As the Chief Scientist for all of the U.S. Air Force’s human-centered research at the Air Force Research Laboratory, I invite you to submit an application to participate in our 2017 Dr. Daniel Repperger Research Intern program. This program posthumously honors Dr. Repperger, who mentored many young people during his 35 year research career with our organization, by providing research opportunities for students to work in one of our facilities under the mentorship of an Air Force scientist. Each of these scientists has been hand-selected to mentor because of their technical knowledge, experience, and willingness to help science and engineering students enhance their learning through participation in an actual Air Force research project.

Please review the information and application instructions on page 4 of this brochure to determine your eligibility and then review the research projects on pages 5-43 to see if any match your research interests. If selected for one of the projects, you will have temporary summer employment through our contract with the Oak Ridge Institute for Science and Education (ORISE) to participate in this 10-week research internship at one of our two research locations: Dayton, Ohio or San Antonio, Texas. Along with gaining first-hand research experience, you’ll learn the inner workings of an operational laboratory and develop contacts and friendships that will last a lifetime. Again, please review the information in this brochure carefully to understand the specifics of the program before you apply. I look forward to reviewing your application and wish you the best of luck in the selection process!

Rajesh R. Naik, PhD, ST
Chief Scientist
711th Human Performance Wing
AFRL leads the discovery, development and integration of affordable warfighting technologies for America's air, space and cyberspace forces. We are a full-spectrum laboratory, responsible for planning and executing the Air Force's science and technology program. AFRL leads a worldwide government, industry and academic partnership in the discovery, development and delivery of a wide range of revolutionary technologies. The laboratory provides leading edge warfighting capabilities keeping our air, space and cyberspace forces the world's best. Operating from over 40 sites worldwide, AFRL focuses on technologies for air vehicles, human performance, materials and manufacturing, sensors, propulsion, space vehicles, directed energy, information and weapons. The lab employs approximately 5,800 government people (1,400 military and 4,400 civilian personnel). It is responsible for the Air Force's science and technology program of $2.1 billion including basic research, applied research, advanced technology development, and an additional $2.3 billion in externally funded research and development.  

**711™ Human Performance Wing**

The 711th Human Performance Wing advances human performance in air, space, and cyberspace through research, education, and consultation, accomplished through the synergies created by the wing’s three distinct but complementary entities:  

The **U. S. Air Force School of Aerospace Medicine (USAFSAM)** is an internationally renowned center for aerospace medical learning, consultation, aerospace medical investigations and aircrew health assessments. The school trains approximately 5,000 students each year. It also performs research on technologies for the rapid detection of chemical, biological and radiological events, hyperbaric medical research and light, durable intensive care capabilities. USAFSAM also has the Nation's only Radiological Assessment Teams available for 24/7 deployment.

The **Human Performance Integration Directorate (711 HPW/HP)** focuses on human performance optimization and sustainment through human systems integration (HSI). The directorate is the bridge among the acquisition communities and lead integration agent for the promotion, guidance, consultation, and implementation of human systems integration. It also provides HSI consulting services and technical advisory support to capability requirements developers, program managers, and engineers throughout the Air Force.

The **Airman Systems Directorate (711 HPW/RH)** leads the U.S. Air Force’s human-centered research, discovering biological and cognitive technologies to optimize and protect the Airman’s capabilities to fly, fight, and win in air, space, and cyberspace. The Directorate provides a strong in-house research program and extensive research partnerships with industry and academia. Its research team is composed of the most diverse range of technical disciplines in the Air Force to explore the human from the bio-molecular level to the societal behavior level. The Directorate focuses its research in four Core Technical Competencies: Training, Decision Making, Bioeffects and Human-centered Intelligence, Surveillance and Reconnaissance.
The Repperger Research Intern Program honors the life and works of Dr. Daniel W. Repperger (1942-2010) a scientist and mentor to many young engineers and scientists. As a researcher in the Air Force Research Laboratory’s Human Effectiveness Directorate for 35 years, Dr. Repperger’s mathematical and scientific innovations have revolutionized image and network complexity analysis. He received international recognition in haptic controllers, human-machine interface performance enhancement, and mathematical methods development. While Dr. Repperger’s significant research accomplishments helped advance the performance of Air Force airmen and the field of human-centered research, his most significant accomplishment may well be the impact he had as a kind and caring mentor of many young Air Force scientists and science and engineering students. Dr. Repperger received a BS and MS in Electrical Engineering from Rensselaer Polytechnic Institute and a PhD in Electrical Engineering from Purdue University. He was a David Ross Research Fellow at Purdue from 1971-1973 and a National Research Council Post-Doctoral Fellow at Wright-Patterson AFB from 1973-1975. A member of Eta Kappa Nu, Tau Beta Pi and Sigma Xi, Dr. Repperger was a Registered Professional Engineer in Ohio and on the Board of Trustees of the Ohio Academy of Sciences. He was a Fellow of the IEEE, Air Force Research Laboratory, American Institute of Medical and Biological Engineering, the Ohio Academy of Science and the Aerospace Medical Association. Dr. Repperger authored over 400 technical journal articles, reports and conference publications, was selected as Associate Editor of five international journals and obtained 14 U.S. patents and 28 Air Force invention registrations. His honors and awards include the Harry G. Armstrong Scientific Excellence Award, Human Effectiveness Directorate Mentor of the Year, IEEE Third Millennium Medal Winner and the IEEE Dayton Fritz Russ Award. Dr. Repperger is listed in the Who's Who in Science and Engineering and the American Men and Women of Science.
REPPERGER RESEARCH INTERN PROGRAM
INFORMATION AND APPLICATION INSTRUCTIONS

<table>
<thead>
<tr>
<th>Program Dates:</th>
<th>June 5 – August 11, 2017 (arrive June 4 – depart August 12)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Program Hours:</td>
<td>40 hours per week Monday-Friday (actual hours set by mentor)</td>
</tr>
<tr>
<td>Stipend:</td>
<td>$12,000 for 10-week period</td>
</tr>
<tr>
<td>Lodging:</td>
<td>Student’s expense - Click on items below for lodging options:</td>
</tr>
<tr>
<td></td>
<td>- Apartment Finder</td>
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<tr>
<td></td>
<td>- Local Hotel Search</td>
</tr>
<tr>
<td>Research Locations:</td>
<td>Wright-Patterson AFB, Dayton, OH or Ft Sam Houston, San Antonio, TX</td>
</tr>
<tr>
<td>Number of Positions:</td>
<td>Approximately 15 students will be selected for participation</td>
</tr>
<tr>
<td>Requirement:</td>
<td>• Enrolled in school seeking an undergraduate or advanced STEM degree.</td>
</tr>
<tr>
<td></td>
<td>• Must be a U.S. citizen</td>
</tr>
<tr>
<td>Final Report:</td>
<td>All selectees are encouraged to prepare a PowerPoint presentation or poster by end of internship. Notifications will be made to those required to present their poster or slide deck during our intern summer close-out summit.</td>
</tr>
<tr>
<td>Application Deadline:</td>
<td>January 6, 2017 at 5:00 p.m. EST</td>
</tr>
<tr>
<td>Application:</td>
<td>Apply through this link: <a href="http://www.orau.org/maryland/repperger.html">http://www.orau.org/maryland/repperger.html</a></td>
</tr>
<tr>
<td>Proof of U.S Citizenship will be required:</td>
<td>• Copy of U.S. Passport</td>
</tr>
<tr>
<td></td>
<td>• Copy of Certified birth certificate issued by the city, county or state of birth</td>
</tr>
<tr>
<td></td>
<td>• Copy of Consular Report of Birth (of U.S. citizen) Abroad or Certification of Birth</td>
</tr>
<tr>
<td></td>
<td>• Copy of Naturalization Certificate</td>
</tr>
<tr>
<td></td>
<td>• Copy of Certificate of Citizenship</td>
</tr>
<tr>
<td>Computer Access:</td>
<td>Students selected will be required to undergo a National Agency Check prior to being granted access to government computer systems.</td>
</tr>
<tr>
<td>Notification:</td>
<td>Students selected for the program will receive a fellowship with the Oak Ridge Institute for Science and Education (ORISE) to perform intern duties in the 711th Human Performance Wing.</td>
</tr>
<tr>
<td>For More Info:</td>
<td>Mike Reynolds, 937-255-7629, <a href="mailto:mike.reynolds.ctr@us.af.mil">mike.reynolds.ctr@us.af.mil</a></td>
</tr>
</tbody>
</table>

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Repperger Research Intern Program
RESEARCH PROJECT: 17-02

COGNITIVE AND HUMAN FACTORS OF ANOMALY DETECTION

PROJECT SYNOPSIS: Many jobs require a person to detect anomalies in routine data input streams. Tasks range from those of Air Traffic Controllers and rush-hour traffic reporters who view video-feeds under real-time pressure; whereas medical researchers and stock market analysts follow large volumes of text data over days to spot new breakouts and trends. Unfortunately, key signals often go undetected and planes crash or markets plummet. We need answers to three questions: How prevalent are failures to detect both "obvious" and subtle items? Why do detection failures occur? How do we improve and aid human monitors? Perceptual and cognitive research shows that people, even when actively looking for anomalies that they have been forewarned about, often miss glaring oddities in dynamic events when they are engaged in information gathering tasks. In additional to psychological research on "change blindness" and "inattention blindness," personality and thinking styles may affect anomaly detection, but the research is still in its infancy. Research projects should focus on the reasons for detection failures and improvement, but also be aware of false alarms and performance quantification. Students can research various factors which contribute to anomaly detection and inattention blindness such as (1) Display factors (e.g., number, position, motion, pattern, & complexity of elements, (2) Task factors (e.g., number of tasks, communications, and distractions), (3) Human factors (e.g. training, workload, personality, culture, teamwork). Student will be involved at all phases of research including hypothesis generation, experimental design, data analysis, and documentation. Original ideas encouraged.

STUDENT LEVEL / DISCIPLINE NEEDED:
PhD, Master’s, Bachelor’s/ Psychology, Human Factors, Engineering

RESEARCH LOCATION: Human Analyst Augmentation, Wright-Patterson AFB, Dayton, OH

RESEARCH ADVISER: Rik Warren, PhD

DEGREE: Experimental Psychology, Cornell, 1975

Dr. Warren is a National Research Council Post-Doctoral Advisor and has mentored numerous NRC post-docs and graduate students. He is a perceptual psychologist and currently is interested in failures of perception to detect critical items in rich natural environments, for example, inattention and change blindness. He is also developing statistical methods for finding anomalies in large and small datasets. The role of cultural factors in perception and mis-perception is also central. He serves on three journal editorial boards and is on the program committees of several social dynamics and complex systems conferences.
Repperger Research Intern Program

RESEARCH PROJECT: 17-03

FROM INSIGHTS IN SOCIAL MEDIA TO INDICATORS OF BEHAVIOR

PROJECT SYNOPSIS: Social media has dramatically changed the information and communications environment landscape, allowing people from all walks of life to exchange information with one, few, or many without physical constraints. It has become a massive source of information and offers a platform for researchers and scientists to study human behavior and activities at scale. Unfortunately, this seemingly unlimited data does not come without challenges; if nothing else, it presents a very unique set challenges that traditional data mining and machine learning methods cannot overcome. As an example, studies have shown evidence of demographics bias in some social media sources due to users who are much younger than the general population. Another form of bias can come from malicious or automated accounts that proliferate the environment with massive amounts of content intended to skew the data. Researchers are now challenged to identify these biases, develop novel ways to evaluate the data, filter the noise, visualize implicit social links, and overcome the “big data” problem all in an effort to understand individual and group dynamics in the social media environment. Research projects should focus on potential solutions to any of the aforementioned challenges (or others related to social media data) with the ultimate goal of effectively leveraging social media information to better understand human behaviors and detect or predict events or activities. Student will be involved at all phases of research including hypothesis generation, experimental design, data analysis, and documentation. Original ideas are encouraged.

STUDENT LEVEL / DISCIPLINE NEEDED:
PhD, Master’s, Bachelor’s/ Social Science, Computer Science, Engineering

RESEARCH LOCATION: Human Analyst Augmentation, Wright-Patterson AFB, Dayton, OH

RESEARCH ADVISER: Rik Warren, PhD

DEGREE: Experimental Psychology, Cornell, 1975

Dr. Warren is a National Research Council Post-Doctoral Advisor and has mentored numerous NRC post-docs and graduate students. He is a perceptual psychologist and currently is interested in failures of perception to detect critical items in rich natural environments, for example, inattention and change blindness. He is also developing statistical methods for finding anomalies in large and small datasets. The role of cultural factors in perception and mis-perception is also central. He serves on three journal editorial boards and is on the program committees of several social dynamics and complex systems conferences.

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Repperger Research Intern Program

RESEARCH PROJECT: 17-05

COMPUTATIONAL MODELS OF HUMAN INFORMATION PROCESSING

PROJECT SYNOPSIS: This research focuses on basic cognitive science research to improve our understanding of human information processing, behavior, and performance. The long-term goal is to develop psychologically valid models of human cognition that can be used in a variety of ways to improve the effectiveness and efficiency of training (e.g., as synthetic teammates or instructors to support training, or as training analysis tools). We are pursuing this long-term objective through the use of computational cognitive modeling, focused on changes in cognitive performance resulting from sleep loss and extended time on task. We utilize a variety of research methodologies, including empirical research studies with human participants, cognitive model development using multiple modeling formalisms, validation of model performance through careful comparison to empirical human data, and development of quantitative theoretical mechanisms to account for important psychological phenomena. We seek interns who can contribute to the development of formal, quantitative accounts of human performance to contribute to these objectives.

STUDENT LEVEL / DISCIPLINE NEEDED:
PhD/ Cognitive Science, Neural Science, Human Factors
PhD/Computer Science, Mathematics, Experimental Psychology
Master’s: Cognitive Science, Neural Science, Human Factors

RESEARCH LOCATION: Cognitive Modeling, Wright-Patterson AFB, Dayton, OH

RESEARCH ADVISER: Glenn Gunzelmann, PhD


Dr. Gunzelmann is a Senior Research Psychologist and the Science and Technology Advisor for the Air Force Research Laboratory's Cognitive Model's and Agents Branch (711 HPW/RHAC). The branch conducts research into the science and application of computational and mathematical models of the human mind. The technology objectives are to create validated, adaptive, and credible constructive agents for Live, Virtual, Constructive (LVC) training, and to enable autonomous agents for human-machine teams in contested environments. Dr. Gunzelmann's background is in developing computational models of human cognition, and leads research in modeling the effects of fatigue on cognition.

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Validation of Computation Models of Energy Deposition Using Advanced Techniques in Small Animal Imaging

PROJECT SYNOPSIS: To understand the biological effects of non-ionizing radiation exposure towards development of technology and maintaining warfighter safety in the battlespace. We study longer wavelength non-ionizing radiation, ranging from the far infrared (Terahertz imaging) to low frequency electrical pulses (used for neuromuscular incapacitation). The biological effects associated with the application of non-ionizing directed energy are difficult to predict, however computational simulations developed by our lab can predict a pattern of energy deposition for a given in vivo model. Through the use of transgenic animals and advanced small animal imaging techniques, we can not only validate the computational simulations of energy deposition by tracking thermal stress proteins, but we can also investigate other molecular pathways up/down regulated by the deposited energy. This project will involve the development/refinement of the standard operating procedures (SOP) for imaging small animals (bioluminescence, fluorescence, and µCT) in the Perkin-Elmer IVIS Spectrum CT.

STUDENT LEVEL / DISCIPLINE NEEDED: PhD, Master’s, Bachelor’s/ Biomedical Engineering, Biology, Neuroscience

RESEARCH LOCATION: Radio Frequency Radiation Bioeffects, Fort Sam Houston, San Antonio, TX

RESEARCH ADVISER: Caleb Roth, PhD

DEGREE: Radiation Bioeffects, University of Texas Health Science Center SA, 2016

Dr. Roth began working for the Air Force Research Laboratory in 2004 as a contractor investigating the biological markers associated with directed energy (radio frequency) exposures. He was awarded the SMART scholarship in 2012 and completed his Ph.D. in 2016. He is currently a principle investigator for efforts in validating computational models of energy deposition in vivo. Dr. Roth uses transgenic organisms and advanced techniques in small animal imaging to track biological markers of radio frequency (RF) exposure over time. Dr. Roth is an accomplished researcher in the field of bioelectrics, specifically in nanosecond pulsed electrical fields with > 30 peer-reviewed publications.
Repperger Research Intern Program

RESEARCH PROJECT: 17-07

BIOLOGICAL EFFECTS ASSOCIATED WITH TERAHERTZ RADIATION

PROJECT SYNOPSIS: Over the past few years, Terahertz (THz) radiation sources and detectors have advanced greatly driving more use of THz-based technologies in many military and civilian operations, such as in wireless communication, security and defense, and in spectroscopy and imaging. The emergence of these new THz systems has opened the door for numerous exciting applications, but the introduction of these new systems has also prompted safety concerns and has stimulated much interest and activity among the THz bioeffects community. The mission of AFRL's Radio Frequency Radiation Branch is to understand the fundamental effects of exposure to THz radiation not only to support the development of exposure standards to ensure the safety of our military personnel, but also to identify areas ripe for exploitation. Specifically, we seek to provide a scientific basis to answer the following questions: (1) What are the exact biophysical and biochemical mechanisms that govern THz interactions with biological structures? (2) Can these mechanisms be exploited for selective non-contact stimulation and control of biological activity? Our current work investigates the effect of THz frequencies on cells. We examine changes in gene expression and epigenetic patterns, and the downstream effects on cellular bioenergetics, intracellular signaling, cellular damage, and survival.

STUDENT LEVEL / DISCIPLINE NEEDED:
PhD/ Biomedical Engineering, Biology, Physics
Master’s/ Biomedical Engineering, Physics, Biology
Bachelor’s/ Biology, Biomedical Engineering, Physics

RESEARCH LOCATION: Radio Frequency Radiation Bioeffects, Fort Sam Houston, San Antonio, TX

RESEARCH ADVISER: Ibtissam Echchgadda

DEGREE: Cellular and Structural Biology, University of Texas HSC San Antonio 2003

Dr. Ibtissam Echchgadda is a Research Biological Scientist for the Air Force Research Laboratory (AFRL), 711 Human Performance Wing, Bioeffects Division, RF Research Branch in Fort Sam Houston, TX. Her current research focuses on investigating the biophysical and biochemical mechanisms that govern Radiofrequency electromagnetic fields interaction with biological systems. Dr. Echchgadda has over 15 years of experience in different basic science and applied research. Before joining AFRL, she worked as a defense contractor for General Dynamics and before that she served as a Research Faculty at the University of Texas Health Science Center San Antonio. Dr. Echchgadda received multiple honorable awards and her work has been published in high-impact journals.

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Repperger Research Intern Program

RESEARCH PROJECT: 17-08

IMPACT OF SHORT PULSE ELECTROMAGNETIC FIELDS ON MAMMALIAN CELLS

PROJECT SYNOPSIS: Our laboratory’s goal is to understand the biological effects of high peak power microwaves. Utilizing directly applied nanosecond pulsed electric fields (nsPEF) as a microwave surrogate; we study changes in cell plasma membrane structure, morphology and physiology, and genetic and proteomic expression. To study such changes, we use electrophysiological and optical microscope systems to record changes in membrane conductance in real time allowing for the determination of thresholds for effect of various nsPEF exposure parameters. In addition, we study the impact of such pulses on neurological cells to investigate the impact of electrical pulses on the conduction of action potentials. Genetic and proteomic techniques are used in conjunction with an exposure system capable of exposing a population of cells to elucidate stressful and lethal exposure endpoints. Lastly, we pursue the development of theoretical models that describe and predict the impact and response of cells exposed to nsPEF. We aim to generate models that compliment empirical results to predict observed cellular effects and lethality. The overarching aim of this research effort is to generate a comprehensive model that can predict the field distribution and biological impact of high peak power microwave exposures to ensure soldier safety in the battlefield.

STUDENT LEVEL / DISCIPLINE NEEDED: PhD, Master’s, Bachelor’s/ Biomedical Engineering, Electrical Engineering, Biology

RESEARCH LOCATION: Radio Frequency Bioeffects, Fort Sam Houston, San Antonio, TX

RESEARCH ADVISER: Bennett Ibey, PhD

DEGREE: Biomedical Engineering, Texas A&M University, 2006

Dr. Ibey began working for the Air Force Research Laboratory in 2007 as the principal investigator of high peak power microwaves (HPPM) bioeffects. His research includes the construction of HPPM microwave systems, the use of patch clamp to study cellular bio-electric effects, the development of theoretical models, cellular microscopy, and the measurement of genetic or proteomic effects of HPPM exposure. Dr. Ibey has published 1 book chapter, 5 patents, and 47 peer-reviewed publications. He is a board member of bioelectromagnetics society, active member of SPIE, and the Direct Energy Professional Society. He was named the AF Junior Civilian Scientist of the Year 2010 and received an honorable mention for the McLucas Basic Science Award in 2011.

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Repperger Research Intern Program

RESEARCH PROJECT: 17-09

Risk Assessment and Bioeffects of Very High Fluence Electron Beams

PROJECT SYNOPSIS: This project will develop risk assessments for military use of very high fluence/high energy electron beams. The project will involve modeling of dose from in field and out-of-field electron beam exposure, measurement of electron beam parameters, prediction of bioeffects, and verification of bioeffects with and animal study of direct exposure. The student will be involved with modeling, phantom selection, dosimetry, and planning for the animal experiment. BACKGROUND: Electron beams have been used in industrial and medical applications for a number of years so tools exist to assess dose and risk from those devices. However, higher fluence and energy electron beams may produce unexpected levels of dose, risk, and bioeffects. This project will look to develop methodologies for assessing dose, risk, and bioeffects for higher fluence and energy devices.

STUDENT LEVEL / DISCIPLINE NEEDED:
PhD, Master’s/ Health Physics, Medical Physics, Nuclear Engineering

RESEARCH LOCATION: Radio Frequency Bioeffects, Fort Sam Houston, San Antonio, TX

RESEARCH ADVISER: Noel D. Montgomery, PhD

DEGREE: Biomedical Engineering, University of Texas SA, 2016

Dr. Montgomery is a Diplomate of the American Board of Health Physics (1995). His main research interests are modeling and measurement of interaction of radio frequency (RF) and ionizing radiation with tissue, dosimetry, and health consequences of exposure. After a 21 year Air Force career as a Health Physicist, Dr. Montgomery returned to school on the Air Force Long Term Full Time Training program where he earned a PhD in Biomedical Engineering with a dissertation titled: Model of Electric Conductivity of White Matter using Magnetic Resonance Imaging Data. His previous work included dose and risk assessments on a variety of ionizing and nonizing systems.

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**Repperger Research Intern Program**

**RESEARCH PROJECT: 17-10**

**BIOLOGICAL INTERACTION OF ENGINEERED NANOMATERIALS: SAFETY TO APPLICATION**

**PROJECT SYNOPSIS:** Engineered nanomaterials (NM) between 1-100 nm in size possess novel physical and chemical properties that can be used to create unique devices. Unique NM quantum characteristics can confer unique electrical, optical and magnetic nanosystem attributes not present in corresponding bulk materials. The use of NM have direct military applications such as; medical, engineering, detection, weapon enhancement, and portable battlefield remote monitoring devices. Due to the plethora of NM physiochemical characteristics (dimensional size, structure, shape and surface chemistries), this project will seek to elucidate fundamental interactions of NMs with biological systems. NMs can initiate novel molecular events such as membrane receptor modulation, enhanced endocytosis dynamics and subcellular signal activation. Through the use of gene-editing technologies, tissue engineering, linked and interchangeable multi-tissue based platforms and air/liquid interface capabilities, our research thrust will aid in the development of novel material-based biosensors for military applications. The incumbent student should anticipate a hands on experience that involves: 1.) Characterization of nanoparticles/advanced materials using various techniques (TEM, SEM, DLS, IC-PMS, BET etc.,), 2.) Systematic testing of NMs using various cell culture models, 3.) Advanced molecular gene editing technologies to elucidate adverse outcome pathways as a result of NMs interaction, 4.) Actively presents their results in lab meetings with the potential to provide a final platform presentation, and 5.) Encouragement to write technical reports or short communication for peer reviewed journals.

**STUDENT LEVEL / DISCIPLINE NEEDED:**
Master’s, Bachelor’s / Biological or Chemical or Material Engineering, Chemistry, Physics, Biology, Biochemistry

**RESEARCH LOCATION:** Molecular Bioeffects, Wright-Patterson AFB, Dayton, OH

**RESEARCH ADVISER:** Saber Hussain, PhD

**DEGREE:** Toxicology, Indian Institute of Chemical Technology, 1991

Saber Hussain, Senior Scientist and Nanotoxicology Group Lead, Molecular Bioeffects Division, Wright-Patterson Air Force Base, Ohio. He is full affiliated Professor of Pharmacology and Toxicology, Wright State School of Medicine, Dayton, OH. Dr. Hussain began (1987) his scientific career as a toxicology research fellow at the highly regarded Indian Institute of Chemical Technology (IICT) and received his doctorate degree in 1991. Here, his novel exploration of heavy metal biotransfer between different proteins in complex biological environment led to a series of prestigious research fellowships in Italy, Switzerland, and the U.S. Dr. Hussain joined the Air Force Research Laboratory at Wright-Patterson AFB in 1999, where his research interests transitioned into elucidating fundamental interaction of engineered nanomaterials with biological system with a special focus on developing nanodevices and evaluating potential toxicity arising from the physicochemical properties of nanoscale structures. His research addressing biomolecular interaction of nanomaterials and its associated toxicity has resulted in author/co-authorship of 120 peer-reviewed publications, several book chapters, and above 200 technical abstracts. He is currently an Associate Editor of Toxicological Sciences and serves as an editorial member of several other toxicology journals including Nanotoxicology Journal. He is a Fellow of the Academy of Toxicological Sciences and Fellow of US Air Force Research Laboratory. He serves as an expert reviewer for several government and private organizations. Dr. Hussain has been the recipient of SOT-AstraZeneca traveling lectureship award and numerous scientific awards and has established a strong collaborative network with over 25 organizations of national and international repute.

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Repperger Research Intern Program

RESEARCH PROJECT: 17-11

PHYSIOLOGICAL RESPONSE(S) TO INTENSE ELECTRICAL STIMULI

PROJECT SYNOPSIS: This project will seek to understand the interaction of electrical pulses and short high-power microwaves (HPM) on biological tissue to understand mechanisms underlying an effect on physiological systems. Significant research has been completed, and is still ongoing, at the cellular level to understand ion flow and membrane changes related to exposure from electromagnetic energy. Current in-lab technology highlights the potential for augmenting and inhibiting sensory feedback and neural motor control. We are assessing changes in synaptic communication and the effect of electromagnetic energy on network functions. We also look at the biomechanical response, thermal response, and pathophysiological mechanisms underlying a response during an exposure condition. Ideal candidates would have expertise in the fields of biomedical engineering, physics, neuroscience or neuro-engineering and a high affinity for quantitative analysis. Familiarity with in vivo and in vitro animal preparations, finite-difference time-domain computational solutions, C++ or Matlab programming, and knowledge of Maxwell’s equations would be a plus.

STUDENT LEVEL / DISCIPLINE NEEDED:
PhD, Master’s, Bachelor’s/ Biomedical Engineering, Computer Science, Electrical Engineering

RESEARCH LOCATION: Radio Frequency Bioeffects, Fort Sam Houston, San Antonio, TX

RESEARCH ADVISER: Michael B. Jirjis, PhD

DEGREE: Biomedical Engineering, Marquette University, 2013

Dr. Jirjis is a research biomedical engineer with the Air Force Research Laboratory (AFRL). His current research focuses on exploring how pulsed electromagnetic fields interact with mammalian cells. He obtained his Bachelor of Science and Doctoral degrees from Marquette University. Dr. Jirjis has over 13 years of expertise working in the biotech and medical device field for Cargill Inc., Medtronic, and Boston Scientific prior to working in the defense industry. Before joining AFRL, Dr. Jirjis worked as a subject matter expert for human effects of NLW technology development and performed biological effect based experimental studies with radio frequency technology.

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Repperger Research Intern Program

RESEARCH PROJECT: 17-12

Investigation of novel signaling elements for non-traditional optogenetic approaches

PROJECT SYNOPSIS: Recent development of light-controlled cellular activity, known as optogenetics, has sparked interest in new methods for light-induced neural and cellular activation. To date, the majority of optogenetics research is performed through transfection of opsins into neurons to control activity, and brain stimulation is conducted through thin fibers inserted directly into the skull of small mammals. Although optogenetics is a useful tool, there are still limitations, and as a result, novel alternatives are desired. To overcome these limitations, we are interested in the use of non-traditional electromagnetic (EM) frequencies in order to move towards a non-invasive optogenetic approach. Specifically, our group focuses on both the molecular mechanisms as well as whole cell models, for the development of new, protein-based sensing elements. Molecular simulations, coupled with ultrafast spectroscopic techniques, will be performed in order to validate the engineered proteins as well as provide novel capabilities to AFRL.

STUDENT LEVEL / DISCIPLINE NEEDED:
PhD, Master’s, Bachelor’s/ Chemistry, Biochemistry, Spectroscopy

RESEARCH LOCATION: Radio Frequency Bioeffects, Fort Sam Houston, San Antonio, TX

RESEARCH ADVISER: Morgan S. Schmidt, PhD

DEGREE: Chemistry, University of Denver, 2012

Dr. Morgan Schmidt joined the U.S. Air Force Research Laboratory (711th HPW/RHDR) in 2016, after working for AFRL as an ORISE and NRC postdoc. Her doctoral research was completed in Chemistry, where she investigated plasma spectroscopic techniques applied to biological and environmental matrices using both laser-induced breakdown spectroscopy (LIBS) and spark-induced breakdown spectroscopy (SIBS). Current efforts are focused on developing new, ultrafast optical techniques such as multidimensional infrared spectroscopy, to investigate novel alternatives to traditional optogenetics through the design of unique, protein-based sensing elements.

NOTE TO APPLICANTS: If selected for participation in this program, you will be offered temporary summer employment through a contract to perform work for AFRL’s Airman Systems Directorate. This is not a U.S Government position. If selected, you will be required to undergo a National Agency Check before being granted access to government computer systems.
Repperger Research Intern Program

RESEARCH PROJECT: 17-13

Machine Learning Methods for High Content Analysis and Genetics-Based Predictive Toxicology

PROJECT SYNOPSIS: Protecting the health of military operators involves assessing, treating and developing countermeasures to illness, injury, or exposure to foreign substances commonly encountered in harsh and varied environments. A complicating factor in this is the wide range of responses that exist for every treatment or exposure due to underlying differences in each person’s genetic profile. Understanding how genetics influences response to chemical exposure is critical for advancing personalized medicine and the Air Force’s Total Exposure Health (TEH). This project seeks to use cellular phenotypic signatures to identify individuals that display extreme hypo/hypersensitivity to chemical toxicants and then identify correlations to specific genetic polymorphisms (i.e. mutations) that may contribute to the differential response profile. This project involves “big data” applications and we are seeking a student with knowledge of advanced computational bioinformatics and/or statistics methods, which will be used for mining the high content and genetic data involved in this project. The ultimate goal of this project is to develop a genetics-based predictive model that can identify individuals that are at a higher risk of adverse health response to toxicant exposure. Students will emerge with rich experience in an in-demand field, and have the opportunity to collaborate with biologists, engineers and programmers, with the goal to publish the work in peer-reviewed journals.

STUDENT LEVEL / DISCIPLINE NEEDED:
PhD, Master’s, Bachelor’s/ Bioinformatics, Statistics, Genetics-Genomics

RESEARCH LOCATION: United States Air Force School of Aerospace Medicine, Wright-Patterson AFB, Dayton OH

RESEARCH ADVISER: Heather Pangburn, PhD

DEGREE: Molecular Toxicology & Cancer Pharmacology, University of Colorado, 2007

Heather Pangburn, PhD, is a Research Toxicologist in the USAF School of Aerospace Medicine, Department of Aeromedical Research, overseeing and conducting research related to Force Health Protection to include precision medicine/total exposure health efforts, in vitro toxicology, hazard detection and air quality monitoring to evaluate human risk. Dr. Pangburn brings 10+ years’ experience in toxicology, molecular biology, cell biology and biochemistry. She received her PhD in Molecular Toxicology from the University of Colorado Health Sciences Center (UCHSC) wherein she examined the biologic and biochemical mechanisms of the chemopreventive effects of non-steroidal anti-inflammatory drugs. Heather subsequently executed her postdoctoral fellowship in the Regenerative Medicine and Stem Cell Biology Program at the University of Colorado Denver studying genetic pathways and identifying genetic alterations that occur in acquired skin diseases such as cancer. Following her fellowship, Dr. Pangburn served as Research Scientist and Radioprotection Team Lead in the Human Signatures Branch of Air Force Research Laboratories 711th Human Performance Wing where she led a team of scientists in identifying and exploiting molecular mechanisms to provide enhanced human performance and injury protection to the warfighter in high radiation environments.

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Repperger Research Intern Program

RESEARCH PROJECT: 17-14

Imaging informatics tools and resources for force health protection research

PROJECT SYNOPSIS: We are looking for students who are interested in applying computer science/engineering to address shortcomings in measuring biological activities. This "big data" project will use bioinformatics to make functional improvements to computational image analyses on an image analysis pipeline software platform supported on supercomputing resources. Students will have the opportunity to hone bioinformatics skills in an existing software platform, with the goal of integrated algorithms for automated measurements of complex biological samples. Students will emerge with rich experience in an in-demand field, and have the opportunity to collaborate with biologists, engineers and programmers, with the goal to publish the work in peer-reviewed journals.

STUDENT LEVEL / DISCIPLINE NEEDED:
PhD, Master’s, Bachelor’s/ Bioinformatics, Engineering-Mathematics, Computer-Information Science

RESEARCH LOCATION: United States Air Force School of Aerospace Medicine, Wright-Patterson AFB, Dayton OH

RESEARCH ADVISOR: Heather Pangburn, PhD

DEGREE: Molecular Toxicology & Cancer Pharmacology, University of Colorado, 2007

Heather Pangburn, PhD, is a Research Toxicologist in the USAF School of Aerospace Medicine, Department of Aeromedical Research, overseeing and conducting research related to Force Health Protection to include precision medicine/total exposure health efforts, in vitro toxicology, hazard detection and air quality monitoring to evaluate human risk. Dr. Pangburn brings 10+ years’ experience in toxicology, molecular biology, cell biology and biochemistry. She received her PhD in Molecular Toxicology from the University of Colorado Health Sciences Center (UCHSC) wherein she examined the biologic and biochemical mechanisms of the chemopreventive effects of non-steroidal anti-inflammatory drugs. Heather subsequently executed her postdoctoral fellowship in the Regenerative Medicine and Stem Cell Biology Program at the University of Colorado Denver studying genetic pathways and identifying genetic alterations that occur in acquired skin diseases such as cancer. Following her fellowship, Dr. Pangburn served as Research Scientist and Radioprotection Team Lead in the Human Signatures Branch of Air Force Research Laboratories 711th Human Performance Wing where she led a team of scientists in identifying and exploiting molecular mechanisms to provide enhanced human performance and injury protection to the warfighter in high radiation environments.

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Facile Total Exposure Health Monitoring using a miRNA/mRNA Response Classifier

PROJECT SYNOPSIS: Modern health care has been energized by technologies that allow gathering an unprecedented amount of data that enable personalized healthcare decisions. The Air Force Surgeon General launched the Total Exposure Health Initiative to support real-time individualized interactive health decisions informed by integrating all relevant data of an individual's lifetime history of exposures. miRNA are small regulatory molecules that control gene expression on a post-transcriptional level. They show changes in expression level in disease or as a result of environmental exposures. We seek to support this effort by developing miRNA signatures that report on exposures of concern to the Air Force. Potential projects within this area might involve: 1) Bench science to expose cells to various compounds and quantitate differentially expressed miRNA/mRNA genes using techniques such as RNASeq, quantitative PCR or nanoString counting. 2) Bioinformatic/statistical analysis of differentially expressed miRNA/mRNA uncovered experimentally 3) Mine existing studies aimed at discovering miRNA responsive to the environment and perform quality control bioinformatic/statistical analysis to evaluate suitability of including in future miRNA reporter panels.

STUDENT LEVEL / DISCIPLINE NEEDED:
PhD, Master’s, Bachelor’s/ Bioinformatics, Statistical Data Mining, Molecular Biology

RESEARCH LOCATION: United States Air Force School of Aerospace Medicine, Wright-Patterson AFB, Dayton OH

RESEARCH ADVISER: Heather Pangburn, Phd

DEGREE: Molecular Toxicology & Cancer Pharmacology, University of Colorado, 2007

Heather Pangburn, PhD, is a Research Toxicologist in the USAF School of Aerospace Medicine, Department of Aeromedical Research, overseeing and conducting research related to Force Health Protection to include precision medicine/total exposure health efforts, in vitro toxicology, hazard detection and air quality monitoring to evaluate human risk. Dr. Pangburn brings 10+ years’ experience in toxicology, molecular biology, cell biology and biochemistry. She received her PhD in Molecular Toxicology from the University of Colorado Health Sciences Center (UCHSC) wherein she examined the biologic and biochemical mechanisms of the chemopreventive effects of non-steroidal anti-inflammatory drugs. Heather subsequently executed her postdoctoral fellowship in the Regenerative Medicine and Stem Cell Biology Program at the University of Colorado Denver studying genetic pathways and identifying genetic alterations that occur in acquired skin diseases such as cancer. Following her fellowship, Dr. Pangburn served as Research Scientist and Radioprotection Team Lead in the Human Signatures Branch of Air Force Research Laboratories 711th Human Performance Wing where she led a team of scientists in identifying and exploiting molecular mechanisms to provide enhanced human performance and injury protection to the warfighter in high radiation environments.
Repperger Research Intern Program

RESEARCH PROJECT: 17-16

Genetic Variability of Phenotypic Outcomes for Individualized Force Health Protection

PROJECT SYNOPSIS: The focus of our research is to develop human stem cell-based assays to identify genetic markers that correlate with organ phenotypic responses following toxic chemical and environmental exposure situations. This includes the use of recombinant DNA modification tools to generate genetic variability, and the use of proteomic and metabolomic analysis as well as cell-based assays for drug/toxin screening in a high-content screening environment. The overall goal of our studies is to identify genetic factors that play a role in human performance and need to be addressed by individualized force health protection. The research is linked to data processing by bio-computational analysis for integration into physiology-based models. The generated physiology based models are aimed towards outcome prediction in individuals with different genetic backgrounds and for improvement of prevention/human physiology requirements, first-response medical intervention and development of novel therapeutic regimen.

STUDENT LEVEL / DISCIPLINE NEEDED:
PhD, Master’s, Bachelor’s/ Information Sciences, Computer Science, Biochemistry

RESEARCH LOCATION: United States Air Force School of Aerospace Medicine, Wright-Patterson AFB, Dayton, OH

RESEARCH ADVISER: Heather Pangburn, PhD

DEGREE: Molecular Toxicology & Cancer Pharmacology, University of Colorado, 2007

Heather Pangburn, PhD, is a Research Toxicologist in the USAF School of Aerospace Medicine, Department of Aeromedical Research, overseeing and conducting research related to Force Health Protection to include precision medicine/total exposure health efforts, in vitro toxicology, hazard detection and air quality monitoring to evaluate human risk. Dr. Pangburn brings 10+ years’ experience in toxicology, molecular biology, cell biology and biochemistry. She received her PhD in Molecular Toxicology from the University of Colorado Health Sciences Center (UCHSC) wherein she examined the biologic and biochemical mechanisms of the chemopreventive effects of non-steroidal anti-inflammatory drugs. Heather subsequently executed her postdoctoral fellowship in the Regenerative Medicine and Stem Cell Biology Program at the University of Colorado Denver studying genetic pathways and identifying genetic alterations that occur in acquired skin diseases such as cancer. Following her fellowship, Dr. Pangburn served as Research Scientist and Radioprotection Team Lead in the Human Signatures Branch of Air Force Research Laboratories 711th Human Performance Wing where she led a team of scientists in identifying and exploiting molecular mechanisms to provide enhanced human performance and injury protection to the warfighter in high radiation environments.

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Mobile Software Application for Cockpit Evaluation of Laser Eye Protection

PROJECT SYNOPSIS: In collaboration with filter developers and operational test organizations, the laser protection team supports development of Laser Eye Protection (LEP) devices by conducting requirements analysis, compatibility and coverage modeling, optical quality measurements and in cockpit evaluations. Currently cockpit assessments are conducted using paper and pencil surveys of acceptability and usability. To improve data collection processing and to move toward performance assessment a mobile software application is needed to support cockpit evaluations. The software application should be hosted on a suite of portable information processing tablets and should be designed to present cockpit LEP assessment surveys, collect and organize response data, record verbal responses, and present simple visual performance tests. In addition, the tablets should be able to communicate with each other to share and synchronize data and perform basic statistical analysis.

STUDENT LEVEL / DISCIPLINE NEEDED:
PhD, Master’s, Bachelor’s/ Computer Science, Information Sciences, Human Factors

RESEARCH LOCATION: Optical Radiation Bioeffects, Fort Sam Houston, San Antonio, TX

RESEARCH ADVISER: Barry Goettl, PhD

DEGREE: Human Factors Psychology, University of Illinois Urbana-Champaign, 1987

Dr Goettl is Program Manager of the Laser Protection program. He has been with the Air Force Research Lab since 1992. During this time his research has focused on skill acquisition, human performance, and intelligent tutoring systems. He has also conducted research on the behavioral effects of High Power Microwave exposure and counter-electronics DE weapons. As Program Manager of the Laser Protection program he leads a team of scientists and engineers conducting requirements analysis, modeling and simulation, laboratory assessments and field evaluation of Laser Eye Protection. He is a member of the Human Factors and Ergonomics Society and is Associate Editor of the Journal Human Factors.
Imaging at the speed of light: Utilizing compressed ultrafast photography to observe fundamental intracellular dynamics in real-time.

PROJECT SYNOPSIS: For many full-field imaging techniques, such as fluorescence based microscopy, imaging speeds are often limited by the read-out rate of the CCD or CMOS detector used. While advances in these technologies have allowed for faster image acquisition rates over time, fundamental physical limits in these devices prevent this technology from further increasing imaging speed. With the recent development of Compressed Ultrafast Photography (CUP), single-shot images at up to 100 billion frames per second have been demonstrated. We have incorporated CUP detection into an inverted microscope to allow for microscopic scale imaging of biological phenomena at unprecedented frame rates. In this project, we seek to further utilize CUP based imaging to greatly enhance the imaging speed of techniques such as fluorescence lifetime imaging, and to utilize this to study the effects of directed energy on the molecular level. Opportunities include laboratory based imaging experiments as well as software development to enhance image processing speeds via GPU processing.

STUDENT LEVEL / DISCIPLINE NEEDED:
PhD, Master’s/ Computer Science, Biomedical Engineering, Biology

RESEARCH LOCATION: Optical Radiation Bioeffects, Fort Sam Houston, San Antonio, TX

RESEARCH ADVISER: Joel N. Bixler, PhD

DEGREE: Biomedical Engineering, Texas A&M University, 2015

Joel Bixler is a Research Biomedical Engineer in the Optical Radiation Branch at the Air Force Research Laboratory Airman Systems Directorate. He joined the Air Force Research Laboratory as a Pathways intern in 2014, and currently works as a principle investigator for a seedling effort to develop ultrafast imaging systems. He is a Co-PI on a three-year Air Force Office of Scientific Research LRIR grant working to combine compressed ultrafast photography with fluorescence based imaging techniques in order to study the effects of directed energy at the molecular level. Additionally, Dr. Bixler works with the modeling, simulation, and analysis team to develop improved methods for modeling laser-tissue interaction.

NOTE TO APPLICANTS: If selected for participation in this program, you will be offered temporary summer employment through a contract to perform work for AFRL’s Airman Systems Directorate. This is not a U.S Government position. If selected, you will be required to undergo a National Agency Check before being granted access to government computer systems.
NOTE TO APPLICANTS: If selected for participation in this program, you will be offered temporary summer employment through a contract to perform work for AFRL’s Airman Systems Directorate. This is not a U.S Government position. If selected, you will be required to undergo a National Agency Check before being granted access to government computer systems.

Reppenger Research Intern Program

RESEARCH PROJECT: 17-19

INVESTIGATING PRIMARY AND SECONDARY BIOEFFECTS OF PHOTOTHERMAL AND PHOTOCHEMICAL EXPOSURE

PROJECT SYNOPSIS: The damaging effects of lasers on cells depends upon the wavelength and intensity of the irradiation, as well as the overall duration of exposure. Photochemical damage is correlated with severe oxidative stress (secondary effects), but little is known about which enzymes are the prime suspects for photon absorption (primary effects). Absorption by chromophores like melanin and water can lead to temperature rises (primary effects) that cause damage via thermal destruction of macromolecules (secondary effects). Our laboratory is interested in the biophysical alterations in the key biomolecules involved in thermal (secondary effects) and photochemical (primary effects) damage. At the cellular level, we study laser bioeffects using microthermography (IR imaging), Raman spectroscopy/imaging, and fluorescence-based microscopic detection of damage, metabolic perturbations, and macromolecule localization. At the molecular level, we study rates of protein denaturation using fluorescence, fluorescence anisotropy, and Raman spectroscopy, while oxidative products are assessed by chemical and physical methods. Biophysical data can supply valuable input for computational models, providing revolutionary enhancements for predicting risk of laser damage on the modern battlefield.

STUDENT LEVEL / DISCIPLINE NEEDED:
PhD, Master’s, Bachelor’s/ Molecular Biology, Cell Biology, Biochemistry

RESEARCH LOCATION: Optical Radiation Bioeffects, Fort Sam Houston, San Antonio, TX

RESEARCH ADVISER: Michael Denton, PhD

DEGREE: Biochemistry, Kansas State University, 1991

Dr. Denton is a Research Biochemist at the Air Force Research Laboratory’s Optical Radiation Branch where he has studied laser-tissue interactions in cultured cells since 2000. His research interests include the study of cellular processes responsible for photothermal and photochemical damage, and the development of computational models describing those processes. Dr. Denton has 28 peer-reviewed publications and is an active member of the International Society for Optics and Photonics (SPIE) and the American Society for Photobiology.
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Repperger Research Intern Program

RESEARCH PROJECT: 17-20

FRACTIONAL ORDER BIOPHYSICS

PROJECT SYNOPSIS: Research has shown that biophysical processes, such as laser-tissue interaction, deviate from the predictions given by traditional mathematical models for short laser exposure times. In general, it was found that the shorter the exposure time is, the stronger the deviation will be. However, generalizing these models by recasting them as fractional order differential equations have resulted in models that show high agreement with experimental observation regardless of exposure duration. The purpose of this project is to analyze these new equations that employ elements of the fractional calculus and apply them to other biophysical phenomena, beginning with thermal diffusion resulting from laser heating. Methods will include an introduction to the fractional calculus; a powerful branch of mathematics dealing with differentiation and integration of arbitrary order, and the development of new analytical and/or numerical models as needed. Secondary objectives will include the development of models that have the capability to simulate combinations of different biophysical processes.

STUDENT LEVEL / DISCIPLINE NEEDED:
Master’s/ Biomedical Engineering, Physics, Mathematics

RESEARCH LOCATION: Optical Radiation Bioeffects, Fort Sam Houston, San Antonio, TX

RESEARCH ADVISER: Andrew Wharmby, PhD

DEGREE: Biomedical Engineering, University of Texas, San Antonio, 2013

Andrew Wharmby is a Research Biomedical Engineer in the Optical Radiation Branch at the Air Force Research Laboratory Airman Systems Directorate. He joined the Air Force Research Laboratory in 2006 where he focused on the development and application of digital image and video processing algorithms, automated instrumentation control, and data analysis for the Vision Science team. He then moved to the Modeling and Simulation team where he developed finite element analysis code for simulating real-time dynamic thermal lensing events in the human eye. Upon completing his Ph.D., he returned to RHDO where he now focuses on the application of fractional calculus to solve problems involving directed energy effects on materials and biological systems.
NOTE TO APPLICANTS: If selected for participation in this program, you will be offered temporary summer employment through a contract to perform work for AFRL’s Airman Systems Directorate. This is not a U.S. Government position. If selected, you will be required to undergo a National Agency Check before being granted access to government computer systems.

Repperger Research Intern Program

RESEARCH PROJECT: 17-21

BIOCHEMISTRY/MOLECULAR BIOLOGY OF PHOTOBIOMODULATION

PROJECT SYNOPSIS: Photobiomodulation (PBM) is the term now used, in place of Low Level Laser (or Light) Therapy, to refer to a general invigoration of cells following exposure to low doses of red or near infrared (NIR) electromagnetic radiation (“light”). Because the first observation of this effect was therapy-like, the vast majority of research on PBM has been therapy oriented. However, PBM has also been shown to protect mouse retina cells in vivo against injurious levels of white light, and for rats against retinal toxicity of methanol, rotenone and MPP+-induced neurotoxicity, and CCl₄-induced liver cirrhosis. In our hands PBM protects cultured human retinal pigmented epithelium (hTERT-RPE) cells, in vitro, against the lethal effects of a pulse of 2 µm laser radiation, modulates expression of genes associated with growth control and apoptosis, increases levels of nitric oxide (NO) in the cells, and stimulates oxygen consumption by mitochondria. The goal of our research effort is to determine if it is possible to increase the magnitude and/or duration of this effect. To this end, we recently found that 810 nm exposures produces ~1.3 times as 637 nm in increasing NO levels, and NO levels are also affected by the sequence of exposures to red and green light. Providing a better understanding of the physiological pathway(s) is (are) needed. Therefore, the effects of different wavelengths of light exposure on reduction/oxidation potentials in cells, nitric oxide induction and biochemistry, cyclic GMP synthase activities, as well as general cell cycle perturbations, cell membrane effects, changes in reactive oxygen species and the competing roles of apoptosis and necrosis are all of interest for defining these observed light-induced enhancements.

STUDENT LEVEL / DISCIPLINE NEEDED:
Master’s/ Biochemistry, Biology, Chemistry

RESEARCH LOCATION: Optical Radiation Bioeffects, Fort Sam Houston, San Antonio, TX

RESEARCH ADVISER: Jeffrey Wigle, PhD

DEGREE: Radiation Biophysics, University of Rochester, 1982

Dr. Wigle is a Research Biological Scientist in the Optical Radiation Branch of the Bioeffects Division. After completing the Ph.D., Dr. Wigle did a Postdoctoral Fellowship in Genetic Toxicology, then joined the USAF, where he served primarily in research management positions. After leaving the USAF in 1999 he worked as an in-house contractor for the Laser Eye Protection Advanced Development Program, and then was hired as a civilian scientist. His overarching research interest is molecular mechanisms of bioeffects from light-tissue interactions. His current research effort is aimed at understanding the biochemistry of red-light induced photobiomodulation in order to determine how one might exploit those pathways towards enhancing performance and protection of the warfighter.
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Repperger Research Intern Program

RESEARCH PROJECT: 17-22

INVESTIGATION OF BIOLOGICAL RESPONSE TO ELECTROMAGNETIC EXPOSURE

PROJECT SYNOPSIS: Understanding the mechanism(s) underlying the interaction of electromagnetic (laser, thermal, short-pulse electric) energies with biological systems is integral for development of novel technologies provided by interfacing these energies with biology. This project focuses on understanding the subtle impacts of electromagnetic energy on cells, with a particular focuses on modulation of neural activity with laser pulses and plasma membrane dynamics. Depending on the interests of the researcher, advanced optical imaging techniques such as fluorescence lifetime, coherent Raman scattering, high-speed imaging, STED, or confocal or multi-photon microscopy may be used to observe the effects on neurons and immortalized cells from stimulation by electromagnetic sources. Individuals with experience with novel biological sensing and imaging techniques are desired, as well as candidates with expertise in neuroscience seeking to expand their repertoire by combining optical approaches with electrophysiology.

STUDENT LEVEL / DISCIPLINE NEEDED:
PhD, Master’s, Bachelor’s/ Biomedical Engineering, Biochemistry, Biophysics, Neuroscience

RESEARCH LOCATION: Optical Radiation Bioeffects, Fort Sam Houston, San Antonio, TX

RESEARCH ADVISOR: Hope Beier, PhD

DEGREE: Biomedical Engineering, Texas A&M University, 2009

Dr. Hope Beier is a principle investigator for efforts applying optical techniques to explore the effects of directed energy on biology. She is PI on two three-year Air Force Office of Scientific Research LRIR grants: one to study the biomechanisms underlying infrared stimulation and activity inhibition of neural tissue and a second to develop high-speed photoactivation-based imaging techniques for observation of biological mechanisms. Dr. Beier has authored 35-peer reviewed journal publications and 5 patent disclosures. She joined the Air Force Research Laboratory in 2010 as a National Research Council Postdoctoral Research Associate and is currently working as a Research Biomedical Engineer.

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Repperger Research Intern Program

RESEARCH PROJECT: 17-23

A HIGH THROUGHPUT BIOINFORMATICS METHOD FOR ANALYZING NUCLEOTIDE POLYMERS DEMONSTRATING PHYSIOLOGICAL EFFECTS WITHIN EUKARYOTIC CELLS

PROJECT SYNOPSIS: Given that the process of folding the entire human genome in-silico remains an intractable problem, this project will utilize viral genomes to reduce the problem domain associated with identifying higher-order (secondary and tertiary) nucleotide structures demonstrating a potential to interact with human physiology. Since the technology required to complete project goals is novel, much of it must be fabricated within the lab. Potential contributions for Repperger interns are many and varied, thus providing appeal to a wide range of scholastic interests. Students interested in combining biology or chemistry with mathematics, engineering, physics, or computer science will have a rich, rewarding research-oriented experience and leave the lab with the lucrative and high-demand bioinformatics skills requisite to education as an inter-disciplinary scientist/engineer. Possible project contributions include smart device app development, relational database development, supercomputer script development, R/MatLab add-in development, C++/Java/Objective-C core algorithm development, GUI design, and more. Ideally, each contribution will result in one or more peer-reviewed publications with associated patent applications, where feasible.

STUDENT LEVEL / DISCIPLINE NEEDED:
PhD, Master’s, Bachelor’s/ Computer Science, Mathematics, Biology

RESEARCH LOCATION: Molecular Bioeffects, Wright-Patterson AFB, Dayton, OH

RESEARCH ADVISER: Stephen Donald Huff, PhD

DEGREE: Bioinformatics, University of Houston, 2011

Upon arrival at the AFRL (RHDJ) in December of 2011, Dr. Huff has labored to establish a state-of-the-art bioinformatics laboratory to 1) investigate the role RNA structural motifs play within eukaryotic cells, 2) facilitate high-content analysis of in-vitro assays, and 3) provide general analytical support to collaborators. The Biological Informatics Group (BIG) within RHDJ has since acquired substantial applications development capabilities with implementations targeting DoD High Performance Computing (HPC) supercomputers, Windows 8 blade server clusters, as well as iOS (Apple), Android (Google) and Windows 7-10 devices. These implementation include multiple instances of parallelized, high-throughput BASH and C++ script data management pipelines (HPC), smart device apps (iOS, Android and Windows handheld devices), a large MySQL taxonomic/genomic database system, and a variety of ancillary software tools developed in Python, R, MatLab, and C++. 

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Low-Latency Plan Execution Monitoring in the CECEP Framework

PROJECT SYNOPSIS: Future autonomous (self-governing) systems will be required to continuously execute discrete solutions. These autonomous systems will have to: (1) solve problems and synthesize discrete plans in order to achieve objectives through specific actions; and (2) closely monitor physical, computational, and human aspects of the environment in order to continuously maintain/repair effective plan execution. This project will focus on the development of the second of these autonomous systems capabilities. In this project, the intern will support the development of a low-latency plan execution monitoring capability in a Technical Cooperation Program (TTCP) Autonomy Strategic Challenge. The intern will research and develop a model-to-model translation capability that will convert plans produced by a Planning Domain Definition Language (PDDL) planner into AFRL’s Cognitively Enhanced Complex Event Processing (CECEP) framework. The model-to-model translation will semantically anchor PDDL plans into the CECEP framework. Translated plans will use formal representations of actions/contexts captured in CECEP during execution to: (1) continuously maintain plan adherence; and (2) inform plan repair when necessary.

STUDENT LEVEL / DISCIPLINE NEEDED: PhD, Master’s/ Computer Science, Cognitive Science

RESEARCH LOCATION: Human Role in Semi-Autonomous Systems, Wright-Patterson AFB, Dayton, OH

RESEARCH ADVISER: Scott A. Douglass, PhD


Dr. Douglass is Senior Cognitive Scientist with Air Force Research Laboratory’s Collaborative Control and Cognition Branch. At Carnegie Mellon University, he acquired expertise in cognitive architectures and the modeling and simulation of complex situated cognitive processes. His research interests include large-scale cognitive modeling, artificial intelligence, knowledge engineering, multi-formalism modeling, and complex event processing. His recent publications have focused on course of action analysis, tactical mission planning, and high-performance constraint solvers.
Repperger Research Intern Program

RESEARCH PROJECT: 17-25

Recognizing and Deciphering Military Symbols in Neuromorphic Architectures

PROJECT SYNOPSIS: The Cognitively Enhanced Complex Event Processing (CECEP) intelligent agent specification and execution framework currently lacks a sub-symbolic pattern recognition capability. For example, it is not currently possible to for CECEP tactical mission planning agents to automatically recognize and decipher commander’s intent in an overlay order graphic containing military symbols. To address the deficiency, this project will focus on the development of a new CECEP information processing capability that: (1) uses spiking convolutional neural network models to recognize and decipher military symbols in overlay graphic orders; (2) computationally realizes these network models in IBM TrueNorth-based neuromorphic architecture; and (3) shares classifier results with CECEP agents through an adapter. Over the course of the project, intern will build military symbol classifiers based on convolution networks. They will additionally program the IBM TrueNorth neuromorphic architecture. Lastly, they will integrate sub-symbolic and symbolic processing in CECEP agents. Project will develop important new sub-symbolic computing capabilities in CECEP that will enable knowledge-based agents to exploit image classifiers executing in neuromorphic architectures.

STUDENT LEVEL / DISCIPLINE NEEDED:
PhD, Master’s/ Neuromorphic Engineering, Computer Science

RESEARCH LOCATION: Human Role in Semi-Autonomous Systems, Wright-Patterson AFB, Dayton, OH

RESEARCH ADVISER: Scott A. Douglass, PhD


Dr. Douglass is Senior Cognitive Scientist with Air Force Research Laboratory’s Collaborative Control and Cognition Branch. At Carnegie Mellon University, he acquired expertise in cognitive architectures and the modeling and simulation of complex situated cognitive processes. His research interests include large-scale cognitive modeling, artificial intelligence, knowledge engineering, multi-formalism modeling, and complex event processing. His recent publications have focused on course of action analysis, tactical mission planning, and high-performance constraint solvers.
Repperger Research Intern Program

RESEARCH PROJECT: 17-26

Accelerating Planning in a Domain Ontology using the Planning Domain Definition Language

PROJECT SYNOPSIS: The Cognitively Enhanced Complex Event Processing (CECEP) agent framework, developed at AFRL, represents domain knowledge as trees of related objects and constraints. These domains are mined using conventional constraint solvers, which allow agents to consider alternative interpretations of the current situation. When complex plans or schedules are represented and mined, however, a CECEP agent cannot currently explore very many alternatives in real-time. Specialized planners exist (e.g., Fast-Forward), which can quickly generate plans for domains described in the Planning Domain Definition Language (PDDL). A bridge between CECEP and PDDL would allow agents to explore much larger spaces of plan alternatives while maintaining real-time performance.

STUDENT LEVEL / DISCIPLINE NEEDED: PhD, Master’s/ Computer Science, Cognitive Science

RESEARCH LOCATION: Human Role in Semi-Autonomous Systems, Wright-Patterson AFB, Dayton, OH

RESEARCH ADVISER: Michael Hansen, PhD

DEGREE: Computer and Cognitive Science, University of Indiana, 2015

Dr. Hansen is a Computer Scientist with the Air Force Research Lab’s Supervisory Control and Cognition Branch. Dr. Hansen received his PhD from Indiana University in 2015 in Computer and Cognitive Science. His research interests include artificial intelligence, knowledge representation, decision making/planning, and programming language understanding.

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Repperger Research Intern Program

Research Project: 17-27

Development of a Mobile Software App for Team-Based Physiological Monitoring in Field Training Environments.

Project Synopsis: In collaboration with the US Air Force Academy, RHCP researchers are working to develop a mobile software app that will provide real-time physiological information and multiple field soldiers to a dismounted commander in charge of monitoring and modulating the behavior of his/her Airmen. Initial app concept needs, user interface design and data transmission structure have been established. The next step is to program and test the app before it is used in laboratory studies and submitted to entry-level field tests.

Student Level / Discipline Needed:
PhD, Master’s, Bachelor’s/ Computer Science

Research Location: Applied Neuroscience and Physiology, Wright-Patterson AFB, Dayton OH

Research Adviser: Adam Strang, PhD

Degree: Cognitive Psychology, Miami University, 2010

Dr. Adam Strang is director of the PaCE (Physical and Cognitive Enhancement) research team. He is a certified and licensed Athletic Trainer with clinical experience in musculoskeletal injury prevention and management. In addition, he has a PhD in cognitive psychology, which includes expertise in cognitive test batteries, psychophysiology, and nonlinear time-series analysis. To date, Dr. Strang has authored more than 60 peer reviewed research articles and presentations.
CAN A ROBOT TEAMMATE REDUCE OPERATOR STRESS?

PROJECT SYNOPSIS: Development of autonomous/agent systems and technologies will enable human-robot teaming. The ultimate goal for these proposed technologies is the creation of sophisticated machines that can act as full teammates alongside their human counterparts. New questions are arising about the varying effects that such intelligent machines may have on their human counterparts. For example, research suggests that in human-human teaming the presence of a teammate who could provide backup support may reduce feelings of stress during performance of a difficult task (e.g., Funke et al., 2016). However, it is currently unclear if the presence of a machine teammate will engender the same stress relief that a human teammate does. An additional consideration in human-machine teaming is embodiment. Embodiment implies a machine that possesses a tangible, physical body. When compared to intelligent agents that exist virtually within a computer, humans interacting with an embodied robot report becoming more engaged and find the robot to be more helpful and enjoyable (Lee et al., 2006; Wainer et al., 2007). As such, an embodied machine teammate may be perceived as more helpful during task performance, leading to greater stress reduction relative to a non-embodied teammate. Consequently, the goal for this research project will be to examine the effects of an embodied and non-embodied machine teammate on human operator workload and stress during a difficult visual search task.

STUDENT LEVEL / DISCIPLINE NEEDED: PhD, Master’s/ Human Factors Psychology, Experimental Psychology

RESEARCH LOCATION: Applied Neuroscience and Physiology, Wright-Patterson AFB, Dayton OH

RESEARCH ADVISER: Gregory Funke, PhD

DEGREE: Human Factors Psychology, University of Cincinnati, 2007

Dr. Funke is an Engineering Research Psychologist in the Air Force Research Laboratory’s Applied Neuroscience and Physiology Branch. His current research foci include human-machine teaming and understanding team processes that contribute to team successes and failures.
HUMAN NECK FINITE ELEMENT MODEL FOR INJURY PREDICTION DURING AIRCRAFT EJECTION

PROJECT SYNOPSIS: AFRL 711th HPW/RHCPT has developed a human neck Finite Element (FE) model in LS-DYNA. The FE model has undergone limited validation under short duration loading events in the Fore/Aft orientation. This research project focuses on correlating the response of the FE neck model to actual human study data and validating the dynamic response of the FE neck model in longer duration dynamic loading scenarios similar to those expected when pilots eject from an aircraft in addition to developing capabilities into the model for neck muscle activation producing similar head rotational loading as observed in human subject studies conducted on the Vertical Drop Tower and Horizontal Impulse Accelerator at WPAFB.

STUDENT LEVEL / DISCIPLINE NEEDED: PhD, Master’s, Bachelor’s/ Biomedical Engineering, Mechanical Engineering, Computer Science

RESEARCH LOCATION: Applied Neuroscience and Physiology, Wright-Patterson AFB, Dayton OH

RESEARCH ADVISER: Casey W. Pirnstill, PhD

DEGREE: Biomedical Science, Texas A&M University, 2015

Casey Pirnstill is a principle investigator for efforts focusing on physiological performance and injury potential in extreme aerospace conditions. Research includes characterization of human response injury criteria with an emphasis on cervical and lumbar spine injuries for acute and chronic exposures. Through the combination of research testing and simulation, current efforts are focused on the development and validation of advanced biofidelic injury prediction models. Dr. Pirnstill joined the Air Force Research Laboratory in 2015 as a Research Biomedical Engineer.
Repperger Research Intern Program

RESEARCH PROJECT: 17-30

RIFLE SHOOTING RANGE NOISE DOSE FOR MARINE RECRUITS

PROJECT SYNOPSIS: Marine recruits engage in a series of training exercises with rifle weaponry at shooting ranges during their basic training. These recruits and their instructors are at high risk for hearing loss due to their repeated exposure to high-amplitude impulsive sounds. An array of microphones will be used to collect noise data across the row of shooter stations and at other locations during weapon firing events. The current project will involve both the calculation of noise doses using the standard approach, as well as the investigation of more realistic physical effects, using the collected dataset.

STUDENT LEVEL / DISCIPLINE NEEDED:
PhD, Master’s, Bachelor’s/ Physics, Mechanical Engineering

RESEARCH LOCATION: Battlespace Acoustics, Wright-Patterson AFB, Dayton OH

RESEARCH ADVISER: Alan T. Wall, PhD

DEGREE: Physics, Brigham Young University, 2013

Dr. Alan Wall is a research physicist and a physical acoustics subject matter expert within the Battlespace Acoustics Branch. Dr. Wall’s research interests include the measurement, modeling and reduction of high-performance jet aircraft noise; and the advancement of hearing conservation through the characterization of other high-amplitude noise sources. Dr. Wall has authored or co-authored 11 peer-reviewed manuscripts, many conference proceedings, and a magazine feature on jet noise. He was awarded the 2013 Leo Beranek Student Medal for Excellence in the Study of Noise Control.

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Repperger Research Intern Program

RESEARCH PROJECT: 17-31

PERSONALIZED SPATIAL AUDIO FOR VIRTUAL/AUGMENTED REALITY

PROJECT SYNOPSIS: Tomorrow's Air Force will rely heavily on the use of virtual and augmented reality for providing non-obstructive information displays, realistic training opportunities, and effective presence in teleoperations. Unfortunately, the bulk of today's technology is focused primarily on providing realistic and compelling visual environments, with less regard for the important role our auditory system plays in maintaining immersion and situation awareness. Our research hopes to help close this gap through the design, development, and validation of spatial soundfield capture, synthesis and rendering technologies for use in virtual and augmented reality displays. The current project will involve incorporation of personalized head-related transfer function technology into existing spatial audio rendering software for use with low-cost VR/AR platforms (e.g. Oculus Rift, Google Cardboard, etc.), and the design of interactive “games” to objectively measure and validate various spatial audio rendering technologies.

STUDENT LEVEL / DISCIPLINE NEEDED:
PhD, Master’s, Bachelor’s/ Computer Science, Psychology, Biomedical Engineering

RESEARCH LOCATION: Battlespace Acoustics, Wright-Patterson AFB, Dayton OH

RESEARCH ADVISER: Griffin Romigh, PhD

DEGREE: Electrical and Computer Engineering, Carnegie Mellon University, 2012

Dr. Griffin Romigh is a research engineer and the program manager of the Enhanced Tactical Communication Group within the Battlespace Acoustics Branch. Dr. Romigh's research interests include the application of signal processing and machine learning techniques to solve problems in the areas of auditory situation awareness and communication. Dr. Romigh has authored or co-authored several peer-reviewed manuscripts, conference proceedings, and a book chapter within the topics of spatial hearing, head-related transfer functions, and speech communication.
Repperger Research Intern Program

RESEARCH PROJECT: 17-32

NEUROPHYSIOLOGICAL PREDICTORS OF AUDITORY PERFORMANCE

PROJECT SYNOPSIS: The processes by which the human brain successfully constructs a representation of the auditory world around us has long been understood to be a hard problem, requiring a synergistic combination of psychophysical approaches, neuroscientific investigations, as well as computational and cognitive modeling approaches. Existing models of auditory processing have historically assumed a bottom-up processing strategy that captures the perceptual portion of audition; target and masker sounds are separated into frequency bands at the cochlea, and analysis by subsequent levels depends on the integrity of the signals at the level of the cochlea. Such traditional models largely ignore the role that top-down processes play in auditory perception. The current project will focus on the neural mechanisms underlying auditory attention, working memory, listening effort and other cognitive processes. By comparing classical psychometrics with electroencephalographic brain responses, we hope to dissociate the temporal dynamics of perceptual and response-related processes into portions that capture top-down expectancy and those that capture bottom-up saliency.

STUDENT LEVEL / DISCIPLINE NEEDED:
PhD, Master’s, Bachelor’s/ Psychology, Hearing Science, Experimental Psychology

RESEARCH LOCATION: Battlespace Acoustics, Wright-Patterson AFB, Dayton OH

RESEARCH ADVISER: Nandini Iyer, PhD

DEGREE: Speech and Hearing Sciences, Ohio State University, 2001

Dr. Nandini Iyer is a Research Audiologist and supervises the basic research program in speech perception and communication in the Battlespace Acoustics Branch. Dr. Iyer's research interests include understanding the interplay between sensory and cognitive factors in speech perception and communication, identifying neurophysiological markers of speech perception, as well as individual differences in sensory and cognitive processes. Dr. Iyer received her Ph.D from the Ohio State University in 2001. Following her doctoral studies, she pursued her post-doctoral studies at the Beckman Institute (University of Illinois at Urbana-Champaign). She then accepted a National Research Council postdoctoral research position at Wright Patterson Air Force Base.

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Repperger Research Intern Program

RESEARCH PROJECT: 17-33

ENHANCING COMMUNICATION IN COMPLEX, AUTOMATION-RICH ENVIRONMENTS

PROJECT SYNOPSIS: Tomorrow's AF will require operators to interact with many sources of automation from assistive agents like intelligent route planners or even fully autonomous systems like UAVs and surveillance satellites. This increased level of automation comes with the ability to communicate from anywhere with anyone in adverse and often rapidly changing environments, thus posing an interesting challenge to communication effectiveness. The aim of the research effort is to develop the scientific foundations of how team members adapt the acoustic and/or linguistic aspects of their speech in disparate acoustic environments. Doing so will motivate the design of robust and novel speech output systems that would sense the communication difficulties and use appropriate signal processing schemes to improve intelligibility, thus promoting communication effectiveness. Aspects of projects might include evaluating ways in which talkers modify/adapt their speech patterns, the time-course/pattern of any adaptations that occur in these environments, and whether or not these modifications/adaptations result in measurable benefits in intelligibility or communication effectiveness.

STUDENT LEVEL / DISCIPLINE NEEDED:
PhD/Hearing Science, Cognitive Science, Psychology
Master’s/ Psychology, Hearing Science, Electrical Engineering
Bachelor’s/ Electrical Engineering, Hearing Science, Cognitive Science

RESEARCH LOCATION: Battlespace Acoustics, Wright-Patterson AFB, Dayton OH

RESEARCH ADVISER: Nandini Iyer, PhD

DEGREE: Speech and Hearing Sciences, Ohio State University, 2001

Dr. Nandini Iyer is a Research Audiologist and supervises the basic research program in speech perception and communication in the Battlespace Acoustics Branch. Dr. Iyer's research interests include understanding the interplay between sensory and cognitive factors in speech perception and communication, identifying neurophysiological markers of speech perception, as well as individual differences in sensory and cognitive processes. Dr. Iyer received her Ph.D from the Ohio State University in 2001. Following her doctoral studies, she pursued her post-doctoral studies at the Beckman Institute (University of Illinois at Urbana-Champaign). She then accepted a National Research Council postdoctoral research position at Wright Patterson Air Force Base.

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Repperger Research Intern Program

RESEARCH PROJECT: 17-34

JET NOISE PROPAGATION FOR AUDITORY PROTECTION AND WELL-BEING

PROJECT SYNOPSIS: Airbase personnel and community members are subjected to annoying, disruptive, and potentially hazardous noise emissions from fighter jet aircraft. The prediction of noise levels incident upon listeners in the vicinity of the aircraft operations drives hearing conservation programs, operational regulations, and basing decisions. Our research is enhancing the reliability of noise emission and sound propagation modeling by eliminating large errors through the inclusion of physically realistic atmospheric effects, interaction of sound waves with ground terrain, the effects of a moving source, and nonlinear propagation. The current project will involve the investigation of fundamental propagation phenomena in these areas to enhance propagation modeling techniques.

STUDENT LEVEL / DISCIPLINE NEEDED:
PhD, Master’s, Bachelor’s /Physics, Mechanical Engineering

RESEARCH LOCATION: Battlespace Acoustics, Wright-Patterson AFB, Dayton OH

RESEARCH ADVISER: Alan T. Wall, PhD

DEGREE: Physics, Brigham Young University, 2013

Dr. Alan Wall is a research physicist and a physical acoustics subject matter expert within the Battlespace Acoustics Branch. Dr. Wall’s research interests include the measurement, modeling and reduction of high-performance jet aircraft noise; and the advancement of hearing conservation through the characterization of other high-amplitude noise sources. Dr. Wall has authored or co-authored 11 peer-reviewed manuscripts, many conference proceedings, and a magazine feature on jet noise. He was awarded the 2013 Leo Beranek Student Medal for Excellence in the Study of Noise Control.

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Repperger Research Intern Program

RESEARCH PROJECT: 17-35

NEAR-FIELD ARRAY FOR WAVE-FIELD SYNTHESIS

PROJECT SYNOPSIS:  Wave-field synthesis is a method for creating a sound field within a constrained area using a large array of loudspeakers. The method is limited in frequency by the distance between loudspeakers. In order to generate a wavefield with sounds that are accurately localizable, the loudspeakers must be very close together. We have created a dimensionally small array with a large number of loudspeakers for the purpose of localization studies. In this project, you will be working on validating the array. This will include calibration of the array, developing signal processing algorithms, and measuring the resulting sound field. This may also involve developing simulations of wave fields produced by the array, including diffraction effects around a head. Previous digital signal processing skills, especially in MATLAB, as well as previous experience with acoustic measurements are strongly desired.

STUDENT LEVEL / DISCIPLINE NEEDED:
PhD, Master’s/ Electrical Engineering, Physics, Mathematics

RESEARCH LOCATION:  Battlespace Acoustics, Wright-Patterson AFB, Dayton OH

RESEARCH ADVISER:  Eric R. Thompson, PhD

DEGREE:  Applied Hearing Research, Technical University of Denmark, 2009

Dr. Thompson graduated with a degree in Mechanical Engineering from Purdue University before working as a technical support engineer for Siemens Electronics Assembly Systems. After six years at Siemens, he decided that it was time for a change, and went to grad school to study engineering acoustics in the Electrical Engineering department of the Technical University of Denmark. During that time, he developed an interest in the study and modeling of auditory perception. After completing a PhD in applied hearing research, he worked as a research engineer at Boston University for two years. In 2011, he came to the Air Force Research Lab’s Battlespace Acoustics branch, and has been continuing to study the human auditory system, with a focus lately on sound localization with hearing protection.

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The Effects of Automation Error Types on Trust and Reliance

Project Synopsis: Unmanned system operators interaction with autonomous systems is ever increasing. At present, these systems are not perfectly accurate and therefore the operator needs to maintain the supervisory control to monitor the system. Since trust is one of the major factors that determine system reliance, it is important to understand how trust is affected when the system is unreliable due to different types of errors. The present project will focus on exploring the effects of automation error change (i.e., from false alarm to miss and from miss to false alarm) on participants’ trust and reliance during a simulated target search mission. These results may suggest how human-machine systems might need to be tailored to optimize future unmanned systems. Psychophysiological measures such as eye-tracking can provide valuable insight on trust processes when humans interact with imperfect automation. Student will be involved in the integration of the eye-tracking equipment and determining optimal data analysis procedures. Additionally, student will be involved experiment preparation, data collection, and documentation/manuscript writing.

Student Level/Discipline Needed:
Master’s/ Robotics, Biomedical Engineering, Human Factors, Psychology
Bachelor’s/ Social Science, Computer Science, Engineering

Research Location: Human Trust and Interaction, Wright-Patterson AFB, Dayton OH

Research Adviser: Svyatoslav Guznov, PhD

Degree: Experimental Psychology, University of Cincinnati, 2011

Svyatoslav Guznov is a research psychologist at the Air Force Research Laboratory, Wright-Patterson Air Force Base. He is conducting research in the areas of human-machine interaction, trust in automation, and suspicion. His current projects are ranging from basic research studies (e.g., exploration of the impact of automation errors on trust and reliance) to more applied studies (e.g., evaluation of pilots’ trust in helicopter automated landing aids).

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Repperger Research Intern Program

RESEARCH PROJECT: 17-37

RECIROCATING ENHANCEMENT OF MACHINE TRANSLATION AND IMAGE PROCESSING

PROJECT SYNOPSIS: When examining datasets, the concept of “deepness” is gaining ubiquity in machine translation (MT), image processing, and fusions of the two. This project looks at algorithmic development in support of MT and image processing integration for reciprocal improvement of both. Applicants should possess substantial knowledge of machine learning techniques and the ability to apply them to both MT and image processing domains with a particular emphasis on implementing “deep learning” tenets such as recurrent and convolutional neural networks. In addition, applicants must have coding experience in a Linux environment with multiple computer languages and software (for example, Theano/Caffe/TensorFlow) or show a propensity to develop such competency during the period of performance.

STUDENT LEVEL / DISCIPLINE NEEDED:
PhD, Master’s, Bachelor’s / Computer Science

RESEARCH LOCATION: Human Trust and Interaction, Wright-Patterson AFB, Dayton OH

RESEARCH ADVISER: John Duselis, PhD

DEGREE: Information and Computer Science, University of California Irvine, 2009

John is a Senior Research Computer Scientist in the Human Language Technology Team of the Airman Systems Directorate at Wright-Patterson AFB in Dayton, OH. Research interests include computer vision, pattern recognition, and machine learning.
SUBJECTIVE EVALUATIONS OF TACTILE STIMULI FOR HUMAN-MACHINE COMMUNICATION

PROJECT SYNOPSIS: Automated systems are becoming increasingly complex, and soon humans will be part of human-machine teams with autonomous systems. Effective human-machine teaming requires transparency, a sense of shared awareness between the human and the machine. One way to achieve transparency is through clear, unobtrusive communication. However, circumstances may not favor traditional verbal communication. High workload, noisy environments may prohibit speech interfaces. Moreover, speech-based interfaces may not be necessary, depending upon the nature of the information. When workload or environmental conditions prevent traditional modes of communication (e.g., speech, text, visual displays), alternative modes of communication may offer viable solutions. To this end, we are interested in exploring vibrotaction as a communication medium (i.e., vibration based touch). Vibrotactile displays have been used for many applications, including alarms, navigation aids, and symbolic communication between ground soldiers. However, the signals used for these applications consisted of simple tactile pulses (or “buzzes”) or carefully timed sequences of tactile pulses. We are interested in expanding the potential vocabulary of these systems by assessing natural perceptual responses to vibrotactile signals with different perceptual qualities. Low frequency buzzes may be perceived as foreboding, whereas high-frequency pulses may communicate urgency. A student selected for this internship will assist with exploratory perceptual research into defining a basic tactile vocabulary based upon perceptual quality, which will be used for future work on system transparency.

STUDENT LEVEL / DISCIPLINE NEEDED:
PhD/Human Factors, Psychology
Master’s/ Biomedical Engineering, Industrial Engineering

RESEARCH LOCATION: Human Trust and Interaction, Wright-Patterson AFB, Dayton OH

RESEARCH ADVISER: John “Chris” Brill, PhD


Dr. John "Chris" Brill is a senior research psychologist at the Air Force Research Laboratory, Wright-Patterson Air Force Base. He is conducting research in the areas of human-machine interaction, trust in automation, and perceptions of multimodal displays and alarms. His current projects range from basic research studies (e.g., exploration of the impact of automation errors on trust and reliance) to more applied studies (e.g., evaluating performance and trust of multimodal alarms in the cockpit).

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Repperger Research Intern Program

RESEARCH PROJECT: 17-39

ENGINEERING IN VITRO MULTICELLULAR ORGAN SYSTEM FOR TOXICOLOGICAL EVALUATION OF ADVANCE MATERIALS

PROJECT SYNOPSIS: Recent trends in engineering multi-organ systems that simulate human organ level architectures through the use of microfluidics and microfabrication techniques have attracted toxicologists to use these models system for toxicological screening. We are currently designing organ level architectures that provides a more physiologically relevant platform for assessments of novel compounds or toxicants over traditional in vitro models. Recently, there have been several peer reviewed papers appearing on organ-on-chip technologies for the high throughput screening of pharmaceutical drugs due to their ability to provide more physiologically relevant assessments. We are currently fabricating a complex 3D multi-tissue model with organized cellular structures, microfluidics, and 3D bioprinting technologies. These precise innovative concepts of cellular constructs could allow for novel multi-organ systems for future toxicological evaluation of Air Force related chemicals. The incumbent student should anticipate a hands on experience that involves: 1.) Principle of Engineering Biology, fabrication and their integration into toxicological testing, 2.) Systematic testing using various cell culture models, 3.) Fabricating complex in vitro cell model systems (3D models, organs on chips, airways on chips, etc.) that better represent the organ systems, 4.) Actively presents their results in lab meetings with the potential to provide a final platform presentation, and 5.) Encouragement to write technical reports or short communication for peer reviewed journals.

STUDENT LEVEL / DISCIPLINE NEEDED:
Master’s, Bachelor’s / Biological or Chemical or Material Engineering, Chemistry, Physics, Biology, Biochemistry

RESEARCH LOCATION: Molecular Bioeffects, Wright-Patterson AFB, Dayton, OH

RESEARCH ADVISER: Saber Hussain, PhD

DEGREE: Toxicology, Indian Institute of Chemical Technology, 1991

Saber Hussain, Senior Scientist and Nanotoxicology Group Lead, Molecular Bioeffects Division, Wright-Patterson Air Force Base, Ohio. He is full affiliated Professor of Pharmacology and Toxicology, Wright State School of Medicine, Dayton, OH. Dr. Hussain began (1987) his scientific career as a toxicology research fellow at the highly regarded Indian Institute of Chemical Technology (IICT) and received his doctorate degree in 1991. Here, his novel exploration of heavy metal biotransfer between different proteins in complex biological environment led to a series of prestigious research fellowships in Italy, Switzerland, and the U.S. Dr. Hussain joined the Air Force Research Laboratory at Wright-Patterson AFB in 1999, where his research interests transitioned into elucidating fundamental interaction of engineered nanomaterials with biological system with a special focus on developing nanodevices and evaluating potential toxicity arising from the physicochemical properties of nanoscale structures. His research addressing biomolecular interaction of nanomaterials and its associated toxicity has resulted in author/co-authorship of 120 peer-reviewed publications, several book chapters, and above 200 technical abstracts. He is currently an Associate Editor of Toxicological Sciences and serves as an editorial member of several other toxicity journals including Nanotoxicology Journal. He is a Fellow of the Academy of Toxicological Sciences and Fellow of US Air Force Research Laboratory. He serves as an expert reviewer for several government and private organizations. Dr. Hussain has been the recipient of SOT-AstraZeneca traveling lectureship award and numerous scientific awards and has established a strong collaborative network with over 25 organizations of national and international repute.

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