost platform have been limited by the difficulties of selectivity and/or sensitivity. Recent work demonstrating a colorimetric output upon IPA binding provided a novel proof of principle assay; however, quantitation and/or real-time detection were not achieved due to the limits in colorimetric techniques including the need to integrate an optical sensor and the difficulty in regeneration (irreversible nature). In this paper, we built off this previous work to generate an electrochemical IPA sensor output. In order to do this, we examined how SWCNT deposition, polymer composition and deposition, and redox chemical additives impact the performance of the sensor. The resistance of polymer-coated carbon nanotubes were measured to continuously monitor IPA level. Here, we developed electrochemical/electronic sensing technology that promises real-time IPA sensing.

RESULTS AND DISCUSSION: The basic foundation to further develop a sensor that is specific to IPA detection is established from this study. A sensor based on the methods described above drastically improved its performance while distinguishing IPA from other volatile organic compounds. The sensing results showed improved signal response demonstrating that the device is selective enough to detect IPA, exceeding the level of performance from commercially available state-of-the-art photoionization detectors. Developing a personal real-time chemical exposure sensor that enables the profiling/reporting of exposure data throughout an 8-24 hr. time frame will greatly benefit the general population's health and performance. Ultimately, the personal environmental and lifestyle data will converge with Big Data and cloud-based computing to play key roles in finding the right preventive, diagnostic, and treatment tools for the disease and/or occupational health issues.

BRIEFING: A Preliminary Look at Hypoxia Compared to Alcohol Intoxication - Beth F. Wheeler Atkinson[1], Jacob Entinger[1*], Mitchell Tindall[1], LT Christopher M. Gilg[2], LT Luke B. Scripture[2], LCDR Daniel L. Immeker[3], LCDR David McEttrick[4], LCDR Lee Sciarini[5], LT Christopher Murr[5]; [1]Naval Air Warfare Center Training Systems Division (NAWCTSD), Orlando, FL; [2]Aviation Survival Training Center (ASTC), Pensacola, FL; [3]Chief of Naval Air Training (CNATRA), Corpus Christi, Texas; [4]Aviation Survival Training Center, Whidbey Island, WA; [5]Naval Survival Training Institute (NSTI), Pensacola, FL

INTRODUCTION: The effects of alcohol consumption are well established in literature and well-known to society (Bailey, Bartholow, Saults, Lust, 2014; Casbon, Curtin, Lang, & Patrick, 2003; Beyond hangovers, 2017). Depending on the level of intoxication, common impairments include: euphoria, impaired judgement and motor skills, loss of coordination, nausea, and memory loss (Elmenhorst et. al., 2009; Vonghia et. al., 2008). As the symptoms and associated dangers resulting from alcohol intoxication are so well-established, other impaired states (e.g., sleep deprivation) are often compared to intoxication (Elmenhorst et al., 2009; Fairclough, & Graham, 2009; Powell et. al., 1999). Hypoxia, a condition that occurs because of a lack of oxygen in the blood, and a known impaired state in aviation settings (Phillips, Drummond, Robinson, Funke, 2016), shares many of the same symptoms associated with alcohol intoxication. These symptoms include mild euphoria, impaired cognitive function and memory, visual difficulties, and speech distortion (Hawking, 1964; Smith, 2008). Despite these similarities, few attempts have been made to explore whether or not the effects of hypoxia and intoxication are comparable. According to the Federal Aviation Administration (2009) an increase in 2000 feet of altitude is similar to an increase in .01% of blood alcohol content (BAC); however, these assertions have yet to be substantiated through empirical testing. This presentation will examine which symptoms are most commonly present at specific altitude/O_2 levels and the severity of those symptoms. Results will be compared to known symptoms and severity at specific BAC levels, and a taxonomy will be presented to visually display how these two types of impairments are related. This quantitative research provides a preliminary look at how hypoxia impacts the aviation community by illustrating the effects of hypoxia with a comparison that is understood by a broader audience.

Author's Note: The views expressed herein are those of the authors and do not necessarily reflect the official position of the DoD or its components. This research is in support of efforts funded by sponsors including the Naval Air Systems Command (NAVAIR) PMA-205 Air Warfare Training Development (AWTD) program, the Small Business Innovative Research/Small Business Technology Transfer (SBIR/STTR) program, and the Naval Innovative Science and Engineering (NISE) program (Section 219).

*Mr. Jacob Entinger was a participant of the Naval Research Enterprise Internship Program (NREIP) assigned to NAWCTSD at the time of this publication.

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BRIEFING: **Life Support System Oxygen Volume Requirements Analysis for X-59 Low Boom Flight Demonstrator (LBFD) Aircraft -** Kurtis R. Long; NASA Armstrong Flight Research Center, Edwards, CA

INTRODUCTION: NASA and Lockheed Martin are currently designing the Low Boom Flight Demonstrator (LBFD) X-59 aircraft; the X-59 will demonstrate that aircraft can fly at supersonic speeds over land without producing loud sonic booms on the ground. Since the LBFD will be flown at altitudes up to 60,000 feet, its NASA-designed life support system must provide sufficient oxygen for the pilot for routine operations, as well as emergency oxygen for use during emergency descent and/or post ejection descent. This presentation includes an overview of the LBFD aircraft oxygen system and details aspects of the analysis used to determine the required capacity of the LBFD's oxygen system.

METHODS: A set of fluid mechanics math models was developed to estimate the volume and volumetric flow rates of both the baseline Liquid Oxygen (LOX; the LBFD is NOT using OBOGS - Onboard Oxygen Generating System) and the compressed gas emergency oxygen system (EOS) for high altitude (60,000 ft.) ejection or "fly down" emergency scenarios. Analytic models developed for this project included component inflation volumes and leak rates, pilot/seat/parachute weight and drag, post-ejection descent rate and duration, EOS bottle flow variation with altitude and pressure, pilot respiration rate, and pressure breathing. These analytic models were validated and then used to evaluate both "typical" and "worst case" scenarios for oxygen volume requirements.

RESULTS AND DISCUSSION: This analysis indicates that the proposed LBFD oxygen system will safely support post-ejection descent from 60,000 ft. down to 10,000 ft. under extreme worst case conditions. This paper is of significance to the SAFE community because it presents the results of a recent volumetric oxygen requirements analysis for a somewhat unusual aircraft configuration.

WEDNESDAY: 9:30 AM – 11:00 AM
BIOMECHANICS (INJURY 2)
LOCATION: CARSON 3/4
MODERATOR: Dr. Adrienne Madison, USAARL

BRIEFING: **Evaluation and Verification of Head Angular Rate Sensors for Calculated Head Angular Accelerometer Head Criteria Risk in Dynamic Impact Events -** Dr. Casey W. Pirnstill[1*], Ms. Elyse Patrick[2] and Mr. John Buhrman[1]; [1]711 HPW/RHCPT, WPAFB, Ohio; [2]Infoscitex Corporation, WPAFB, Ohio

INTRODUCTION: Rocket sled testing for USAF ejection seat and EGRESS PPE is often very costly (>$200k) per test and can contain a large series of tests per program (>20) for airworthiness assessment. Recently the USAF has updated the head injury criteria requirements for testing and it now requires recording 3-axis head angular accelerations and 3-axis linear accelerations. Due to the size of historically-used head angular accelerometers and their high cost, this study evaluated using head angular rate sensors to replace the current head-angular accelerometers in the manikin head-forms. The study used in-house tower and sled testing followed by multiple test cases of rocket-sled tests with both angular accelerometer and angular rate sensors onboard for comparison.

METHODS: In this work we will present three separate test series evaluating match paired sensor testing of the proposed angular rate-based approach for determining USAF head injury criteria performance vs. utilizing traditional angular accelerometers. Initial studies will include data from human and manikins on WPAFB's Vertical Deceleration Tower (VDT) and Horizontal Impulse Accelerator (HIA) followed by rocket-sled tests utilizing both sensor configurations.

RESULTS AND DISCUSSION: Results of the three studies described on the VDT, HIA and Rocket-sled test track (over 100 impacts) illustrate the feasibility of moving to a smaller and cheaper form factor for utilization in impact testing while providing equivalent results during ejection related events.

BRIEFING: **Development of Lateral Lower Neck Injury Risk Functions for Hybrid III and THOR-K ATD –** Putnam, J.B. [1], Somers, J.T.[1], Newby, N.J. [1],Preston, G. [1], Yoganandan, N.[2], Humm, J.[2]; [1]KBRwyle, Houston, TX; [2]Medical College of Wisconsin, Milwaukee, WI

INTRODUCTION: In an effort to improve occupant safety during dynamic phases of spaceflight, the National Aeronautics and Space Administration (NASA) has worked to develop occupant protection standards for future crewed spacecraft. One key aspect of these standards is the development of spaceflight relevant injury risk functions for anthropomorphic test devices (ATDs). These injury risk functions are required for all load directions and to be accurate at low injury risk levels, as multi-directional dynamic loading of spaceflight crew is a high probability event under current vehicle designs. In this study lower-neck injury risk functions are developed for the Hybrid III and THOR-K ATD under lateral loading.

METHODS: Data were collected from THOR-NT far side impact, and THOR-K and Hybrid III full-restrained lateral tests performed at the Medical College of Wisconsin. Each condition was match paired to post mortem human surrogate (PMHS) testing. As different ATD's were used between the selected test series, finite element (FE) simulations of the THOR-K and Hybrid III were developed to predict the ATD response in these conditions. Survival analysis will be used to relate lower-neck ATD responses to measured injury outcomes

RESULTS AND DISCUSSION: Results identify response differences between the THOR-NT, THOR-K, and Hybrid III ATD's under lateral impacts. Differences are primarily driven by belt interaction and impact load level. Based on previous lower-neck injury risk development as well its improved belt interaction biofidelity, THOR-K response is expected to better correlate to the risk of lower-neck injury under lateral loading. Injury assessment reference values will be developed for lower-neck shear and bending moment for both ATDs.

BRIEFING: **Investigation of the Impact Performance of the U.S. Navy Flight Deck Cranial –** G. Alston Rush, Ph.D., Christian Gotsch, Rich Coughlan; Naval Air Warfare Center Aircraft Division, Patuxent River, MD

INTRODUCTION: The current Flight Deck Cranial, HGU-25, does not meet any impact protection standard, requirement, or specification, however, it has been in use for over 35 years as a head protection system for shipboard crews, ground maintenance crews, and civilian passengers aboard USN/USMC aircraft. The Cranial's design, and presumably its impact performance, has not substantially changed since 1949. In fact, the foam liner material was originally selected for its shipboard availability as a pipe insulator. Maintainer head protection has been neglected for decades even with the availability of Commercial Off-the Shelf (COTS) solutions that offer significantly better impact protection. The David Clark K10, Gentex APC-2G (formerly Aegisound ATI), and Creare's Flight Deck Cranial (FDC) helmets were developed under a Navy Small Business Innovation Research (SBIR) effort to meet a fleet need for improved head and hearing protection and have been used by NAVSEA, Joint Strike Fighter (JSF), and industry. Therefore, an investigation is warranted of the head protection performance of the aforementioned helmet systems and of the design space of the HGU-25.

METHODS: Impact Attenuation tests were conducted on the David Clark K10, Gentex APC-2G, Creare FDC, and HGU-25 according to the ANSI Z89.1-2003 standard for Type II, Class G helmets with the exception of environmental conditioning protocols and sample quantities. All helmet testing for this study was conducted at ambient temperature (70 ± 2°F), while the ANSI Z89.1 standard requires impact testing of helmets conditioned in cold, hot, and wet environments. Impact tests were performed in NAVIAR's Helmet Lab on a monorail drop tower using an ISO Size J headform. Tests were conducted on a minimum of three samples at an impact velocity of 3.5 ±.1 m/s with a headform assembly mass of 5.0 ±.05 kg. The APC-2G and FDC assets were previously used for fleet evaluation and were in good condition. All K10 and "current" HGU-25 (manufactured in 2014) assets were unused "out of the box" prior to testing. The "legacy" HGU-25 assets were used, fleet representative assets with an unknown usage history and noticeably different liners with a higher density foam, as compared to the "current" HGU-25 assets. Three consecutive drops were performed with a time interval of 30 ± 5 seconds for each helmet configuration at crown, front, and rear impact locations. The ANSI Z89.1 150 G acceleration threshold was utilized for comparative analysis. In addition, the Head Injury Criterion (HIC) and Gadd Severity Index (SI) have been included for analysis and will be compared against published injury thresholds. The performance of "legacy" and "current" HGU-25 Cranials were evaluated in comparison to "modified" Cranials with enhanced liners for improved head protection.

RESULTS AND DISCUSSION: The current HGU-25 failed to meet the ANSI Z89.1 150 G threshold for any impact. Impact tests of the current HGU-25 generally resulted in the highest peak G, HIC, and SI for any headgear tested in this study. According to accepted National Committee on Standards for

Athletic Equipment (NOCSAE) SI tolerances, a severe head injury (SI > 1000) would have resulted from any rear impact with the current cranial. In general, the legacy HGU-25 failed to meet the 150 G peak acceleration threshold, but it resulted in appreciably better results than the current cranial. Significant variation was observed between the legacy and current cranial liners and between legacy cranial test assets. The lack of configuration control for the HGU-25 has resulted in unreliable impact attenuation performance of the system. The impact attenuation results of the modified HGU-25, Gentex APC-2G, David Clark K10, and Creare FDC helmet systems are presented.

WEDNESDAY: 9:30 AM – 11:00 AM
ALSS (CLOTHING)
LOCATION: CRYSTAL 1/2
MODERATOR: Ms. Dana Anton, Wright-Patterson AFB

BRIEFING: Kerosene Fire Resistance on Pilot Flight Equipment in the French Air Force - Masseboeuf S., Riera C., DGA Aeronautical Systems (French Ministry of the Armed Forces), Balma, France

INTRODUCTION: DGA Aeronautical Systems conducts a large panel of fire resistance testing, mostly dedicated to prove compliance with the dedicated parts of FAR 25 regulations. As part of the French Ministry of the Armed Forces, DGA Aeronautical Systems has also developed specific fire test protocols to ensure satisfying aircrew protection based on its own feedback from past experience. Consequently, a kerosene fire resistance test has become mandatory for any Pilot Flight Equipment used in the French Air Force.

METHODS: Depending on the nature and size of the specimen under evaluation, two different test benches are operated. Kerosene burner is generally used to evaluate the fire resistance of small specimens which have no major interaction with the other flight equipment (e.g. gloves, socks, etc.). A larger kerosene tray is used with a fully equipped and instrumented manikin, set on a motorized seat support. Specimens are subjected to an F34 kerosene fire for a duration of 8 seconds with a 25 kW/m² heat flux and an average surrounding temperature of 900°C (1,650°F).

RESULTS AND DISCUSSION: The test is considered successful if self-extinguishability is reached within 5 seconds after the specimen is removed from the fire. Depending on the specimen under evaluation, additional success criteria may be requested. For example, for a flight jacket, attention will be paid to the integrity of the elements placed inside the pockets (electronic devices, first-aid kit, whistle, etc.) and of the buoyancy pads, that no material leakage can come in contact with the skin, and to the integrity of the internal parts of jacket. Even though this test protocol is very helpful to evaluate Pilot Flight Equipment together, the test conditions are often considered too severe to pass the success criteria.

BRIEFING: Strain Measurement on Pilot Flight Equipment – Mr. Shivprasad; Survitec Group, Birkenhead, UK

INTRODUCTION: Anti-G garments protect fast jet pilots from G-induced loss of consciousness (GLOC) which has contributed to many fatal incidents. The garments are mission-critical and expensive, so prolonging service life with the required performance characteristics is of great interest.

Strain distributions at some local areas within the garment are well-understood; however, the strain field distribution over larger areas and its impact on failure is less known. A series of experimental tests using 3D Digital Image Correlation (3D DIC) were conducted to analyse the full-field displacements and strains to potentially optimise the garment design. The areas of interest were identified. The identified areas were then analysed using a combination of strain gauges and a new and novel approach to strain measurement using conductive thread (string-gauges) to measure the directional strains and the effect of stitching, material grain orientation and attachment. The critical areas were where the zips are attached. The lateral stresses were indirectly measured using the string gauges to assess and ascertain the stress generated for selection of right zip strength. The webbings and cords which were subjected to loading were also put under test for measurement of strain. These strain values were then plotted against the strength of the material to obtain the correlation between the strain and strength of material. Additionally, the project undertook strain measurement on buckles. Buckles play a vital role in different garments from adjustment to load carrying. The conventional method of specifying the load requirements on a buckle accounts only for directional loading. Survitec undertook series of experiments and investigation to understand the loading on buckles for multi-directional loading to optimise the design of the buckles. The loading method and design methodology were analysed, simulated and validated in CAD/CAE against the experimental values obtained. The evaluation gave insight to the forces generated during the loading of the buckles. Based on the loading direction and conditions, optimum buckle designs were generated.

BRIEFING: An Innovative Approach to Reducing Weight and Volume in Aircrew Survival Equipment & Apparel – Ms. Elizabeth Brown; Survitec Group, Birkenhead, Merseyside, UK

INTRODUCTION: It has long been known that human and aircraft performance is impaired by excess weight and volume. In the confined environment of a modern-day cockpit, the demands on space and weight are at a premium as each aspect of the aircraft and the safety equipment worn on the human are in competition for the limited space or 'real estate' available. Additionally, the need to equip the aviator with more tools to combat the enemy in the event of a downed aircraft, as well as more survival aids and personal protection to survive in harsher environments, has driven the requirement to minimize the weight and footprint of other survival equipment stowed on the aircraft.
Survitec is a leading provider of below-neck aircrew safety equipment, responsible for numerous step changes in safety, particularly in relation to post ejection/emergency egress in-water performance and survival of aircrew. Working closely with industry partners, Survitec have utilized advances in textile technology and created innovative design solutions which reduce bulk and weight on three key survival products to date: Life Preserver Unit, Single Seat Liferaft, and a Rapid Don Exposure suit.

This presentation outlines the work undertaken to implement the weight and bulk reductions that the Survitec New Product Development Team have achieved to date on these products, the challenges encountered, and the testing undertaken to ensure that safety-critical performance characteristics were not compromised on these lighter-weight products, as well as considering the future development work needed.

WEDNESDAY: 9:30 AM – 11:00 AM
SAFETY/INJURY
LOCATION: CRYSTAL 3/4
MODERATOR: Mr. John Plaga, Wright-Patterson AFB

BRIEFING: Litter Patient Motion and Vibration During Transport Aboard the Ambulance Bus (AMBUS) - Suzanne D. Smith, PhD[1], David S. Burch[2], Brittany L. Fouts[2], Christopher S. Dooley[2]; [1]711 Human Performance Wing, Airmen Effectiveness Directorate (711 HPW/RHCPT); [2]711 Human Performance Wing, School of Aerospace medicine (USAFSAM/FHE); Air Force Research Laboratory, Wright-Patterson AFB, OH

INTRODUCTION: Military medical transport throughout the en route care (ERC) continuum exposes patients to dynamic motion and vibration that may influence patient health outcomes. The United States Air Force School of Aerospace Medicine (USAFSAM) has established the goal of characterizing the dynamic environment across transport phases and platforms to gauge impact on patients. The objective of this study focused on ground transportation via the AMBUS, a bus retrofitted for patient transport.

METHODS: Five patient locations were tested using three subjects positioned on standard litters attached to the sides of the AMBUS (left and right sides; mid and aft sections; mid and upper tiers). Triaxial acceleration pads were attached between the subject back and pelvis and the litter interface. Triaxial accelerometer packs were attached to the subject leg, chest, and head (using a bite bar). A total of four test runs were completed over a designated route at Wright-Patterson AFB with and without litter bracing by trained providers. Twenty-second data records were collected at designated sites during each test run. Each record was processed to generate the frequency spectra. The ISO 2631-1 guidelines were used to assess comfort.

RESULTS: A prominent vertical acceleration peak was consistently observed between 2 and 4 Hz. The highest overall accelerations were observed at the aft litter location. The effect of bracing was not clear and requires further analysis. Based on the ISO guidelines and the vibration total value *(VTV)* calculated at the pelvis interface, the patient would perceive the vibration as "uncomfortable" to "very uncomfortable".

DISCUSSION: The low frequency vibration and associated comfort reactions occurring during AMBUS transport strongly suggest the injured patient will experience pain and additional compromise to health outcome. Knowledge gained will improve the ability to configure the AMBUS to minimize motion and vibration during transport and improve the delivery of care.

BRIEFING: Retrospective Review of Causes in Military Ground Vehicle Accidents, 2010-2015 - Jennifer D. Dudek, MPH[1,2], James S. McGhee, MD MPH[1], V. Carol Chancey, PhD[1], Mary C. Clouser, PhD MPH[3, 4], Daniel V. Wise, M Ed [1,2]; [1]U.S. Army Aeromedical Research Laboratory, Fort Rucker, AL; [2]Laulima Government Solutions, LLC, Orlando, FL; [3]Leidos, San Diego, CA; [4]Naval Health Research Center, San Diego, CA

INTRODUCTION: A team from the Tank Automotive Research, Development, and Engineering Center (TARDEC) requested the Joint Trauma Analysis and Prevention of Injuries in Combat (JTAPIC) partnership conduct a retrospective analysis of casualties from ground vehicle accidents. The primary focus of the study was to examine accident narratives and casualty injuries to improve occupant survivability. The analysis included nonbattle related injuries and deaths sustained by U.S. Army Service Members in the following vehicle platforms: High Mobility Multipurpose Wheeled Vehicle (HMMWV), Mine Resistant Ambush Protected (MRAP), Stryker, and Family of Medium Tactical Vehicle (FMTV).

METHODS: The Survival Analysis Team of the United States Army Aeromedical Research Laboratory (USAARL) conducted a multistage retrospective analysis of ground vehicle collision, rollover, or collision with rollover accidents from 2010 through 2015. Cases were identified from multiple data sources and reviewed by a panel of military, civilian, and contractor subject matter experts. Statistical significance was set as $p < 0.05$.

RESULTS and DISCUSSION: There were a total of 365 accidents with 558 casualties (512 nonfatal and 46 fatal). Rollovers were the leading cause of accidents, casualties (both nonfatal and fatal), and injuries. Rollovers were most frequently caused by a sequence of driver actions and difficult environmental conditions. Overall, driver actions were the leading causes of all accident types.

This study identified several common trends among the vehicle platforms important to the development of strategies to prevent or mitigate traumatic injuries in ground vehicle accidents. Driver errors seemed to be rooted in drivers' failure to match driving maneuvers to the vehicle characteristics and environmental conditions. These findings have implications for doctrine, training, and vehicle design. Further study regarding driver attitude and training methods is needed. As expected, unrestrained occupants sustained more injuries and injuries of greater severity compared to restrained occupants.

BRIEFING: Cramped Workstations Aren't SAFE: An Investigation into Aircrew Musculoskeletal Pain - Dr. Daniel Mountjoy, Ms. Andrea Wolf, Mr. Corey Shanahan, Maj Bryan Jackson, and Capt Daniel Neal; Air Force Research Laboratory, 711[th] Human Performance Wing, Wright-Patterson Air Force Base, Dayton, OH

INTRODUCTION: An investigation was launched on behalf of an aircrew community at the request of a squadron flight doctor who was compiling anecdotal evidence of musculoskeletal injury related to poor workstation accommodation. A 2015 survey from the community revealed that 75% of the respondents were experiencing back-pain. Armed with this evidence, an effort was launched to examine the risk of work-related musculoskeletal disorder (WRMSD) development associated with the crew workstations. The effort included interviews, administration of a discomfort survey, recording of traditional and digital 3-D workstation measurements, and biomechanical risk analysis of aircrew postures. Workspace and postural data were compiled and compared to established design standards to determine the ergonomic suitability of the current aircrew workstation configurations. Additionally, representative crew postures were analyzed for risk of developing musculoskeletal disorders using the Rapid Upper Limb Assessment (RULA) tool.

RESULTS AND DISCUSSION: Results revealed a high number of areas non-compliant with MIL-STD-1472G specifications, and high levels of risk of developing WRMSDs. Recommendations have been made for task changes and workstation reconfiguration.

WEDNESDAY: 11:15 AM – 12:15 PM
ALSS (SOLUTIONS HEAD-TO-TOE)
LOCATION: CARSON 1/2
MODERATOR: Mr. Mike Jaffee, NAVAIR

BRIEFING: Technology Improves Hearing Protection, Mission Effectiveness and Situational Awareness for Commercial and Military Aircrew/Aircraft Maintainers – Collier, Michelle, Gentex Corporation, Boston, MA

INTRODUCTION: Hearing protection, speech intelligibility, and situational awareness are problematic in and around most commercial and military aircraft flown today, negatively affecting long-term hearing health, and mission effectiveness and endurance of aircrew and aircraft maintainers. To better address this, Gentex Corporation developed Gentex Wire-Free Communication Earplugs (WCEP) and True 3D Hearing Technology (T3HD).

The WCEP achieves dual hearing protection and improved passive noise attenuation for clearer communications, while providing redundant operations to existing equipment speakers. Operating on the principle of Near Field Magnetic Induction (NFMI), communication wires to the earplug are eliminated, simplifying helmet donning and doffing, and eliminating snag and hot spots allowing for enhanced performance, safety, and comfort. The WCEP are easy to use with CBRN gear as they eliminate the need to have wires pass through equipment.

T3HD restores and enhances "natural hearing" for improved situational awareness and robust hearing protection.

BRIEFING: SPURS – A Boot Mounted LIDAR System to Aid in Parachute Landing - Michael R. Sedillo, Air Force Research Laboratory, Wright Patterson Air Force Base, OH

INTRODUCTION: Parachutists are frequently injured when they misjudge their height above ground causing them to mistime their canopy flare or do not flare at all because they did not see the ground at night. Military paratroopers often listen for their equipment suspended on drop lanyards to hit the ground as an indication of their impending ground impact. This is not always effective in high-noise environments or simply because they do not have suspended equipment. The Air Force Research Laboratory's BATMAN Team is developing an ankle-worn device for parachutist that accurately measures the distance-to-ground and notifies the jumper as they descend to various predetermined altitudes. This lightweight, portable device, called SPURS, is especially useful during night jumps when the ground is not visible, thereby providing the parachutist notification to prepare to land. The SPURS device is the first component of a larger system in development by the BATMAN Team intended to improve the overall safety of parachutists.

WEDNESDAY: 11:15 AM – 12:15 PM
U.S. AIR FORCE RAPID ACQUISITION INITIATIVES
LOCATION: CARSON 3/4
MODERATOR: Ms. Jennifer Farrell, Wright-Patterson AFB

BRIEFING: Human Systems Program Office Physiological Monitoring Initiatives – Lt. Jessica Farris; AFLCMC/WNU, Wright-Patterson AFB, Dayton, OH

INTRODUCTION: The USAF has been dealing with Unexplained Physiological Episodes (UPEs) for several years on multiple platforms. Currently, there is an ongoing UPE problem in the T-6A Texan II training aircraft at all Undergraduate Pilot Training (UPT) bases. Unfortunately, the world of physiological monitoring is in its infant stages when it comes to integration with aircrew and aircraft. During the recent string of UPEs in the T-6, it became apparent that the need for physiological monitoring was crucial in understanding aircrew physiological characteristics in flight. Due to the urgency, the Human Systems Program Office tested and fielded a device called SPYDR produced by Spotlight Labs, LLC. The device is an ear cup mounted pulse oximeter that measures blood oxygen concentration, heart rate characteristics, g maneuvering, and cabin pressure during flight. It also has the ability to warn aircrew of physiological symptoms real-time in the cockpit. The USAF has a need to fully understand aircrew physiology to better protect them in flight and over time. Devices like SPYDR will allow commanders to make decisions on aircrew and aircraft based on objective data rather than subjective data. Ultimately, SPYDR may be one of many devices that make up a future physiological monitoring suite.

BRIEFING: USAF Female Aircrew Flight Equipment Challenges – Capt. Nina Rourke, AFLCMC/WIS, Wright-Patterson AFB, Dayton, OH

INTRODUCTION: The mission of the USAF Human Systems Program Office is to "Save or improve Airmens' lives." While there are countless Aircrew Flight Equipment (AFE) items that are fielded and sustained to meet the needs of the entire flying Air Force community, a number of gaps have been identified with respect to female-specific (but not female-exclusive) requirements. Historically, the aircrew community has been dominated by men, but as a consequence of living in a digital age, the relatively few women in that community have been able to form a network of communication and support. This has highlighted clothing and equipment specific safety concerns, eventually gaining the support of Air Force Chief of Staff General Goldfein, who was quoted as saying, "What we're finding is that women have been flying for years wearing gear that's been designed for men." This problem is the result of cultural challenges, inefficient processes, poor communication, monetary restrictions, education shortfalls, and the simple reality that women are a minority in a world that develops requirements based on the needs of the majority. If the U.S. Air Force fails to address these concerns, not only is the safety of current aircrew at risk, but recruitment will continue to be an overwhelming obstacle for a pilot-poor Air Force. This presentation outlines the equipment challenges faced by female aircrew, describes the Human Systems Program Office's efforts to address those challenges, and highlights the roles of key stakeholders in the traditional acquisition process.

WEDNESDAY: 11:15 AM – 12:15 PM
TECHNOLOGY INTEGRATION
LOCATION: CRYSTAL 1/2
MODERATOR: Mr. Fillip Behrman, NAVAIR

BRIEFING: SAFE Integration of Small UAS – Ms. RaNae Contarino; R Cubed Engineering LLC, Palmetto, FL

INTRODUCTION: Prior to this century, the National Airspace System (NAS) was primarily used by manned, commercial private or public aircraft – the exception being model airplanes that were flown within line-of-sight of the operator, in low altitude airspace, and controlled by radio or tether. Within the last decade, tens of thousands of small Unmanned Aircraft Systems (UAS) have entered the NAS; and the single greatest fear of all stakeholders is a collision between a manned aircraft and UAS. The very largest UASs, developed for military and national security purposes, are few in number, not weight critical, and equipped with collision avoidance technology; but the smaller UASs have severely constrained SWaP (Size, Weight and Power) capacity, limiting any potential to be equipped with integrated collision avoidance technology – until now.

To be effective in the NAS, a CAS (Collision Avoidance System) must geospatially know where it is and where all other proximate aircraft are. It must be capable of communicating with legacy transponders and NextGen ADS-B transmitters, as well as with ATC which can provide non-cooperative primary radar contacts in addition to cooperating (transponding) aircraft. To be fully functional, a UAS' CAS must operate like a much larger, commercial CAS, including the capability to interrogate other aircraft when outside ground radar coverage. With the FAA's mandate for all aircraft to equip with ADS-B transmitters by January 1, 2020, a UAS operating in the NAS will need to transmit/receive on either 1090 MHz, 978 MHz or both to ensure complete traffic information. Technology advances in the past decade have resulted in micro-electronics that can provide all of the required functionality in a very tiny package, smaller and lighter than a smartphone – and more powerful.

This briefing is based on actual prototype designs that have been flight tested in a U.S. Navy SBIR project.

BRIEFING: **The Use of Mobile Technologies in the Navy for Training -** Jesse Gusse; Naval Air Warfare Center Training Systems Division, Orlando, FL

INTRODUCTION: What Mobile technologies fundamentally give individuals in their personal lives is the ability to access multiple tools in a single device (instant information access, phone, entertainment, GPS, camera, etc.) and they give it to them wherever they are. The benefits of having this technology at their fingertips cannot be overstated.

The use of mobile technology in the Navy could potentially offer the same benefits; enabling just in time training for safety. However, some unique hurdles need to be overcome. Most notably cost and cybersecurity concerns have limited the ability to introduce widespread mobile use in the Navy. Additionally, in many cases mobile devices have been introduced to Sailors with a very limited set of abilities turned on and therefore have limited their interest in embracing them.

Cybersecurity has placed a requirements path on mobile devices that is very costly. IT Lifecycle maintenance costs have always been a heavy burden, but the recurring cost for security management of the devices has driven the price to levels that makes it unsustainable for most communities. Additionally, mobile devices have been placed in Sailors' hands but have had limited functionality. To many sailors the cons still outweigh the pros because they were not able to use the device in the ways they expected. Mobile devices need to be introduced in a way that enables all the benefits of the technology, otherwise it becomes a burden.

This paper will discuss the challenges that have been encountered when trying to introduce mobile devices, the efforts underway to address them, and what could be possible.

WEDNESDAY: 11:15 AM – 12:15 PM
SYSTEMS APPROACH TO ENGINEERING
LOCATION: CRYSTAL 3/4
MODERATOR: Mr. Eric Schwartz, NAVAIR

BRIEFING: SAFE at Any Speed - Can We Make Things Too Safe? – Plaga, John; Human Systems Integration Directorate, Human Performance Wing, Wright-Patterson AFB, Dayton, OH

INTRODUCTION: System safety improvements and safety culture have undergone a revolution since the 1960's when many automobiles were still offered with seatbelts as an option and child car seats were basically miniature seats loosely strapped into the car with little or no restraints. Other safety improvements have been made as a result of computer technologies and digital control systems such as the Automatic Ground Collision Avoidance System (Auto-GCAS), anti-lock braking systems, traction control, backup cameras, lane departure warnings, and even Tesla's Autopilot feature. Although many of these technologies greatly improve the safety of operators, passengers, and pedestrians/bystanders, any unintended consequences that may result from these safety systems need to be known by the designers and stakeholders. These unintended consequences can create other safety issues, may reduce the ability of the operator to perform his or her duties, or result in the safety system not being used or being used improperly. Other unintended consequences include the negative learning that is associated with using one system with particular safety systems that are not on another similar system. This briefing will provide several examples where safety systems can create adverse conditions or have a negative impact on DoD mission execution and how these potential effects must be considered during requirements development, design, and verification of the system.

BRIEFING: Deriving Engineering Solutions by Virtual Testing - Aamir Jafri; Naval Air Warfare Center Aircraft Division, Patuxent River, MD

INTRODUCTION: Computer simulation and virtual testing is extremely important to execute a viable engineering solution. A complex physical system in an interior or exterior of any environment (automotive, aerospace, military vehicles, etc.) that undergoes an extremely aggressive loading cannot be directly designed using hand calculations especially in the event of indirect load transfer to the structure. Numerical solvers exist which can be used to resolve complex models undergoing a plastically non-linear stress and strain material deformation. The results obtained through the analysis/calculation of these solvers are used prior to the physical testing to mitigate risk and increase confidence by the design, certification and product development engineering team before performing a physical test or freeze the design.

DISCUSSION: The health of the physical product design depends on an intelligent usage of virtual testing methods. Protocols for best practices are explained in different industry documents (used by the SAE aircraft seat committee and LSTC-AWG members) which can be followed for reference. Successful employment of virtual testing depends on the following:

1- Reducing variability from the complex system
2- Verification
3- Validation
4- Factor of safety
5- Prediction

REFERENCES: ARP5765, AC-20-146A and LSTC AWG-MDG

WEDNESDAY: 1:15 PM – 2:15 PM
NAVAIR SYSTEMS ENGINEERING TRANSFORMATION
LOCATION: RENO BALLROOM
MODERATOR: Ms. Maria Thorpe, NAVAIR

This panel provides an in-depth discussion regarding NAVAIR's Systems Engineering (SE) Transformation command initiative. The objective of this initiate is to reduce weapon development cycle-time by at least 50%.

The development cycle-time for major weapons systems have become excessively lengthy, up to 15 years, while the threat cycles from our adversaries have continued to accelerate.

Our current paper-centric engineering practices are not optimized for modern complex weapon system development. Several key engineering challenges have driven traditional engineering practices towards obsolescence. These challenges include dramatic increases in system complexity, connectedness, security, and compressed development time-lines. The complexity of modern weapons systems continues to rapidly increase driven by exponential growth in system connectivity, interdependencies, and information flow. Also, our increased dependence on networked systems to deliver effective warfighting capability has, in turn, greatly increased system vulnerability as a target. And finally, our workforce has evolved to be more geographically, functionally, and culturally distributed.

To meet these challenges requires a transformation of the engineering workforce, tools, processes, and practices. Today, such transformation is possible given recent advances in High Performance Computing (HPC) and formal modeling language, tools, and methodology.

The briefing will discuss the elements of the SE Transformation, implementation strategy, and the deployment status of the transformation.

Jaime A. Guerrero, SSTM, AIR-4.1 SE Transformation Director,
Naval Air Systems Command (NAVAIR)

Mr. Jaime Guerrero is the Director of SE Transformation at Naval Air Systems Command (NAVAIR), Patuxent River, MD. He is responsible for leading the execution and deployment of the SE Transformation initiative across the NAVAIR enterprise. Mr. Guerrero joined the civilian ranks at NAVAIR in the early 90s after serving several years in military uniform. Since then, he has worked on several major weapons systems including F/A-18 and F-35. Mr. Guerrero currently serves as a Senior Scientific Technical Manager. He is a NAVAIR Associate Fellow and holds a BS and MS degrees in Electrical Engineering from Texas A&M and Virginia Tech respectively.

WEDNESDAY: 2:30 PM – 3:30 PM
USAF AND USN ACQUISITION PM BRIEF
LOCATION: RENO BALLROOM
MODERATOR: Edgar A. Poe III

This panel provides an update from Service Acquisition Office Leads on current and future aircrew protection equipment development and acquisition programs.

A question and answer session will follow after each Service presentation.

Presenters include:

UNITED STATES AIR FORCE – EMILIO “V” VARCARCEL, Senior Materiel Leader, Human Systems Division

Emilio “V” Varcarcel is the Senior Materiel Leader, Human Systems Division, Agile Combat Support Directorate, Wright-Patterson Air Force Base, Ohio. Mr. Varcarcel is responsible for providing advanced performance, survival and force protection capabilities to US and allied air, ground, and naval forces. His responsibilities span development, production and sustainment of human-centered systems including aircrew life support, egress, survival, nuclear/biological/chemical defense, aeromedical/aerovac equipment, medical information, safe-to-fly certification testing, AF uniforms, and aircraft mishap analysis.

In 1983 Mr. Varcarcel started his 20-year military career at Holloman AFB, as an ICBM guidance systems test engineer, followed by another test assignment at Eglin AFB, certifying aircraft compatibility of multiple developmental weapons on F-111, F-15E, F-16, F-4E, and RF-4C aircraft in support of the SEEK EAGLE certification effort. He was a member of the GBU-28 Bunker Buster bomb development team and led the team that tested and certified it on the F-111 in a record 17 days during Operation Desert Storm. The GBU-28 was successfully employed prior to the end of the conflict. In 1994 he was assigned to the C-17 System Program Office as the Program Manager for Test and Modification. He executed over 2,200 modifications in under 6 months and delivered 16 fully modified C-17s to AMC in order to achieve critical IOC milestone on time. He was handpicked by Brig Gen Johnson in 1997 to lead his Director's Action Group, where he was accountable for control/release of program information and interfacing with congressional staffers and higher HQs. In Dec of 1997, Lt Col Varcarcel moved to HQ AFMC/DR as Chief of the Planning & Programming Branch. Responsible for all PPBE decisions for the Product Support Business Area's $8.5B POM submission and execution of $1.88B annual budget. He was then assigned to AFSAC where he led the CENTCOM and PACOM/SOUTHCOM Support divisions. Managing AFMC's FMS country programs for 12 Arab and 37 Asian and South American nations with total sales exceeding $37B in support of COCOM's strategic objectives. After retiring in 2003, he worked for H.J. Ford and Dynamics Research Corporation for three simultaneous consulting efforts within the F-16 Program Office, AFRL/XP, and AFSAC organizations at Wright-Patterson AFB. In Feb 2005 he returned to Federal Service as a civil servant in HQ AFMC/A2/5 where he led multiple AFMC/CC directed initiatives such as the Aging Aircraft Replacement Strategy and the Organizational Consolidation & Workload Assessment (OCWA). In Sep 2007 he became the Chief of International Programs for the Large Aircraft Infrared Countermeasures (LAIRCM) Program Office. Responsible for all Foreign Military Sales programs of the LAIRCM system, with total sales exceeding $700M and responsible for integration/support of the LAIRCM aircraft self-defense system into 10 different aircraft types, totaling 63 military and 12 Head of State aircraft. In Feb 2012 he was assigned as Deputy Division Chief within the Capability Planning Directorate, responsible for SBIR programs and execution of ASC/CC's High Velocity Life Cycle Management (HVLCM) initiative and supported the transition of acquisition processes to the new Air Force Life Cycle Management Center. The team successfully captured all existing processes, and instituted pilot programs to improve problem areas. He was next promoted as Chief of the Acquisition Services Division, Acquisition Excellence Directorate, as well as PM in Charge of the SCAT 1 (ACAT I equivalent services acquisition program) Engineering, Professional, and Administrative Support Services (EPASS) Program Office reporting to AFPEO/CM. EPASS was AFLCMC's first-ever $5B A&AS strategic sourcing initiative responsible for acquiring the services of 5000+ support contractors across all AFLCMC installations. AFLCMC and AFMC leaders praised this revolutionary strategy and OSD (AT&L) called it a "game changer."

EDUCATION

1983 Bachelor of Science, Aeronautical Engineering, Embry-Riddle Aeronautical University, FL
1986 Master of Science, Industrial Engineering, New Mexico State University, NM
1987 Squadron Officer School
1996 Advanced Acquisition and Sustainment Management, Air Force Institute of Technology, WPAFB.
1997 Air Command and Staff College
1998 Advanced Test and Evaluation Course, Naval Postgraduate School, Monterrey, CA.
1998 Advanced Program Management Course (APMC), Defense Systems Mgt College, Fort Belvoir, VA.
2000 Middle East Orientation Course, USAF Special Operations School, Hurlburt Field, FL.
2000 FMS Management, Defense Institute for Security Assistance Management, WPAFB, OH.
2008 Acquisition Leadership Challenge Program - II (ALCP-II), Atlanta, GA.
2009 Air War College
2012 Air Force Civilian Leadership Course, Richmond, VA.
2015 Acquisition Leadership Challenge Program - III (ALCP-III), Atlanta, GA.
2015 Capitol Hill Workshop, Dayton, OH.

ASSIGNMENTS

May 1983–Aug 1986 Test Eng., Central Inertial Guidance Test Facility, 6585th Test Gp, Holloman AFB, NM.

Sep 1986–Jun 1991 Asst. Chief, Stores Compatibility Section, Office of Aircraft Compatibility, 3246th Test Wing, Eglin AFB, FL.

Jul 1991–Jul 1994 Commandant of Cadets, Asst. Professor of Aerospace Studies, AFROTC OL 755A, Mayaguez, PR.

Aug 1994–Dec 1997 Program Manager, C-17 Test & Modification; Chief, Director's Action Group (DAG), C-17 Systems Program Office, Wright-Patterson AFB, OH.

Dec 1997–Dec 1999 Chief, Planning and Programming Branch, Operations Division, Directorate of Requirements, HQ AFMC/DR, Wright-Patterson AFB OH.

Dec 1999–Feb 2003 Chief CENTCOM & PACOM Divisions, Global Mgt. Directorate, AFSAC, WPAFB, OH.

Mar 2003–Feb 2005 Senior Enterprise Engineer supporting AFRL, AFSAC, and F-16 Program Office, HJ Ford, a DRC Company, Fairborn OH.

Feb 2005–Mar 2006 Acq. Manager, Capabilities Integration Directorate, HQ AFMC/A2/5, WPAFB, OH.

Mar 2006–Aug 2009 Chief, PM Functional Office Branch, Intelligence and Requirements Directorate, HQ AFMC/A2/5, Wright-Patterson AFB OH.

Sep 2009–Jan 2012 Chief, LAIRCM International Programs Branch, Aircraft Survivability Division, Mobility Directorate, ASC, Wright-Patterson AFB OH.

Feb 2012–Nov 2012 Deputy, Enterprise Integration Division, Capability Planning Directorate, ASC/XRC, Wright-Patterson AFB OH.

Nov 2012–Aug 2017 Chief, Acquisition Services Division, and EPASS Program Manager, Acquisition Excellence Directorate; AFLCMC/AZZ, Wright-Patterson AFB OH.

AWARDS AND HONORS:

2015 USD (AT&L) Workforce Individual Achievement Award for Services Acquisition
2011 Aeronautical Systems Center (ASC) Small Team of the Year
2009 Meritorious Civilian Service Award
2005 HQ AFMC/A2/5 Civilian of the Year
2003 HQ AFMC Team of the Quarter
2002 Spirit of AFSAC Award
1998 HQ AFMC IPT of the Quarter (1st & 3rd Qtrs)
1995 John J. Welch Award for Excellence in Acquisition Management
1992 Secretary of Defense Superior Management Award
1991 General Bernard P. Randolph (AF Systems Command) Engineering Award

PROFESSIONAL CERTIFICATIONS:

Level III – Acquisition Professional Development Program (APDP): Program Management
Level II – APDP: Test & Evaluation
Level I – APDP: Systems Planning, Research & Development Engineering
Level I – APDP: Life Cycle Logistics

UNITED STATES NAVY - CAPT Dave "Pud" Padula, Aircrew Systems Program Manager

Captain Padula earned his commission from the United States Naval Academy with a Bachelor of Science degree in 1990 and was designated a Naval Aviator in July 1992.

During multiple operational fleet tours he served the Airborne Mine Countermeasures community flying the MH-53E and UH-1N helicopters. He was designated as Detachment Officer-in-Charge during OPERATION IRAQI FREEDOM and later as Commanding Officer (CO) of Helicopter Mine Countermeasures Squadron Fifteen (HM-15). As Squadron CO, he was responsible for the overall morale, welfare, safety, and operational readiness of 660 Sailors, 13 MH-53E helicopters, and six AMCM weapon system types with a $20M annual operating budget. His forward-deployed squadron was recognized with the Battle Efficiency "E" for CY2009 for operational excellence.

Within the acquisition community, he served as the H-53 in-service Assistant Program Manager for Systems Engineering. In this billet, he was the lead engineer for the CH-53D, CH-53E and MH-53E helicopters. His efforts led to a Level III certification in the Systems Planning, Research, Development, and Engineering acquisition field. Later, he attended the Industrial College of the Armed Forces where he simultaneously earned full Joint Professional Military Education, completed the Defense Acquisition University's Senior Acquisition Course, and earned a second Master of Science degree in National Resource Strategy from National Defense University. He then served as the Assistant Commander for Acquisition (AIR-1.0) Chief of Staff and Naval Aviation Enterprise (NAE) War Council Chairman. During this tour, he attained a Level III certification in Program Management and was selected into the AC URL Major Program Management career track. He subsequently served as the TH-57 Training System Integrated Product Team Lead developing, acquiring and supporting CNATRA training solutions for the production of all USN, USMC and USCG rotary wing aviators. He was later selected to lead a cross-organizational special project team reporting directly to Naval Aviation Enterprise leadership before reporting as Chief of Staff for Program Executive Officer Air ASW, Assault, and Special Mission Programs (PEO(A)). After serving an additional tour as Principal Deputy Program Manager for Tactical Airlift Program (PMA207) he was slated to his current position as Program Manager for Aircrew Systems (PMA202). His personal decorations include the Meritorious Service Medal (5 awards), Navy Commendation Medal (5 awards), Navy Achievement Medal (2 awards), and various other campaign awards and unit commendations.

Captain Padula is married to the former Laura Ditty of Milwaukee, WI. They reside in California, Maryland with their daughter, Elissa, and son, Ryan.