The 711th Human Performance Wing

The mission of the 711th Human Performance Wing (711 HPW) is to advance human performance in air, space, and cyberspace through research, education, and consultation. The Wing supports the most critical Air Force resource—our operational military forces. The Wing’s primary focus areas are aerospace medicine, human effectiveness science and technology, and human systems integration. In conjunction with the Naval Medical Research Unit-Dayton and surrounding universities and medical institutions, the 711 HPW functions as a Joint Department of Defense Center of Excellence for human performance sustainment and readiness, optimization, and enhancement.

Purpose

This booklet is intended as a technology transfer tool for our potential partners in industry and academia. It outlines 711 HPW resources and partnership tools for educational research agreements, technology transfer and transition, innovative research options, and business development opportunities.
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The 711th Human Performance Wing (711 HPW) is located at Wright-Patterson Air Force Base, Ohio. Organizationally, the Wing consists of three mission units.

**Human Effectiveness Directorate (RH)**
Leads the Air Force in human-centered science and technology research

**U.S. Air Force School of Aerospace Medicine (USAFSAM)**
Finds solutions to operational needs of today and tomorrow and prepares new aeromedical experts for future global challenges

**Human Systems Integration Directorate (HP)**
Integrates human performance sustainment, optimization, and enhancement through the application of operational knowledge and evidence-based Human Systems Integration; to ensure an overwhelmingly effective United States Air Force warfighter through the integration of people and technology for total systems performance; to be the U.S. Air Force human performance and Human Systems Integration lead execution agent to the Department of Defense, Air Staff, and Major Commands, system program offices, science and technology, acquisition, logistics, and test centers.
**Human Effectiveness Directorate**

The Human Effectiveness Directorate (RH) integrates biological and cognitive technologies to optimize and protect the Airman’s capabilities to fly, fight, and win in air, space, and cyberspace. Scientists, engineers, and professionals from a variety of disciplines provide this support in four divisions: Decision Making, Bioeffects, Training, & Human-Centered Intelligence, Surveillance, and Reconnaissance (ISR).

**Decision Making**

The Warfighter Interface Division is at the heart of human effectiveness – seamlessly linking human functionality to the weaponry, information, and environment of war. Warfighter Interface Division technologies help mitigate the ambiguities of war for aerospace forces.

**Bioeffects**

The Bioeffects Division conducts research on laser, radiofrequency, and molecular bioeffects. The vision of the division is to protect against and exploit the bioeffects of battlefield environmental stressors. Bioeffects Division scientists are recognized worldwide for their comprehensive understanding of optical, radiofrequency, nanomaterial, and toxicological stressors critical for establishing international safety standards. Integrating bioeffects data with human factors research provides threat characterization leading to development, analysis, and field tests of sensors and equipment for hazard protection. Through rigorous research and experimentation, the Bioeffects Division provides data and predictive models of target and collateral effects to
optimize directed energy weapons for transition.

**Training**
The Warfighter Readiness Research Division keeps warfighters ready to roll on a moment’s notice with training research that provides scenarios so realistic, deployed men and women feel “like they’ve been there before.” That is important, because there is no substitute for experience. Experts conduct the training research necessary to give our warfighters the experience of war without the risks or the costs.

**Human-Centered ISR**
The Human-Centered Intelligence, Surveillance, and Reconnaissance Division develops and researches human-centered technologies, processes and organizational strategies for cyber, ISR, and information/influence operations. Research supports Air Force warfighters by improving situational awareness and threat detection through the understanding and exploitation of human “patterns of life,” and by conducting advanced technology development to predict adversarial activities, derive courses of action, and ultimately understand, influence, and defeat enemy behavior.
U.S. Air Force School of Aerospace Medicine

The U.S. Air Force School of Aerospace Medicine (USAFSAM) is an international leader in aerospace medicine, occupational/environmental medicine, and preventive medicine as well as related disciplines ranging from industrial hygiene to worldwide epidemiology.

In collaboration with four Air Force facilities and three world-renowned universities, USAFSAM uses state-of-the-art classrooms and immersive training environments to prepare new aeromedical experts for future global challenges. Partnering with the Centers for Disease Control and Prevention, USAFSAM is a global reference center and has the Department of Defense’s busiest clinical, radiological, and chemical laboratories. USAFSAM has been home to the world’s experts in clinical aviation medicine since 1918.

Scientists, engineers, and professionals from a variety of disciplines provide this support in three divisions: Education and Training, Research and Technology, and Consultation.

**Education and Training**

USAFSAM conducts initial and advanced officer and enlisted professional training for bioenvironmental engineers, public health, aerospace physiology, and aerospace medicine.

As the Air Force’s premier training platform for combat medical training and aeromedical evacuation, USAFSAM utilizes state-of-the-art simulators, live subjects, and rigorous in-residence training at three of the nation’s top trauma
centers to prepare Air Force medics for contingency operations and rapid evacuation anywhere in the world.

**Research and Technology**

USAFSAM researchers continue to define new frontiers in aerospace medicine and health hazard assessment. The aerospace medicine teams study and expand the world’s knowledge of ophthalmology, cardiology, pulmonology, and human cognitive performance under rigorous conditions, improving human performance well beyond previous boundaries. USAFSAM’s extensive ultra-high technology laboratories process more than 45,000 lab samples per week, conducting complex virology and bacteriology studies from around the globe as a crucial part of our nation’s epidemiological surveillance activity. Researchers enhance, appraise, and field microminiaturized detection technology for human health hazards from chemicals, biological and radiological sources, and develop the tools, tactics, and procedures for use worldwide.

**Consultation**

USAFSAM provides around-the-clock response and consultative capability for aeromedical, chemical, biological, and radiological health hazard needs. The experienced staff advises health and medical officials on sample collection, epidemiologic surveillance, aeromedical treatment, and hazard assessment. In every facet of aerospace medicine, from aviator health and hyperbaric medicine to advanced molecular detection and epidemiology, a USAFSAM expert is only a phone call away.
Human Systems Integration Directorate
The Human Systems Integration Directorate (HP) makes the human factor a top priority by ensuring that systems are in tune with the human operator using the human systems integration process model. The HP staff makes certain that any product or technology, such as weapons, computer networks – even facilities and working conditions – are designed, adapted, or developed with human capabilities and limitations in mind.

Scientists, engineers, and professionals from a variety of disciplines provide this support in two divisions: Implementation and Analysis

**Implementation**
The Human Performance Optimization Division advances human-centered design in the acquisition of weapons systems to maximize total system performance and reduce life cycle costs. The Division also facilitates human systems integration process implementation during weapons systems requirements development and acquisition across the Air Force enterprise areas of aeronautical, C4ISR, munitions, and space/missile, and consults with high performance teams, program managers, systems engineers, and integrated product teams to execute human systems integration.
**Analysis**

The Human Performance Sustainment Division delivers evidence-based solutions to human performance problems by providing a scientific and research interface for field organizations. The Division promotes human performance target levels throughout a career while minimizing total life-cycle costs, and monitors and assesses human performance requirements in newly developing weapons systems.
Technology Transfer Opportunities

The Air Force Technology Transfer Program was created to assure all Air Force science and engineering activities promote the transfer or exchange of technology with state and local governments, academia, and industry. These activities enhance the economic competitiveness of industry and promote the productivity of state and local governments while leveraging the Department of Defense (DoD) research and development investment. They can also serve academia by opening up expanded areas of exploration and cooperation. The end result is a strong industrial base the Air Force and DoD can utilize to supply their capability shortfalls.

Partnering with the Air Force can be readily accomplished through a variety of technology transfer agreements. These partnerships can be in the form of collaborative research, testing of innovations or products, providing excess equipment to schools, or licensing Air Force technologies. These agreements protect the partner while allowing Air Force resources to focus activities on solving common problems and advancing technical solutions.

There are many mechanisms and programs used to facilitate the transfer of technology. Examples of mechanisms frequently used are Cooperative Research and Development Agreements, Educational Partnership Agreement, Commercial Test Agreements, Patent License Agreements, and Partnership Intermediary Agreements.
Cooperative Research and Development Agreement
A Cooperative Research and Development Agreement (CRADA) is a legal agreement between a federal laboratory and one or more nonfederal parties such as private industry or academia. Mutually beneficial, the parties share the risks and benefits of collaborative research and development. The end objective of a CRADA is to advance science and technology that not only meets Air Force mission requirements but also has viability in other potential commercial applications.

Educational Partnership Agreement
An Educational Partnership Agreement (EPA) is a formal agreement between a defense laboratory and an educational institution to transfer or enhance technology applications and provide technology assistance for all levels of education (pre-kindergarten and up). It is open to local education agencies, colleges and universities, and nonprofit institutions dedicated to improving science, technology, engineering, and mathematics education.

Patent License Agreement
A patent is a grant issued by the U.S. Government giving an inventor the right to exclude all others from making, using, or selling the invention throughout the U.S. or importing the invention into the U.S. Patent License Agreements (PLAs) maximize the use of Air Force technology in the private sector, stimulate research, make available new products and processes and create new industries and job opportunities, all of which benefit the U.S. economy and provide royalty income to the Air Force.
Commercial Test Agreement
Under a Commercial Test Agreement (CTA), the Air Force Research Laboratory has the authority to make available, at a prescribed fee, the services of any government laboratory, center, or other select test facilities materials, equipment, models, computer software, and other item testing. This agreement is available to any individual, partnership, corporation, association, state, local or tribunal government, or an agency or instrumentality of the U.S. CTAs offer a gateway to world-class Air Force laboratories and facilities.

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Small Business Innovation Research Program
The Air Force Small Business Innovation Research (SBIR) Program is designed to stimulate technology research by small businesses while providing the U.S. government with cost-effective technical and scientific solutions to challenging problems. SBIR also encourages small businesses to market SBIR technology in the private sector.

SBIR has four principal objectives:

1. Stimulate technological innovation by small business
2. Increase small business participation in meeting federal Research and Development (R&D) needs
3. Increase the commercialization of technology developed through federal R&D
4. Enhance outreach efforts to ensure that all qualified small businesses are aware of the SBIR program and the many benefits it provides

SBIR is a three-phase process:

- Phase I: technology feasibility is determined and contracts are valued up to $150,000, lasting from six to nine months.
- Phase II (awarded to successful Phase I contract winners): necessary R&D is accomplished to produce a well-defined product/process. These awards typically span two years to accomplish the primary research effort and are valued up to $1,000,000.
- Phase III: commercialization of the technology using private sector or federal agency (non-SBIR) funding to commercialize a Phase II project result.
Twelve federal agencies—among the DOD are Air Force, Army, and Navy—set aside a portion of their R&D budgets for SBIR contracts. Each year, these agencies identify various R&D topics for pursuit by small businesses under the SBIR program. The topics are then released in a pre-solicitation, allowing small business to discuss topics with experts. The second release is the final solicitation. Contract winners are chosen on competitive merit by an agency’s technical and scientific experts.

Additional detailed information on the Air Force SBIR Program is available by calling the Air Force SBIR Program Office, and visiting the Air Force SBIR/STTR web site.

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RH Organic Research Capabilities
Decision Making Core Technical Competency

**Battlespace Acoustics Laboratory Complex**

The Battlespace Acoustics Laboratory Complex at Wright-Patterson Air Force, Ohio seeks to revolutionize auditory displays and communication systems to maximize operator effectiveness in complex acoustic environments. Unique, world-class laboratories containing highly-specialized, state-of-the-art equipment are employed in research focused on the basic and applied aspects of auditory and speech perception, communications, hearing protection, and in the development and optimization of advanced auditory and multisensory displays for information portrayal in support of the needs of the warfighter.

Throughout its history, the Battlespace Acoustics Laboratory Complex has produced a number of world firsts including the first operational three-dimensional (3-D) audio display system and the first operational active noise reduction headset and earplug.

**Auditory Localization Facility**

This laboratory comprises a 4.26 meter diameter geodesic sphere positioned inside an anechoic chamber with 277 loudspeakers. The configuration simulates complex real-world auditory environments and can present 16 sounds simultaneously,
from select (or all) locations. The laboratory is used to perform research in spatial hearing, head-related transfer functions, and 3-D audio.

**High-Intensity Noise Emulation Facility**
This laboratory, capable of generating broadband noise environments up to 142 decibel, supports development of advanced active noise reduction technologies. It further enables research in the determination of noise exposure criteria for intense noise fields, as well as in the assessment of speech intelligibility in intense noise fields.

**Advanced Speech Perception Laboratory**
This laboratory is designed for assessing improvements in speech intelligibility afforded by spatial separation. Research is also conducted in spatial hearing and sound source localization. Located inside an anechoic chamber, the test setup consists of a 21-loudspeaker array arranged in an arc along the horizontal plane. Accordingly, 21 sound sources can be simultaneously presented to the test subject.
Integrated Visualization Platform
This laboratory is designed for evaluating the effectiveness of advanced displays and technologies in operationally relevant scenarios. It includes multimodal display systems, such as stereoscopic visualizations, 3-D audio, and haptic/tactile displays. Essentially, the laboratory consists of multiple, distributed, immersive environments that collectively depict a common, synchronized virtual environment. The distributed, immersive, virtual environment includes a large-screen data wall integrating multiple independent projectors and a four-wall immersive laboratory at Wright State University (Dayton, Ohio) linked via a private, high-speed network to a five-wall immersive laboratory located at WPAFB, Area B.

Counter Listener Acoustic Warfare Laboratory
The Counter Listener Acoustic Warfare (CLAW) laboratory is a secure lab area seeking to integrate emerging forecast tools with human factor user requirements. The laboratory utilizes visualization, audio technology and high definition information portrayal techniques to test candidate methods for best enabling planners to dominate the acoustic order of battle.
Crew Systems Integration Laboratory

The purpose of the Crew Systems Integration Laboratory (CSIL) is to revolutionize human-machine interface technologies to control, manage, and operate multiple heterogeneous unmanned air vehicles (UAV) with minimal crew size. AFRL uses a variety of laboratories and equipment to study all aspects of human-machine inter-action applied to semi-autonomous and heterogeneous unmanned aerial systems (UAS). The goal is to afford all human operators every advantage in monitoring and controlling future weapon systems, which are growing increasingly autonomous with every new generation.

The CSIL consists of the following:

- A research center/theater room that provides advanced capabilities for collaborating with other agencies.
- An innovation center with a variety of advanced immersive controls and displays.
- A test and integration center supporting both UAS flight test integration and support and UAV hardware-in-the-loop testing.
- A design and development center that provides state-of-the-art software development tool sets for rapid prototyping and integration with the Vigilant Spirit Control Station.
• A Human Automation Lab for the development and evaluation of multiple dynamic levels of human engagement with autonomous system control. The lab will facilitate the shared understanding of autonomous system goals and planning through the utilization of intuitive displays.

Since its inception, this laboratory has provided game-changing capabilities to the Vigilant Spirit Control Station, as demonstrated during the 2007 and 2009 Talisman Saber exercises. The laboratory team was also awarded the 2008 Air Force and Air Force Materiel Command Outstanding Science Award.

Applied Neuroscience Laboratory Complex
Located at WPAFB, Ohio, the Applied Neuroscience lab researches and develops technologies to optimize Airmen individual and team performance across all AF domains. Research focuses on three key challenges: the ability to sense or detect individual and team cognitive or functional state, assess the state relative to performance, and augment
performance to optimize mission effectiveness. The goal is to develop performance monitoring and regulation solutions to improve resiliency and actively enhance performance. The laboratory complex consists of the following:

**Individual Performance Laboratories**

These labs provide an extensive suite of neuroscience devices suitable for conducting studies of individual mental state. The suite includes:

- devices for electroencephalography (EEG) and electrocardiography (ECG) such as high-density systems, wireless systems, portable systems for use in flight, and dry/no prep systems
- on and off-head eye trackers
- digital optical cameras for facial expression analysis
- thermal cameras for facial temperature sensing
- transcranial Doppler technology for measuring cerebral blood flow
- cerebral oximetry technology for measuring regional oxygen saturation.

Computing capabilities include real-time processing and triggering of adaptive aiding as well as logging for post hoc analysis.
Team Performance Laboratories
The team performance lab has the ability to be partitioned from one to three lab areas. This provides the flexibility to configure an area to a specific domain environment for research. Currently, one of the areas is configured as a cyber facility environment for cyber operator research. All the lab areas support research on team processes and team performance with a focus on neurophysiological indices as a means to enhance team effectiveness and adaptability, support robust decision making, reduce team workload, and improve situation awareness in distributed team environments.
Lab capabilities include:

- transcranial Doppler technology for measuring cerebral hemodynamics
- cerebral oximetry technology for measuring regional oxygen saturation
- psychophysiologic data collection capabilities (EEG and ECG)
- head and eye-gaze tracking
- speech recognition, communication, and voice analysis applications
- Cyber Nexus simulator (unique to cyber)
- several synthetic task environments for distributed team operation simulations.
**Human Universal Measurement and Assessment Network Laboratory**

Human Universal Measurement and Assessment Network Laboratory (HUMAN) is equipped with a state-of-the-art multimodal data acquisition system, including sensors to monitor brain, heart, muscle-activity, eye movement, respiration, galvanic skin response and other body signals. This data is collected and analyzed along with performance data to compile a comprehensive picture of drivers that may affect operator workload and decision making ability. This understanding will provide opportunities to implement performance augmentations or mitigations enabling Warfighters to optimize performance and successfully accomplish their missions.

**Behavioral Neuroscience Laboratory**

This lab supports cognitive research using rodent models. Capabilities for behavioral assessments include:

- Morris water maze and Barnes maze (spatial memory)
- elevated plus maze (anxiety)
- open field (exploration and anxiety)
- acoustic startle (reactivity)
- forced swim (depression), fear conditioning and sensory neglect.
The laboratory also includes provisions for environmental enrichment, motor skills training, and chronic variable stress.

The focus of this laboratory is to evaluate the performance changes in stressful environments and explore techniques to improve performance.

**Biochemical Neuroscience Laboratory**

This biochemistry lab is set up for protein analysis using Western blot, enzyme linked immunosorbent assays, immunohistochemistry, and bead-based immunoassays. The focus of this laboratory is to evaluate various types of biomarkers and determine the relationship between cognitive performance and environment.

**Human Performance Laboratory**

This 3000-square-foot laboratory includes a battery of Woodway Desmo and Force treadmills with metabolic carts used in the performance of VO2 max and power assessments. Other resources include two Velotron bicycle ergometers, a pair of Monark cycle ergometers (one configured as a hand crank unit), two reaction response evaluators (Makoto), an Oxycon Mobile lung
function testing system (with telemetry), as well as other physiological monitoring, training and performance assessment equipment. An additional pair of Lode Excalibur Sport cycle ergometers is being used in conjunction with a CorTemp system that has temperature sensing pills for monitoring core body temperature. A DEXA scanner for precise and accurate measurement of lean body mass is located in a room immediately adjacent to the main workout and testing part of the lab. A small wet lab is available to support testing. The focus of this laboratory is on evaluating the effects of physical training on cognitive performance and the potential mechanisms by which they are connected.

**Applied Neuroscience Research Corridor**

This corridor features a series of four sound-insulated testing laboratories, an observation suite, and a medical screening room. The four testing laboratories are ideally suited for individual human cognitive research paradigms and are easily reconfigurable for a variety of protocols.

The labs house numerous brain physiological monitoring
devices such as cerebral oximeters, a transcranial Doppler, and Grass Telefactor EEG equipment.

In addition, the labs contain non-invasive brain stimulation equipment such as transcranial direct current stimulators that can be used to study cognitive enhancement interventions. All four lab rooms can be monitored simultaneously and remotely from the observation room if desired.

Additionally, the medical screening room houses a variety of medical equipment including a crash cart, ECG monitoring equipment, etc. that can be used in case of a medical emergency or to screen potential study participants for health risks prior to enrollment into an experiment.

**Human Vibration & Performance Laboratory**

This laboratory houses the Six-Degree-of-Freedom Motion Simulator (SIXMODE), a human-rated multi-axis vibration laboratory capable of recreating a variety of operational vibration signatures collected aboard military air vehicles. The laboratory is set up to conduct human performance studies during exposure to the operational stressor and includes the NASA Multi-Attribute Task Battery (MATB), the NTI ARMORY, NASA Task Load Index, and various surveys for assessing the perception of vibration and comfort.
Physiological measures can also be obtained using the Equivital™ LifeMonitor System.

**Biodynamics Research Laboratory**
This facility consists of a Horizontal Impulse Accelerator, a Vertical Deceleration Tower, and a Vertical Impact Device (all man-rated) used to generate impact acceleration profiles for tests with human and manikin subjects. The response data are used to define the effectiveness of operational and prototype protection concepts and develop injury criteria for the purpose of improving warfighter protection and performance.

**Battlespace Visualization Laboratory Complex**
The Battlespace Visualization Laboratory Complex uses a variety of laboratories and equipment to study all aspects of visual performance, including research to enhance the display of complex air, space, and cyber information. The goal is to enhance warfighter information processing utilizing visual displays thereby improving decision making and operational effectiveness.
Over the course of its history, the Battlespace Visualization Laboratory Complex has supported the transition of several helmet-mounted display technologies that have been incorporated into many currently fielded systems including the Joint Helmet-Mounted Cueing System. It has also produced a number of world firsts: the panoramic field-of-view night vision goggle (NVG), a night helmet cueing system, a variable-transmittance visor, an NVG with head-up display, an NVG compatible cockpit lighting system, a low-profile NVG, and a portable NVG approach path indicator. The two primary research thrusts are information fusion and information visualization.

**Visualization Observatory**

The observatory is equipped with a 17" Planewave Corrected Dall-Kirkham Astrograph telescope. This device is specially designed to allow wavelength collections between 250nm-2500nm and will support the development of multi-spectral fusion research.

**Dynamic Visual Assessment Laboratory**

This 200 foot long room permits a choice of visual targets, lighting conditions, visual tasks, and observer motion-states using a rail-based system capable of
simulating high speed closure rates. This laboratory consists of high-detail, reconfigurable multispectral terrain boards that can simulate visible, near-infrared, short-wave infrared, and long-wave infrared bands for both terrain and targets. Further, a fully registered four camera system is capable of collecting visible, near-infrared, short-wave infrared, and long-wave infrared spectral bands. These two systems together allow for conducting person-in-the-loop visual performance testing simulating a wide range of real-world environmental conditions. Finally, this laboratory houses a quad-emissive display with the ability to display a resolution test pattern that can be sensed simultaneously in the aforementioned spectral bands, allowing the testing of new sensor technologies and algorithms.

**Display Metrology Laboratory**
This lab consists of a collection of manual to fully-automated equipment that allows for the measuring of sensors and displays from the visible to long-wave infrared. It can accommodate a range from micro to large screen displays.

**Visualization Laboratory**
This is a reconfigurable operations center environment where many different displays can be used to evaluate the gamut from single to multiple user operations.
Specifically, it contains a number of specialized displays including nine different true 3-D displays that span from helmet-mounted displays to the DARPA Urban Sand Table next-generation holographic display, as well as four different multi-touch surface displays. A number of commercial off-the-shelf and in-house developed interaction devices are also used for testing interaction with multi-dimensional data.

**Computational Laboratory**
This laboratory contains a number of commercial off-the-shelf and in-house software packages allowing for both statistical analysis as well as mathematical modeling of human performance data.
Bioeffects Core Technical Competency

**Laser Laboratories, Tri-Service Research Laboratory**

The Directed Energy Bioeffects Division maintains well over 100 lasers of all pulse widths, wavelengths and powers available to conduct a full range of bioeffects research. The lasers are used in all levels of research from 6.1 to 6.3 and from subcellular to integrated human response.

**RF Anechoic Chambers, Tri-Service Research Laboratory**

In collaboration with the Navy, there are 12 RF Anechoic and static free exposure chambers located at TSRL. These chambers cover the majority of the RF spectrum and vary in size from bench level to whole-human exposure capacity. The chambers are routinely used to examine new bioeffects for pulsed and CW RF frequencies, as well as to test live tissue exposures to new sources and directed energy weapons.

**Nanomaterial Characterization Laboratory, WPAFB**

This laboratory provides analysis of Air Force relevant nanomaterials received or synthesized in-house that have potential inherent toxicity.
The laboratory specializes in aqueous and biological solution and system behavior of nanomaterials and has characterization instrumentation. Capabilities include multiple enhanced microscopes for detection of nanomaterial (bench-top electron, two high illumination, confocal, and inverted microscopes), a Zetasizer (charge and solution size), and a scanning UV-visible spectrophotometer.

**Biological Safety & Cell and Tissue Culture Laboratories, WPAFB**

Two lab culture facilities for mammalian cell culture engineered with BioSafety hoods and a chemical preparation hood, sterile culture incubators with the required refrigeration for media storage. The labs are used for cell-based assays, pathway analysis, and molecular mechanisms study under the Molecular Bioeffects research sub-CTC.

**Outdoor Directed Energy Laboratory, TSRL**

400 meter outdoor laboratory for conducting laser and RF exposures.
**Laser Threat Simulator, TSRL**
The Laser Threat Simulator is an FAA accredited single engine flight simulator which has been modified to incorporate red and green lasers to conduct human use research on pilot performance while being exposed to lasers. The simulator includes a fully functional, two-person, single engine aircraft cockpit and panoramic projection.

**Analytical Chemistry Laboratory, WPAFB**
This laboratory houses the capability to analyze small molecules that are important in toxicity chemical detection and nanomaterial chemical analysis. It also has capabilities to analyze biomarker events important in molecular cognition, toxicity and nanomaterials response. The lab includes liquid chromatographs with molecular ion mass (mass spectrometer), solution ion, fluorescence, absorption detection capabilities, and gas chromatographs with molecular ion mass, flame, and nitrogen-phosphorus detection capabilities.
**THz Exposure Laboratory, TSRL**

The THz laboratory at the TSRL houses one of 6 THz sources in the country used for bioeffects research. There are only 6 table-top THz sources available in the US and RHD is fortunate to have one of them to lead research in live tissue absorption and understanding of exposure effects.

**Genomics, RNA, DNA Analysis Laboratory, WPAFB, TSRL**

This lab includes capabilities for performing gene expression analysis and RNA Splicing Exon arrays (Affymetrix whole transcriptome coverage), Quantitative Real-time Polymerase Chain Reaction (candidate genes), genotyping using SNP arrays (whole genome coverage) and Restriction fragment length polymorphism, microsatellite and copy number variation (candidate genes). The lab also includes data analysis capabilities such as novel bioinformatics approaches including statistical analysis of differential gene expression, Statistical analysis of gene enrichment (differential pathway regulation analysis), multi-pathway biological network analysis and modeling, statistical analysis of genome-wide SNP association, and development of advanced data mining algorithms.
Proteomics and Metabonomics Laboratories, WPAFB, TSRL

This laboratory has capabilities for advanced analytical chemistry methods used for screening and isolating differences of proteins and metabolites for novel biomarker discovery. Among the instruments included are a MALDI UltraFlextreme (Imaging), Bruker Daltonics (large molecule, polymer, and tissue analysis), liquid chromatography-Linear Ion Trap mass spectrometry instruments, and LTQ-Velos (Orbi) from ThermoFisher used for quantitative and qualitative proteomics and accurate mass analysis, and small molecule profiling.

Protein-Molecule Interaction Laboratories, WPAFB

This suite of laboratories contains cell culture support and protein-molecular binding behavior analysis systems including high throughput screening equipment, thermal calorimetry, and kinetic/dynamic binding behavior analysis.

Biological Radiotracer Laboratory, WPAFB

This laboratory contains a 4-ft chemical hood with scintillation and gamma counters for assay of radiolabeled tracer ($^{125}$I, $^{31}$P, $^{32}$P, $^{14}$C) in Molecular Bioeffects studies.
**Beowulf Cluster, TSRL**

This is a 128 node High Power Computer capable of solving complex electromagnetic-tissue interaction computations.

**Biological High Performance Computing Hardware and Software SKIF Lab, WPAFB**

Computational modeling and analysis of protein-protein and protein-small molecule interactions.
Training Core Technical Competency

Learning and Assessment Research for Distributed Mission Operations (DMO) and Live, Virtual, and Constructive (LVC) Operations Testbed, WPAFB, OH:

This testbed consists of four high-fidelity flight simulators and central control station with multiple wall mounted displays to monitor each test mission. These simulators are equipped with cutting-edge air and ground representation systems, robust prototypical constructive computer generated forces (CGF) research systems, a variety of performance measurement, mission planning and after action review tools, and a number of operationally relevant F-16 operational flight program configurations. The testbed is used to develop, demonstrate and evaluate scalable and deployable training and rehearsal technology for tactical weapons employment, encompassing mission planning, training and rehearsal, C2 notes of the kill chain, and performance assessment in both stand-alone and LVC environments. The objective is to optimize human performance via continuous learning, rehearsal and aiding across LVC domains. This testbed provides research methods and tools that are leveraged by all the other research activities in the CTC.
Air Operations Center Training Research Testbed

The Air Operations Center (AOC) Research Testbed is a simulation-based training research environment based on the Theater Battle Management Core Systems Lite. In addition to actual AOC applications, the testbed also includes data capture and performance measurement capabilities allowing researchers to work directly with operators to study mission essential competencies (MECs) and knowledge, skills and experiences (KSEs) required to develop expert AOC planners and operators both as individuals and as teams. In 2010 we extended investigations into capabilities of the testbed to support the integration of intelligence, surveillance and reconnaissance as well as cyber training research activities.

The Performance and Learning Models (PALM)

The Performance and Learning Models (PALM) laboratory provides support for both basic and applied research in cognitive and mathematical modeling. It includes networked workstations, ISCAN/Polhemus head-mounted eye trackers, a remotely piloted vehicle simulation and a dedicated data collection room with six workstations for human subjects testing. In addition to local computer resources, the PALM laboratory has established an infrastructure for distributed, high-performance computing (D/HPC) for the purpose of model testing and validation, including access to multiple DOD operated HPC laboratories and a volunteer computing network.
**The Integrated Combat Operations Training Research Testbed**

This testbed includes a number of relevant research environments supporting individual and team training research for theater mission sets. The Joint Terminal Attack Control (JTAC) Training and Rehearsal System (TRS) is a 180-degree field of view immersive dome that can present visual and audio representations of real-world combat scenarios enabling forward controllers to exercise simulated air-to-ground attacks on enemy positions. It provides a testbed for exploring advanced training and rehearsal capabilities for Joint Services and Air Force Special Operations. The JTAC TRS was recently integrated with our Remotely Piloted Aircraft (RPA) simulation environments to provide a robust theater kill chain training research capability. The combination of the Reaper RPA simulator, Air Support Operations Center (ASOC) simulation system and JTAC TRS allows researchers to develop training research scenarios at various individual and team levels across the theater kill chain.

**Gaming Research for Integrated Learning Laboratory (GRILL)**

The GRILL consists of multiple top-of-the-line desktop computers, deployable tactical trainers, network architecture, and numerous interface devices. It incorporates COTS and GOTS software allowing student and
faculty researchers to access and integrate potential desktop training solutions and collect data automatically. The GRILL provides a flexible, unclassified research venue to quantify and demonstrate the potential learning impacts of high fidelity commercial gaming environments used as research and training environments for individual and team decision making tasks. Work in the GRILL directly addresses findings and recommendations from a 2009 SAB Summer Study chartered by COMACC to examine and leverage advances in gaming and other virtual training technologies for addressing operational readiness gaps.

**Night Operations Center of Excellence**

The Night Operations Center of Excellence (COE) laboratory is a user-funded laboratory that includes a classroom, audio/visual editing room, light-tight eye-lane, electro-optical test laboratories, virtual terrain board, and a variety of precision measuring equipment. The COE supports US AIR FORCE and USN/USMC Night Vision courseware development, Night Vision Goggle Instructor Course, and provides quick reaction science and engineering response to user night operationally-related needs.
Human-Centered Intelligence, Surveillance, and Reconnaissance Core Technical Competency

3-D Human Signatures Laboratory (HSL)
The 3-D Human Signatures Laboratory, located at WPAFB, OH, provides the capability to collect ground-truth biomechanics, anthropometry and physiology data simultaneously using fielded sensing modalities, such as radar, infrared, and thermal imagery to provide advanced solutions for human-centric ISR needs. The 3-D HSL is approximately 2000 square feet of lab space with:

- Elevated sensor control room 100 ft away from the data collection area
- Loading dock access for outdoor surveillance
- 70 foot indoor track for human movement analysis
- Elevated projection system for monitoring sensor signals
• RH-owned equipment includes:
  ▪ Ten camera 3-D motion capture system from Motion Analysis Corp including outdoor use option
  ▪ Cyberware WB4 3-D whole body laser scanning system
  ▪ 3dMD Active Stereo Photogrammetry whole body scanning system
  ▪ Two short wave infrared (SWIR) camera systems with filters and software for automated skin detection
  ▪ 2-D high resolution digital video cameras
  ▪ Two Photon-X volumetric video cameras
  ▪ Custom built 4-computer server rack system for real time data collection, software development, signal processing, and analysis
• AFIT-owned equipment includes:
  ▪ Two SWIR cameras with filters and software for automated human detection research
  ▪ Hard-drive computer rack for signal processing and analysis
  ▪ Hyper-spectral imaging sensor that allows for the evaluation of light reflectance across an expanded range of wavelengths
• RY-owned equipment includes:
  ▪ E-Series Linear Frequency Modulated Homodyne Radar System
  ▪ MWIR Polarimetric Imaging Test Field Instrument (SPITFIRE)
  ▪ LWIR Polarized Infrared Advanced Tactical Experiment (PIRATE)
Data collected from the 3-D HSL feeds research and development in the Biofidelic Avatar Modeling Laboratory and the Biosignature Data Information System.

**Biofidelic Avatar Modeling Laboratory**
The focus of this lab, located at WPAFB, OH, is to develop a virtual world with human avatars that biofidelically represent humans and their activities. These virtual representations are then used for human threat recognition training and smart sensor development. In particular, this laboratory develops human avatars for virtual replication of human size, shape and motion data collected in the 3-D HSL. The laboratory consists of six human modeling workstations with CUDA processors, a biodynamics modeling cluster (32-node Linux Mini-Cluster used for high performance computer graphics and dynamic digital human modeling) and four 55” visual display screens. The laboratory includes several software platforms for virtual world modeling including SubrScene and CryEngine3 and for biofidelic human modeling including Blender, 3-DsMax, and Maya. In addition to receiving human data from the 3-D HSL, back-end data engines for the Biofidelic Avatars are provided by the BioSignature Data Information System.

**Bio-signature Data Information Systems (BioSigData)**
This system is located at WPAFB, OH and is housed on both
the 88th Communication Group’s Collaborative User Domain Server (controlled public) and RHX’s Server (DoD internal). The system supports human modeling research in RHX, as well as other DoD, academic, and industry partners.

Subsystems include:
- ARIS (Anthropometry Research Information System)
- 3-DMRIS (3-D Motion Research Information System)
- HSAS (Human Shape Analysis System)

**Behavioral Influences Lab (BIL)**
This laboratory at WPAFB, OH supports research to develop a theoretically driven, empirically substantiated foundation for identifying systemic human trust-based vulnerabilities across the ISR domain. The goal is to develop trust-based behavioral models and analyst guidance to better understand how actor/adversary trust-based vulnerabilities can be identified and exploited.

**Molecular Signatures Laboratory Complex**
This 72,000-square-foot laboratory complex at WPAFB, OH contains a molecular chemistry laboratory, a state-of-the-art nanomaterial laboratory, as well as a BSL-3 laboratory.

**Volatile Organic Compound (VOC) Differential Profiling and Characterization**
State of the art gas chromatography/mass spectrometry instrumentation for VOC and odor print profiling and identification are maintained both at WPAFB, OH and the University of
Cincinnati. This combination of instrumentation, in-house scientific expertise, and novel data analysis approaches give AFRL unequaled capability in the differential evaluation of volatile compounds and determination of unique odor profiles of various physiological states for subsequent utilization in relevant ISR applications.

**Discover, Define, and Develop (D3) Lab**
This classified space at WPAFB, OH is primarily used for hosting computers, and testing and integrating algorithms in support of RHX ISR research.

**Speech and Multimodal Applied Research Test-bed (SMART) Laboratory**
This laboratory at WPAFB, OH consists primarily of computers for testing and integrating speech translation algorithms.

**Speech and Communication Research, Engineering, Analysis, and Modeling (SCREAM) Laboratory**
The purpose of the SCREAM laboratory at WPAFB, OH is to research and develop human language technologies (HLT) for ISR. Primary components of HLT include:

- Automatic speech recognition (ASR)
- Statistical machine translation (SMT)
- Natural language processing (NLP)
- Information retrieval (IR)
- Other speech and language processing techniques

The SCREAM lab contains more than 600 processing cores, 4.8 Tb of memory and shared disk space of over 50 Tb available on a gigabit connected grid. Single computer nodes
have as much as 288 GB of memory for processing large machine translation experiments. A mix of commercial software and open source software from academic, government, and federally-funded R&D laboratories is used in the research. Laboratory assets also include numerous speech and text databases for use in conducting research.

**Chemical, Biological, Radiological, and Nuclear (CBRN) Defense Modeling, Simulation, and Analysis (MS&A) Laboratory**

This lab is located at WPAFB, OH and supports quantitative operational effects analyses to determine the impact of CBRN attacks and incidents. The operational effects analyses calculate the effects in operationally relevant terms, such as degraded sortie rates and casualties (lethal, incapacitated, and threshold). By using operationally relevant metrics, disparate solutions may be compared on a consistent basis. This capability also includes engineering level analyses applying the latest contamination transport and diffusion models to evaluate materiel in a simulated contamination environment. The lab has supported the development of an operational risk assessment tool by executing a large matrix of detailed simulations and distilling the results into a fast running easily understood software application. The hardware suite includes: Four 2.33 GHz Quad Core Intel Xeon® L5410 servers controlled by a 1.86 GHz Intel Celeron® Computer.
It also includes two 2.8 Ghz Intel Core® i7 64-bit computers and seven older desktop systems re-purposed to support lab efforts.
USAFSAM Organic Research Capabilities
Force Health Protection Core Research Competency

FHT is the USAFSAM lead in the evaluation and translation of biological and toxicological technology for medical and human performance to enhance military capabilities.

Areas of interest include development of medical and public health intelligence, and research into chronic and acute toxicological threats. This laboratory is equipped with state-of-the-art technology to help answer unique questions to help fill gaps in the following areas:

*Commercial Off The Shelf Technology (COTS) Testing and Evaluation*

USAFSAM has seven years of experience testing various technology platforms in molecular, genetic, environmental, and food and water testing to assure that the technology meets manufacturers’ claims.

*Molecular Biology*

USAFSAM has several real-time PCR technologies including those currently fielded and utilized in laboratory response networks. This allows the ability to rapidly test and bring online new assays needed to offset the potential impact of new and emerging infectious diseases.

*Molecular Genetics (Next Gen Sequencing) and Bioinformatics*

USAFSAM has a unique next-generation sequencing
capability, housing five different types of sequencers that can provide critical information about any genetic sequence, from short nucleotide sequences to full human genomes and equivalent. In addition, USAFSAM houses bioinformatics software and analysis capabilities that can help both design assays and interpret the resulting data that is generated from these technologies.

**Microbiology**

USAFSAM has viral and bacterial culture capabilities, along with an impressive bacterial and viral repository, including simulants for some BSL-3/BSL-4 organisms used to test and evaluate various in-house and commercial assays.

**Biochemistry and Pathology**


In addition, USAFSAM houses a state-of-the-art automated slide stainer (Ventana Benchmark Ultra) which allows for microscopic study of the localization of cellular proteins and nucleic acids via immunohistochemical and chromogenic in-situ hybridization.

**Bio-signatures for ISR/Operational Environment**

This 72,000-square-foot molecular laboratory space at WPAFB, OH contains a 1500-square-foot entomology laboratory, a state-of-the-art nano-material laboratory, as
well as the only AF BSL-3 laboratory certified to work with select agents.

**Entomology Laboratory Capabilities**
The Entomology Laboratory facility and a controlled testbed are based on industrial greenhouse designs. The facility has an administrative suite laid out for three personnel, two labs, an environmentally controlled Vivarium, and a small storage area. The testbed has three areas—storage, wind (breeze) tunnel, and an environmental chamber suite.

**Entomology Dry Laboratory**
This is a dry lab with light microscopes (stereo or dissecting and bright field), Polymerase Chain Reaction (PCR) equipment (heating blocks, thermal cyclers, electrophoresis systems, vortexes, etc.), biological safety cabinet (Class 2 / Type A2), gas system (vacuum, CO2 and forced air) and multiple computing station hookups. The research capabilities currently cover the areas of biomimetics (e.g. insect flight mechanics for use in Micro Air Vehicle studies and AFIT collaborations), genetics (e.g. partnerships with USAFSAM’s education and consultation sections), as well as basic entomology work.

**Arthropods Vivarium Laboratory**
This is the Vivarium which is capable of independent temperature and humidity controls. It is used primarily to maintain relevant colonies of arthropods but could be used for vertebrates as well. Plans are in the works to purchase electrophysiology equipment. There are computing station
hookups, housing and feeding equipment, and independent wet lab functions.

**Entomology Wet Laboratory**
This is the wet lab which is equipped for protein isolation/serological work (e.g. Western Blotting equipment, micro-plate photometer, etc.), gel imaging system, biological safety cabinet (Class 2/Type A2), environmental test chamber and computing station hookups.

The environmental testbed is designed with intentions to conduct research in the areas of insect flight mechanics, plume modeling, and basic research in the area of odor detection, tagging/tracking/locating (TTL) of insects. It includes a storage area, colonies and individuals in environmental chambers involved in active research and plants needed to support the natural biology of laboratory colonies, a wind tunnel where insects are exposed to odors of interest for the purpose of developing models in the areas mentioned previously. There is an arrangement of four high speed video cameras and complementary analysis software used to capture and analyze relevant information. No other entomology lab, to our knowledge, possesses these capabilities in tandem. Not only is the entomology lab unique within AFRL, it is also largely unmatched by any other individual entomology lab in the U.S.

**Environmental Health Risk Assessment**
FHT provides cutting edge assessment of technologies to respond to emerging operational risks and identifies new
risks (knowledge gaps) for toxicological research. FHT develops, tests and modifies for optimum field use of CBRN and other environmental hazard detection technologies to modernize the force. In addition, FHT has the capability to evaluate nanotoxicity risks, and provide mitigation strategies that will minimize the toxicological effects of identified nanoparticles.

**Entomology Public Health Consult Laboratory**

The Entomology laboratory, part of USAFSAM/PHR, has microscopes, ELISA readers, and thermocyclers. The laboratory is prepared to support arthropod identifications from CONUS and OCONUS locations. The laboratory regularly provides surveillance for arthropod-borne pathogens such as West Nile virus, Western Equine Encephalitis, leishmaniasis, or malaria.
**Research Altitude Chambers**

The U.S. Air Force School of Aerospace Medicine was awarded a contract on 14 June 2010 for four research altitude chambers at Wright-Patterson Air Force Base, Ohio. The chambers will be operational in June 2013.

**Altitude Training Chambers**

The U.S. Air Force School of Aerospace Medicine received two altitude training chambers from Holloman Air Force Base, New Mexico and Hill Air Force Base, Utah on 18 and 21 June 2010. The chambers became operational in March 2011.
Center for the Sustainment of Trauma and Readiness Skills (C-STARS)

C-STARS Cincinnati

The University of Cincinnati (UC) Medical Center was selected by the United States Air Force because of its national reputation for providing the highest level of care in a busy academic/urban Level-1 trauma center. The recognized excellence of patient care and scientific research led to UC’s selection in 2001 as one of only five national military/civilian collaborative training centers. Cincinnati CSTARS has trained more than 700 military medics since its first class in 2002. Strong collaboration and support from the UC College of Medicine, University Hospital and UC Surgeons has been a key to the success enjoyed by this very special center.

- Established in 2001 - first course in 2002 - cadre increased in 2004
- Located at the Level-1 trauma center at University Hospital
- 14-day course aimed to sustain CCATT skills for Active Duty, Reserve and Guard
- More than 3,300 trauma patients treated at Trauma Center at University Hospital in 2008

Cincinnati C-STARS has deployed in support of Operation Iraqi Freedom and Operation Enduring Freedom as well as in support of Homeland Defense missions during hurricanes Katrina and Gustav and other disasters. Currently members of
the Cincinnati CSTARS cadre are deployed to Ramstein Air Base (Germany) and Bagram Air Base (Afghanistan).

**Goals**

- Preserve life and quality of life for injured soldiers on battlefields worldwide.
- Train military medics in the lessons of “Right patient. Right place. Right amount of time.
- Provide translational lessons from the battlefield to the civilian community.
- Define the next generation of medical care and support equipment through innovative and leading edge research at an academic center of excellence.

Collaborative efforts are underway to establish a center of excellence for research for the injured patient, with a focus of relevance to the wounded soldier: University of Cincinnati Center for Combat Casualty Care. A few of the initiatives that will help us move to the next level are:

- Research in the use of Autonomous Controllers that can monitor and support a patient’s condition during travel better than a human controller
- Research to discover if, and under what conditions, patient transport can exacerbate the inflammatory response to injury
- Investigate the effects of hypertonic therapy in patients with traumatic brain injury. This study will also allow real-time monitoring of the effects of transport and acceleration on the head-injured patient.
C-STARS Baltimore

Shock Trauma has deep historical ties with the nation’s armed forces through its physicians and nursing staff. The University Of Maryland School Of Medicine has maintained a working relationship with the physicians of institutions such as Walter Reed Army Medical Center and the Maryland National Guard for decades. These relationships have taken on new meaning in this period of actual and anticipated terrorist attacks. Shock Trauma at the University of Maryland School of Medicine is host to the largest C-STARS program in the country, providing real-time training in trauma and critical care for U.S. Air Force physicians, nurses, OR technicians, Special Operations medics and chaplains prior to their deployment to the Middle East. Thirteen "permanent" Air Force personnel in several trauma and critical care specialties join the School of Medicine faculty and participate with the Program in Trauma faculty in training approximately thirty Air Force personnel per month from bases around the world. Relationships established and the cooperative learning environment have extended far beyond the classroom to include telemedicine consultations with military personnel in field hospitals in Iraq and Afghanistan and treatment of wounded soldiers upon their return to the United States.
C-STARS St. Louis

St. Louis University (SLU) is the third location in the country with a Center for Sustainment of Trauma and Readiness Skills program, a cooperative two-week program that provides Air Force medical personnel with real-life, hands-on trauma experience to prepare for the sorts of trauma cases that are seen in combat. Through clinical rotations with SLU trauma doctors and nurses and weekly simulation exercises, Air Force doctors, nurses and medics have the opportunity to sharpen and refresh their trauma care skills prior to deployment.

The C-STARS program at SLU is one of only three Air Force-academic partnerships in the country. While all three sites provide essential training to combat medics, SLU's program was highlighted for its leadership and collaborative medical research effort.

Established in 1836, Saint Louis University School of Medicine has the distinction of awarding the first medical degree west of the Mississippi River. The school educates physicians and biomedical scientists, conducts medical research, and provides health care on a local, national and international level. Research at the school seeks new cures and treatments in five key areas: cancer, infectious disease, liver disease, aging and brain disease and heart/lung disease.
The 711 Human Performance Wing
How to Work with Us

If you are interested in discussing our laboratory and research capabilities further, please contact us! The 711 Human Performance Wing has numerous facilities available for possible private, commercial, or academic use. The facilities are made available to collaborating organizations through a contractual arrangement on a research and development project, which permits such organizations to use the 711th Human Performance Wing facilities rather than constructing their own.

However, not all facilities are included in this guide, due to their sensitive nature or over capacitated use.

To collaborate with our facilities, please contact our Technology Transfer Office at 1-800-222-0336.

Contact Us

711 HPW Small Business Innovation Research (SBIR):
1-800-222-0336

711 HPW Corporate Communications:
937-255-3814