



*Excellence in*

# RESEARCH, INNOVATION, AND TECHNOLOGY TRANSFER

at Fayetteville State University



Innovation and Technology Transfer Put  
Fayetteville State University on the Research Map

# CONTENTS

<i>Introduction</i> .....	<b>PAGE 2</b>
<i>Bringing the Pentagon to FSU</i> .....	<b>PAGE 3</b>
<i>GSA Schedule at FSU</i> .....	<b>PAGE 4</b>
<i>Veteran Entrepreneur Partnership</i> .....	<b>PAGE 5</b>
<i>ERP Advanced Analytics Center</i> .....	<b>PAGE 6</b>
<i>SAP Next-Gen Lab</i> .....	<b>PAGE 7</b>
<i>Current Patents</i> .....	<b>PAGE 8</b>
<i>Advanced Sensors Research</i> .....	<b>PAGE 17</b>
<i>Agricultural Research and Service</i> .....	<b>PAGE 19</b>
<i>Medical Research and Service</i> .....	<b>PAGE 21</b>
<i>Grants and Contracts</i> .....	<b>PAGE 24</b>
<i>Selected Partnerships and Agreements</i> .....	<b>PAGE 25</b>
<i>Centers &amp; Facilities</i> .....	<b>PAGE 26</b>
<i>FASTeR</i> .....	<b>PAGE 27</b>
<i>FSU &amp; ORAU</i> .....	<b>PAGE 29</b>
<i>STEM Educational Programs and Partnerships</i> .....	<b>PAGE 30</b>

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## INTRODUCTION

Fayetteville State University (FSU) is a public comprehensive regional university that promotes the educational, social, cultural, and economic transformation of southeastern North Carolina and beyond. The primary mission of FSU is to provide students with the highest quality learning experiences that will produce global citizens and leaders as change agents for shaping the future of the State. Awarding degrees at the baccalaureate and master's levels, and the doctorate in educational leadership. FSU is located close to Fort Bragg, the largest Army installation in the nation.

# The Visionary Leaders of **RESEARCH** at FSU

The Research Leadership of Fayetteville State University welcomes you to view this compilation of the work of the creative minds of the University. Through independent thought acted out in a collective environment, the faculty and staff of FSU are broaching micro-level problems that are leading to macro-level solutions. From postulate, to proof, to product, to patent, FSU is a small institution that is making a major impact on the world of research and development.

This magazine, while not comprehensive, will provide you with samples of the quantum leaps in research, innovation, technology transfer, partnerships, and Grants & Contracts competitiveness of the University during the past couple of years.



*Dr. James A. Anderson, Chancellor*



*Dr. Pamela Jackson, Provost and Vice  
Chancellor for Academic Affairs*



*Dr. Daryush ILA, Associate Vice Chancellor  
for Research and Technology Transfer*



Bringing the

# PENTAGON to FSU

DoD Opportunities Worth Billions of Dollars Announced  
at Fayetteville State University



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*Chancellor James Anderson receiving a DoD award during Pentagon to People meeting from Dr. Dorothy Huston on behalf of the Office of the Under Secretary of Defense.*



Over 20 parallel one-on-one and group meetings were arranged in advanced in order to expand the FSU-DoD/Contractors, and other University partnerships. Chancellor James Anderson showed his commitment to DoD by attending the entire two-day meeting.

## Futuristic Projects

Developing protective, light clothing for soldiers; designing a revolutionary energy source for combat vehicles; and testing medical devices that stop bleeding until help arrives are just a few of the futuristic projects in which Fayetteville State University faculty, staff, and students are involved.



# GSA SCHEDULE

## AT FAYETTEVILLE STATE UNIVERSITY

**Fayetteville State University is Awarded U.S. General Services Administration Contract for Training and Technical Assistance.**

U.S. General Services Administration (GSA) has awarded the University a five-year Multiple Award Schedule (MAS) contract to offer training (through GSA Schedule 874.4) and technical assistance services (through GSA Schedule 874.1).

### ***Services offered through the GSA schedule include:***

- Organizational Leadership
- Project Management
- Data Analysis
- Artificial Intelligence
- Machine Learning
- Cybersecurity
- Emergency Planning
- Geospatial Information Systems
- Advanced Materials Analysis
- Nursing
- Counseling
- Social Work
- Languages
- Communication

FSU is particularly focused on offering military installations and federal agencies in the state of North Carolina an enhanced set of proven, highly responsive training and technical assistance capabilities. In addition to leveraging the expertise of faculty and staff, FSU's Office of Customized Training and Technical Assistance will be drawing upon the assistance and collaboration of subcontractors - with the objective of increasing the share of Federal contracts awarded to North Carolina institutions and corporations.



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# VETERAN ENTREPRENEUR PARTNERSHIP

The Veteran Entrepreneur Partnership will provide advanced teaching, mentoring and support to assist transitioning veterans, military spouses and the FSU student entrepreneurs.

The program's objective is to provide the essential skills and knowledge needed to improve the business startup success rate in the region.



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# ERPAAAC

## ERP ADVANCED ANALYTICS CENTER

Advanced research of industry interest on fundamental research in Enterprise Resource Planning (ERP), Data Science, Machine Learning, Management, Artificial Intelligence, and other industry interests that can drive innovation across the U.S. economy.

Certified training in ERP Systems and Data Analytics to include SAP S/4 HANA (ERP), SAP Cloud Analytics, Oracle ERP Cloud, Windows Dynamics (ERP), SAS Analytics, and ABAP.

Offering consulting services and research support for R&D projects



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The SAP Next-Gen Lab connects students, researchers, and startups with SAP customers and partners to develop new technology innovations that are linked to the 17 UN Global Goals.

By setting up the SAP Next-Gen Lab, Fayetteville State University opens the possibilities for industry collaboration with SAP's ecosystem of more than 404,000 customers across 32 industries in 180 countries. The regional customers of SAP include Mann+Hummel Grope, DuPont, Goodyear, and U.S. Army.

## SAP Next-Gen Lab at FSU

A large graphic in the background of the lower half of the page. It features a dark blue background with a grid of hexagons. Overlaid on this is a complex network of glowing blue and yellow lines and nodes, resembling a molecular structure or a data network. The nodes are small circles, and the lines are thin and curved, connecting various points across the space.

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Innovation and Technology Transfer

# CURRENT PATENTS



**Silica Plant Based Growth Medium represents the first patent issued to Fayetteville State University.**

## Silica Based Plant Growth Medium

Silica Plant Based Growth Medium represents the first patent issued to Fayetteville State University. Patent number 8,516,741 was issued 27 August 2013. Its inventor, Dr. Steven Singletary, was formerly a member of the Department of Biological Sciences. His idea was to create a medium that could be used to germinate seeds and grow seedling in space. He succeeded!

The patent is for a method and associated composition for growing plants in an unconventional media. This was done by creating a gel precursor that becomes extremely viscous and is capable of holding water. The composition can be varied to add nutrients to the gel. The purpose of the gel is to offer an alternative to soil and other substances from which water can drain via gravity or in space by simply holding water in place.

The gel with nutrients can then be used to germinate seeds and to support the growth of seedlings, which can then later be transplanted to allow the growth of crops and other plants on other planets.

## High Efficiency Thermoelectric Device

### What if you could charge your phone simply by holding it in your hand?

What if you could charge your phone simply by holding it in your hand? Dr. Daryush ILA has invented and patented a truly unique metamaterial that allows just this, and much more.

The thermoelectric multi-layer nanostructured device converts any amount of heat to electricity!

The new material has a high figure of merit, is extremely pliable, and can be cut, shaped and sewn, allowing for the creation of wearable, formable, comfortable, electricity generating fabrics and materials.

Imagine a tent that generates electricity... a blanket for your car engine that creates power... the applications are endless.



**Imagine a tent that generates electricity...  
a blanket for your car engine that creates power...**





**With ViVex-Cel, Fayetteville State University won third place in the International Innovations in Material Science (iMatSci) Competition sponsored by the Materials Research Society.**



## ViVex-Cel Advanced Wound Recovery Device

ViVex-Cel is a patented advanced wound care recovery device. The device is designed for chronic wounds (those that take 3 or more weeks to heal) and supplies the necessary environment for enhanced wound care recovery. The customizable device provides hydration, electrolytes, and a stable and selectable pH directly to the wound site. It can also deliver analgesics and anesthetics directly to the wound. Device removal does not damage the healing wound and the device can stay in place up to 10 days, thereby reducing medical staff costs. It is also available in a desiccated battle-field ready form.

With ViVex-Cel, Fayetteville State University won third place in the International Innovations in Material Science (iMatSci) Competition sponsored by the Materials Research Society. The inventor of ViVex-Cel, Dr. Carla Raineri Padilla, represented the university.

The iMatSci competition is designed to demonstrate the latest and greatest innovations in materials science. There were 2 rounds of competition and the top 26 international finalists, were allowed to demonstrate their inventions at the MRS meeting. Finalists included entrants from the United States, Ireland, Korea, Mexico, France and Brazil.



# Agro-Tiling for Extreme Environments

While the global population increases and while deserts are rapidly increasing in size, crop production is decreasing. Unfortunately, increased desertification is not the only extreme environment that impedes food crop production. The world is still dependent on outdated farming techniques, most of which require high amounts of water for irrigation. While attempts have been made to advance sustainable farming in extreme environments, there has been little success and the success there has been is too costly for the world's poorest people and nations to employ.



The inventors, Dr. Daryush ILA and Dr. Carla Padilla, are addressing these problems with the development of agro-tiles. Agro-tiles are portable and can be used immediately for farming. They require little water and are easily installed and are extremely economical. The agro-tile provides a matrix for plant growth, along with the needed nutrients and can be made to the specific needs of each environment and crop type. The agro-tiles are lightweight, and extremely economical and can be installed easily by hand.



## High Figure of Merit Thermoelectric Materials

**Fayetteville State University** has patented a completely unique method for producing nanomaterials with High Figure of Merit Thermoelectric properties. Figures of Merit quantify the performance of devices. The inventor, Dr. Daryush ILA, first invented the material and then invented a method for producing the metamaterials to scale up the synthesis of such materials.

Around the world people are trying to understand the physical properties of metamaterials consisting of selected regimented quantum dot super lattices with extraordinary optical, thermal, electrical, and Seebeck properties and use this knowledge to address the present and future needs. This in-house-developed technique, as indicated in several patents by Dr. Daryush, addresses the strategic energy need by taking advantage of the otherwise impossible-to-achieve improved physical properties of such materials, like generating electricity from heat at as high an efficiency as possible, by, using a heat source, like a human body (37 °C, 98.6 °F), or car engine, and a cold source such as air or any source under 27 °C (53.6 °F) to generate large amounts of electrical energy by these materials. Using the same materials in Peltier mode produces an addressable material (a blanket), pixel by pixel (few nanometers each), to become invisible in the ultraviolet-visible-infrared range.

In most cases metamaterials are created in very small sizes; although able to create multiple batches, the material size is restrictively small. Dr. ILA's method allows for the creation of large metamaterials composed of Quantum Dot Super Lattices that, can be cut, folded, bent and sewn; thereby, leaving the uses up to the imagination of the user, without the restrictions imposed by the size of the material. The entire Superdome could then be covered and generate massive amounts of electricity.

**The entire Superdome  
could then be covered and  
generate massive amounts  
of electricity.**



# Cannamix

**Dr. Shirley Chao** has a unique interest in the effect insects have on crops. Insect pests cause substantial damage to stored food products, especially grains and vegetables, throughout the world. Some of the principal pests that cause damage are the adult and larval stages of beetles and the larval stages of moths. All may be problematic by their presence, either alive or dead, in grain that is to be processed for food. Due to the toxicity of current synthetic pesticides to human/animal health, there was a need to develop a safer, more effective insecticide that targets insect pests, specifically without harming non-target animals and humans.

Plants of the Family Cannabaceae have been shown to alter the development of insects. The unique properties of Cannabaceae include its toxicity toward insect pests and, at the same time, its beneficial characteristics toward humans and other vertebrates. The product called CannabixMix disrupts reproduction and the normal development of insects at the larval stage. Dr. Chao has a full patent.





# Pollution Remediation Product



The Pollution Remediation Product (Patent Pending) is a highly effective method for cleaning oil on water and on land. The product was invented by Mr. Tommy Hall of Fayetteville, NC. Mr. Hall approached FSU to validate and test his product. This has resulted in the first patent shared between a community member, Mr. Tommy Hall, and the University.

The product, called “Plashtic” by Mr. Hall, absorbs oil, floats on water, is extremely light weight, with a high oil absorption capacity and can be compressed for storage and transport. More importantly, the oil absorbed by the “Plashtic” can be recovered for reuse, by simple mechanical pressing of the material and after use the “Plashtic” can be recycled into more usable “Plashtic”

The “Plashtic” is composed of completely recycled materials, thermoplastics and coal combustion products (coal ash and fly ash). Plastics disposed in the environment are extremely persistent and hard to degrade, while coal combustion products are both persistent and toxic. This new product uses both to clean the environment. It is literally the best of both worlds, it gets rid of toxic waste products and cleans the environment, while releasing usable oil.

## Size and Composition Controllable Nanowires

Dr. Zhiping Luo of the Research Office and Director of the Southeastern NC Regional Microanalytical and Imaging Consortium, is creating and growing new size-controllable nanowire compositions.

Nanowires have a diameter of  $10^{-9}$  meters, or 1 billion of them could fit in one meter. These amazing meta-materials can be used for a myriad of applications, including the detection of extremely low amounts of radiation.

## Regimented Quantum Dots

**Dr. Daryush ILA** the Associate Vice Chancellor for Research and Technology Transfer Officer has created new methods to produce regimented quantum dots. Quantum dots are nanocrystals ( $10^{-9}$  meters) that are semiconductors that mimic the properties of an atom, but that are wholly engineered. This allows for the bending of electromagnetic waves, items can become invisible to wavelengths of light, or bend sound around them. The materials are super thin, and ultra-lightweight.





## Advanced Fuel Cells

Department of Chemistry, Physics and Materials is developing new fuel cell materials. The newly created materials have an extremely high affinity for hydrogen. Hydrogen fuel cells generate power and have zero emissions except clean, pure water. These new fuel cells are important to our national security, our energy independence and to global environmental protection.



### Dr. Shubo Han's Work

- ✓ Protein Interactions in Neurodegenerative Diseases
- ✓ Nanomaterials
- ✓ Biosensors
- ✓ Electrochemistry

ADVANCED

# SENSORS

## RESEARCH

### Radiation Sensors

The negative effects of radiation pose a threat to our citizens, our military and our astronauts. Conventional detectors require relatively high and dangerous amounts of radiation. This is often due to the naturally occurring background gamma radiation produced by our sun, or other stars. Imagine detecting damaging radiation at the microscale, before it becomes damaging or even life threatening.

The two innovators from FSU are Dr. Daryush ILA and Dr. Zhiping Luo, who are developing these sensors. Dr. Luo is working on synthesis of arrays of nanowires. Dr. ILA and his partners at ORAU and the U.S. Army Research Laboratory are synthesizing and prototyping a triangulating detection system which will allow precision three-dimensional mapping of the radiation from long distance with no to minimum interference from cosmic or background radiation. These tiny arrays of detectors will be life-savers.



### Chemical Sensors

This is a broad area of research for the university and is being conducted by the Department of Biological and Forensic Sciences, the Department of Chemistry, Physics, and Materials at FSU. Researchers are developing sensors for detection of hazardous chemicals in the environment, chemicals released by radiation damaged cells, chemicals released by crops and a variety of other types of chemicals.



## Explosive Sensors

Dr. Shubo Han of the Department of Chemistry and Physics is developing a portable nanomaterials based detector for explosives, especially Trinitrotoluene (TNT) and its most explosive derivatives. The detector is based on the construction of novel biosensors from nano-shells and spheres bound with enzymes to detect explosives via volumetric method. The use of these highly sensitive detectors will help reduce injury due to explosives to our troops abroad, and if used in this country, reduce the threat posed from terrorists.



## Threat Detection in Trapped Air

Dr. Daryush ILA and his team are working on detecting, biological, chemical and explosive threats entering our nation by analyzing the air trapped in planes. Through the rapid detection of threat signatures, this unique potential will allow the nation to determine if a biological agent has entered the nation through an infected person, or if individuals who have created chemical or explosive weapons have entered.



# AGRICULTURAL

## RESEARCH AND SERVICE

### Research into Crop Pests

Crop loss to insect pests globally amounts to billions of dollars and decreases the amount of food available for both humans and animals. Dr. Lieceng Zhu of the Department of Biological Sciences has been investigating how heat stress compromises a plants resistance to parasites. Specifically she has been working with wheat and the Hessian Wheat Fly. She is examining the interactions, the effects of heat on the plants resistance and better methods to control the pests.

### Soybean Genetics

Soybeans are a critical food crop and are an excellent source of plant created protein. Dr. Abdelmajid Kassem has been investigating the genetics of various subspecies and cultivars of soybeans. The goal is to determine which types will grow best where, and how to increase production of this important food crop.



# International American Moroccan Agricultural Sciences Conference



**Agriculture is a major source of income and the largest industry and employer in the Kingdom of Morocco.**

**Morocco** was the first nation to recognize the United States independence and U.S. - Moroccan diplomatic ties continue to be excellent. Thus, it was fitting that the US serve as an organizer for the first International American Moroccan Agricultural Sciences Conference – AMAS Conference.

The establishment of this conference was spearheaded by Dr. Abdelmajid Kassem, Chair of FSU's Biology department. The conference was produced with the hope that it would lead to greater involvement by the U.S., not only in Moroccan agriculture, but also in other sectors of the economy. Over 120 experts in Agricultural Sciences, scientists, faculty, and students from the United States, Germany, France, Algeria, Turkey, the Netherlands, United Arab Emirates, Senegal, and India.

The Conference has benefited both U.S. and Moroccan students and scientists, and will certainly have an impact on the economic transformation of the agriculture sector in Morocco, opening a market with tremendous opportunities for U.S. companies and investors in that country.





# MEDICAL

## RESEARCH AND SERVICE

### Post-Traumatic Stress Disorder (PTSD) in the Military

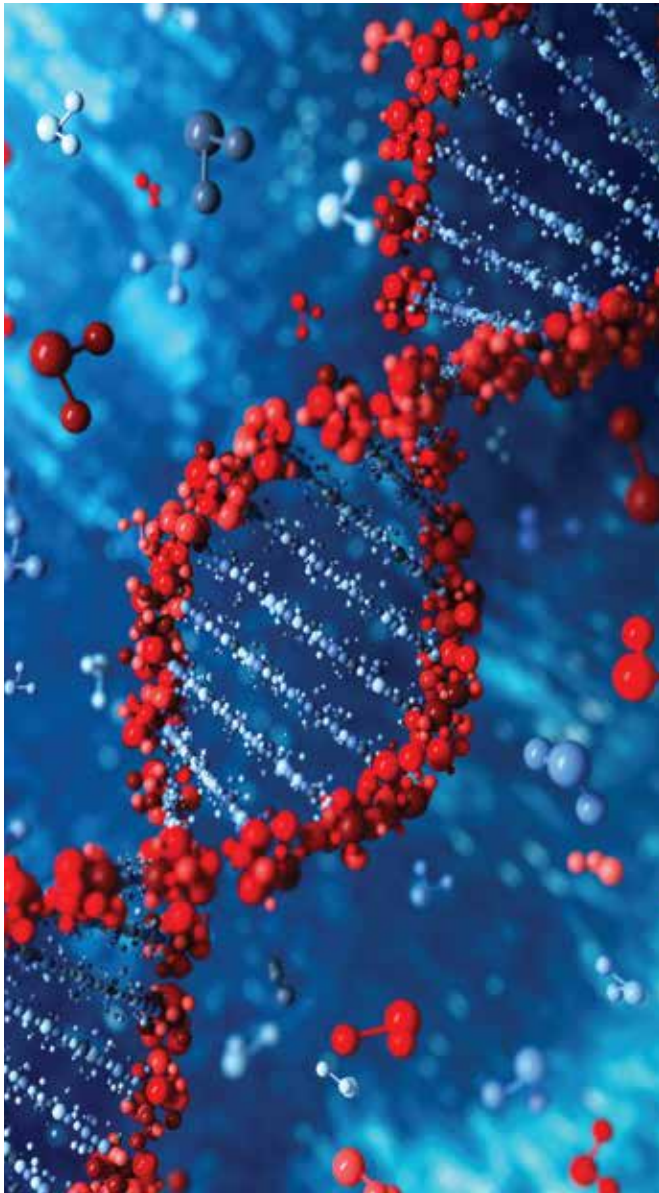
FSU, because of its close ties with the military and the concern for their wellbeing, has been extremely active in PTSD research and treatment. The effort has been interdisciplinary and has included the Departments of Communication, Nursing, Psychology and Social Work.

Dr. Pius Nyutu of the Department of Psychology conducted research on social support of combat veterans with PTSD. In “Battling the Stigma: Combat Veteran’s Use of Social Support in an Online PTSD Forum,” Dr. Stana examined posts from 63 combat veterans and found the most common types of support for PTSD that they were seeking were informational support, along with to a lesser degree social support and a new area of conflict resolution.

Dr. Afua Arhin and Dr. Sheila Cannon both of the Department of Nursing, along with Dr. Kimberly Tran, of the Department of Psychology have been actively studying the effects of acupuncture as part of a holistic treatment of PTSD in combat veterans. “Acupuncture as a Treatment Option in Treating Post-Traumatic Stress Disorder-Related Tinnitus in War Veterans: A Case Presentation.”







## Mammalian Reproduction and Fertilization

**Dr. Subir Nagdas** of the Department of Chemistry and Physics is actively researching the role of the sperm acrosome in reproduction and is focused on identifying the mechanisms regulating the release of acrosomal hydrolases during the egg-induced acrosome reaction and elucidating the role of the epididymis in maintaining sperm viability.

## Identification of Individual Humans through DNA from Hematophagous Insects

**Dr. Khalid Lodhi**, Director of the Forensics Sciences Program is currently researching and has been successful in extracting DNA from the blood diet of bed bugs and mosquitoes and then creating a DNA profile and identifying the human individual that it came from. Dr. Lodhi is currently expanding his research into other hematophagous insects and in developing time lines from blood meal to human DNA individual identification.





## Traumatic Brain Injury (TBI) and Alzheimer's

**Dr. Shubo Han** of the Department of Chemistry and Physics is investigating the links between TBI, the aggregation of amyloid  $\beta$  peptide with heavy metal ions associated with Alzheimer's disease (AD) to better understand the progression of the disease. Currently, AD is the most common neurodegenerative disease, affecting millions of people in the United States. With the increasing rates of TBI in the military, the number of individuals with Alzheimer's will increase greatly in the upcoming decades.



## Vaccine Development

**Dr. Eid Haddad** of the Department of Biological Sciences is working on a multivalent vaccine for influenza. The new vaccine would provide protection against the majority of forms of influenza. This would prevent "flu" vaccine providers from using the best guess of what strain of flu would appear the next year.

## Medical Devices

**Dr. Carla Raineri Padilla** of the Office of Sponsored Research and Programs is actively involved in developing medical devices for wound recovery and treatment and for patient treatment. She currently has one patent and is working on others.



# GRANTS & CONTRACTS

*Geospatial Intelligence*

*Military Social Work Program*

*Bill and Melinda Gates Foundation*

*Special Operations Forces  
Training Contract*

*GSA Schedule at FSU*



# SELECTED


## PARTNERSHIPS AND AGREEMENTS

- **U. S. Army Medical Command Cooperative Research and Development (CRADA)**
- **NASA Space Act Agreement (SAA)**
- **Oak Ridge Associated Universities Mentor-Protégé Agreement**
- **Combat Capabilities Development Command - Army Research Laboratory Education Partnership Agreement (EPA)**
- **Global Special Operations Force Foundation Agreement**
- **Fort Bragg Research Institute Partnership**
- **USDA Cooperative Agreement**
- **BAH Mentor-Protégé Agreement**
- **NIST Partnerships for Research and Education in Materials**
- **Brian Hamilton Foundation Innovation Veteran Entrepreneur Partnership**



# CENTERS and FACILITIES

## Center for Defense and Homeland Security



**FSU's** Center for Defense and Homeland security hosted its Annual Military Affiliates Cybersecurity Education Symposium and Job Fair. The symposium brought together national and regional cybersecurity experts who engaged military affiliates, industry partners, federal contracting agencies, national laboratory cyber experts, military leaders, legislatures, UNC system faculty and FSU Alumni.

Over 300 people attended to gain and share information, as well as to network and collaborate with regard to resources. Attendees included high school and college educators, private industry representatives, scientists, and military personnel.

Panel discussions addressed cybersecurity related topics in Employment, Federal Contracting and Entrepreneurship, Research and Technical Training, and the Capabilities of Military Affiliates. As one of the few historically black colleges and universities (HBCUs) with a cybersecurity curriculum, FSU has proudly taken a leadership position in showcasing how HBCUs can play an important role in this expanding industry.

Visit [www.cdhs.uncfsu.edu](http://www.cdhs.uncfsu.edu)





# FASTeR

## Facility for Advanced Science Technology & Research

The university has recently started the Facility for Advanced Science and Technology Research (FASTeR).

The facility is committed to supporting cutting-edge research, transformative hands-on education and technical development. FASTeR is headed by Dr. Daryush ILA, the Associate Vice Chancellor for Research. The facility is well equipped with a variety of materials testing and production equipment.

This facility will provide state-of-the-art materials processing and characterization capabilities and professional service for faculty, staff, and students at Fayetteville State University and external agencies in the southeastern North Carolina region and beyond, to support cutting-edge research, transformative hands-on education, and technical development.



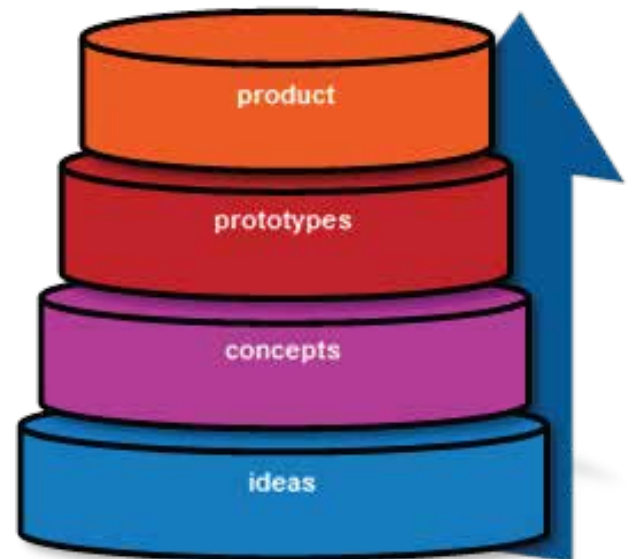


## Prototyping, Validation and Verification Laboratory

*Where Imagination Becomes Reality!*

“It’s fun to imagine the impossible” - Walt Disney

The Prototyping Facility, or more properly the Prototyping, Validation and Verification Facility founded in 2016 is headed by Dr. Daryush ILA. The facility provides space, equipment and technical expertise to inventors both inside and outside of the university. The well-equipped facility has a vast variety of equipment, supplies and capabilities, including additive manufacturing, electrical work, lasers and optics, mechanical shop, glass working, environmental testing and monitoring equipment, and biomedical device creation capabilities.





# FSU & ORAU

## MENTOR PROTÉGÉ COLLABORATION

What Does FSU & ORAU Mentor Protégé Program Offer?

Further the development of a mature STEM business model.

Assist in the development of faculty and students toward research and internship opportunities.

Enhance FSU's ability to successfully compete for government contracts.

Expand FSU's diversity of partnerships.

[WWW.UNCFSU.EDU/RESEARCH](http://WWW.UNCFSU.EDU/RESEARCH)



# STEM Educational Programs & Partnerships

- **AmeriCorps VISTA - Volunteers in Service to America**
- **Bronco STAR - Supporting Transition, Access & Retention**
- **GEAR-UP - Gaining Early Awareness Readiness for Undergraduate Program**
- **McNair - McNair Scholars**
- **NASA Space Act Agreement**
- **NASA Swarmathon**
- **Planetarium**
- **PREM - NIST & FSU Partnership**
- **REEF - Research Education Enrichment Facility**
- **RISE - Research Initiative for Scientific Enhancement**
- **STEAM - Science, Technology, Engineering, Advocacy and Mathematics**
- **TRIO**
- **Upward Bound**
- **U.S. Army Medical Command CRADA - Cooperative Research and Development Agreement**
- **U.S. Army Research Lab Educational Partnership Agreement**





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