U.S. Army Research Laboratory South

PARTNERSHIP SUMMIT 2018:
UNIVERSITIES OF THE SOUTHWEST

RICE UNIVERSITY • HOUSTON, TEXAS • APRIL 24-25, 2018

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1. Event Summary

As summarized by Dr. Michelle Atchison, University of Texas System;
Dr. Dimitris Lagoudas, Texas A&M

This first-time event was hosted by Rice University to bring together 19 major academic partners in the region with key US Army Research Laboratory (ARL) staff to share updates on research, discuss key development challenges and interests, and network across the attending organizations. On the first day of the ARL South Partnership Summit, Dr. Alexander Kott, ARL Chief Scientist, provided overviews of the nine ARL Essential Research Areas (ERAs). In total, 42 ARL staff and 130 participants from 19 universities attended. The second day's agenda concentrated on technical discussions among subject matter experts in a series of breakout sessions. A special session to highlight diversity in Science, Technology, Engineering, and Mathematics (STEM) was led by Dr. Patrice Collins, ARL Outreach Special Programs Manager.

1.1 Key Outcomes and Comments

Key outcomes and comments included the following:

- This was a first-of-its-kind event allowing academic partners to gather and meet with the U.S. Army Research Laboratory (ARL) staff for specific review and discussion of priorities for ARL South and the broader ARL Open Campus Initiative.
- Academic attendees praised ARL for providing this convergence forum that is a unique opportunity for academics to gather.
- Follow-on summits may not be needed or perhaps could be considered for a biannual schedule.
- Spin-off forums by technical focus were recommended to support deep-dive reviews on a smaller scale.
- The regional summit enhanced cooperation and awareness among the participants on ongoing research efforts and the possibility for intra-campus collaboration.
- The proposed way ahead is to use summit information to further define ARL South in three ways:
    1) Core research activities by University (primary/secondary activities). Incorporating regional ties and organizations to further expand ARL research support.
    2) Other strengths and possible research topics for future ARL consideration in the region include academic and government organizations with a primary focus in these areas and emerging capabilities. Additional consideration will be given to possible collaboration with industry elements.
    3) Support for other Army activities in the region that could leverage ARL South activities and results.
- Information from the meeting will be shared with other ARL staff and regional leads for possible interregional development and overall strategy development options for ARL.

1.2 Next Steps

The following next steps were identified:

1) Work with group leaders identified by ARL for the specific areas above.
2) Work with partners/universities to identify collaborative efforts and common facilities of interest to ARL.
3) Technical specific groups formed during the summit will immediately begin meeting regularly to continue building the robust research programs essential to success for ARL.

2. Perspectives from the University of Texas and Texas A&M Systems

Dr. Michelle Atchison and Dr. J Martin Scholtz

In order to seize upon the opportunities available to us through the US Army's Open Campus research model, the systems make the following observations and recommendations.

The principal investigators are the key focus for successful collaboration supported by system-level advocacy/support. Partnerships are established by mutual research interests among trusted researchers. While reaching agreements on research collaborations, well-defined objectives and goals are crucial. Resources should be scoped and identified to meet research requirements.

What makes this model successful will be our researchers conceptualizing "outside the box" research projects that will be mutually beneficial. Objectives and goals should be well defined since they are critical to program success. Multiple disciplines that include hard and soft sciences will lead to robust solutions to technical problems. Creative thinking will play a major role as we leverage partnerships and networks. We have to identify and exploit strengths among all institutions to capitalize on complementary capabilities.

Once researchers from multiple institutions have achieved trust and identified beneficial research opportunities, they should inform university/agency administration for extra support in terms of coordination, logistics, and connectivity with ARL administration. Proactive communication and idea generation is essential. University faculty should be in contact with ARL researchers and be encouraged to initiate ideas and discussions.

3.1 Human Performance/Synthetic Training Environments

Session led by Dr. Valerie Rice, ARL

3.1.1 Top Points

The session participants identified technologies essential to the success of meeting Army requirements in this area. Physiological sensing and imaging that include thermal sensing, optical wavelengths, and Magnetic Resonance Imaging are important biomarkers. We must advance existing biological (neuro) computational modeling and simulation. We can advance armor development to prevent injuries, and also treat injuries if they do occur using injury mechanisms characterized through both animal and human models.

The group discussed the need to advance simulation and animation for augmented learning, including virtual reality and immersion, keeping feasibility, usability, and maintainability in mind. Other priority areas of research will lead to interventions to improve cognitive and physiological functions (neuromodulation, medical therapeutics, and microbiome). And finally, big data analysis and sharing are essential in rapidly advancing in these areas. While not part of ARL's purview, the group emphasized the need for further research regarding post-traumatic mental health.

3.1.2 Collaboration and Community

The following are capabilities/facilities that the group identified:

- Visualization lab at Texas A&M (and others)
- Big 10 academic alliance: Traumatic brain injury collaboration
- NASA food science (Texas A&M) and training center
- Mind Research Network (MRN)
- Food protein center, microbiome (University of Oklahoma, Texas A&M)
- Simulation centers (blast centers/robotic rehab)
- Biological, computational, and deterministic models
- Sensors Center (Texas A&M)

3.2 Artificial Intelligence/Machine Learning

Session led by Dr. Tien Pham, ARL

3.2.1 Top Points

The group emphasized the context of Dirty, Dinky, Dynamic, and Deceptive Data (D5) context. It is essential for the Army to consider mobility in multi-domain battle, including the physical domain as well as the cyber domain. The group discussed big data versus little data, to include volume, variety, velocity, and value. Other technical requirements include adversarial learning and reasoning, as well as interpretability and explain ability. ARL is establishing the Army Artificial Intelligence Institute that will support research and collaboration in artificial intelligence (AI) and machine learning (ML) for autonomy.

3.2.2 Collaboration and Community

The group determined a need for future follow-on meetings and recommended that prior to meetings short-term challenges should be distributed for hackathons. Concrete and measurable stretch demonstration and challenge problems should be developed. Capstone projects should be undertaken by universities that incorporate or are derived from these challenge problems. To encourage networking and optimize individual expertise, cohorts of students from different universities should be established and placed for a period of time at ARL alongside Army researchers. Finally, access and sharing of data and models will rapidly advance autonomy technology.

3.3 Cyber and Electromagnetic Technologies for Complex Environments

Session led by Jerry Clarke, ARL

3.3.1 Top Points

While the group quickly ascertained that the topic was broad, critical points were highlighted:

- Cyber and network security: “connect ‘em and protect ‘em”
- Deception and camouflage: human behavior versus technology
- Alternatives to radio wave communication: visible or ultraviolet scattering
- Human dynamics of cyber security

3.3.2 Collaboration and Community

The group concurred that the community of partners must place more focus on the ARL ERA lines of effort. The group will elicit talent, creativity, and expertise that was very evident among all the participants. Each carry a forte that can complement and/or augment those of the group. The group expressed a desire to design and carry out a cyber-related “Mad Scientist” competition. The group discussed the cultural differences between academia and the Army, and how these must be considered to ensure a meaningful partnership.

3.4 Synthetic Biology

Session led by Dr. Dimitra Stratis-Cullum, ARL

3.4.1 Top Points

Ideally, the collaboration will produce near-term proof-of-concepts that will lead to achieving long-term goals. Biosensors (e.g., sprinkle biomaterials) should be developed for assessment. Ideas for long-term projects include fast generic/modular/reprogrammable tools (e.g., adaptable for the Soldiers' needs), sensing for specific light (e.g., directed energy sensing), and detection patches (e.g., wearable biosensing). Other applications include biology for corrosion (i.e., purposeful induction or prevention, or non-proliferation materials).

3.4.2 Collaboration and Community

Consensus among the group was that there is a need to make ARL's challenges well known. There is a need for improved communication. This could be accomplished by having ARL scientists on university committees. The group suggested creating virtual centers to engage essential contributors. Also, ARL-sponsored projects within the universities would advance technology while increasing awareness of Army problems and requirements. Recruiting veterans in this specialized field would facilitate connection of new technologies with Army problems and solutions. Other biotechnology ideas were discussed but are not specific to synthetic biology. These include the following:

1. Bio-inspired/biomimicry – Making and breaking materials through synthetic biology to alter its function (triggering degradation, or controlling self-healing).
2. Human performance – Probiotics that lead to enhanced productivity and resiliency (e.g., minimizing stress, strain, or local health issues).

3.5 Tactical Unit Energy Independence

Session led by Dr. Brett Piekarski, ARL

3.5.1 Top Points

The group realized quickly that they needed to think bigger than individual efforts in order to achieve world-class leadership in this field. Specific technical areas highlighted included: hybrid approach, using intelligent systems (i.e., AI/ML for energy usage and planning), energy use cognitive load, and human sources of energy. Finally, the group recognized that there is an established need to understand energy balance and Army needs.

3.5.2 Collaboration and Community

The group recognized the need to meet quickly and more often. They will plan a workshop to explore a consortium on unmanned aerial vehicle power. They want to clearly identify facility capabilities of all the partners.

3.6 Human–Agent Teaming

Session led by Dr. Kaleb McDowell, ARL

3.6.1 Top Points

The group discussed the best ways to connect to better communicate goals and determine a best operational method. They decided that an electronic forum would be the ideal way to brainstorm, solving problems with the brightest minds engaged. There was a concern about how to get and keep funding, and again, the group realized that through regular engagements, opportunities for funding could be communicated and embraced jointly.

4. Other Ideas

Session led by Dr. Peter Reynolds and Dr. Scott Schoenfeld

Each breakout session reported other ideas that, while not directly related to their session, were worthy of mentioning to the summit participants. Many of these other ideas were brought up by multiple groups. They are as follows:

- Now that contacts have been made among the technical disciplines, technical-specific meetings should occur to focus on ARL ERA lines of effort that will lead to creating solutions for Army-specific problems that will satisfy Army requirements.
- This networking meeting is the start of what will be meaningful, trusting, long-term relationships. It is important to cultivate an environment that allows creativity and productivity.
- Ways to elicit talent, creativity, and expertise are through synergistic events such as hackathons and technical-specific “Mad Scientist” competitions.
- Army and academia partners have to realize and be sensitive to cultural differences.
- Research efforts must have concrete and measurable evaluation criteria.
- Access to partner facilities will lead to quicker technology advancement. This includes computational resources, data, and simulators/simulation environments, testing facilities, and so on.
- Army should provide input to universities during faculty hires so universities can recruit faculty who can support research relative to Army requirements.
- The ARL South community will benefit through outreach to underserved student populations by building expertise in the STEM fields. ARL South will benefit by including small and growing institutions with fewer resources in their partnerships.

Selected Charts from University Summaries

HOUSTON COMMUNITY COLLEGE

An Overview of a Materials Science Educational Program at a Large Urban Community College: *Identifying and Developing Talent*

Overview

- Houston Community College is one of the largest community college systems in the nation. (114,000 students annually)
- It also reflects the future demographics of urban America. The majority of our students are non-white; as 37% are Hispanic, 30% are African American, 15% are Asian, 14% are white, 2% are mixed-race, 2% are "other".
- More than 70% are part-time students and more than half of them are self-financing their engineering education.
- Females comprise 58% of the student population (22% in engineering).

- Today we have more than 2600 students who are declared engineering majors enrolled in our Associate of Science in Engineering Science (ASES) degree program.
- The program started in 2012 with 48 declared engineering majors.

The West Houston Center for Science and Engineering

WHC Mission

- *Develop innovative educational programs, courses, seminars & REU opportunities*
- *Develop and Provide Stewardship of Partnerships*
  - Educational
  - Business & Industry
  - Professional Org
  - Federal Agencies
- Student Awareness – Transfer, Degree Completion & Graduate Education

The Intersection / Identifying & Developing Talent

The Intersection

"…seeking to leverage regional expertise and facilities throughout the south central region to accelerate discovery, innovation and transition of science & technology…."

Identifying & Developing Talent

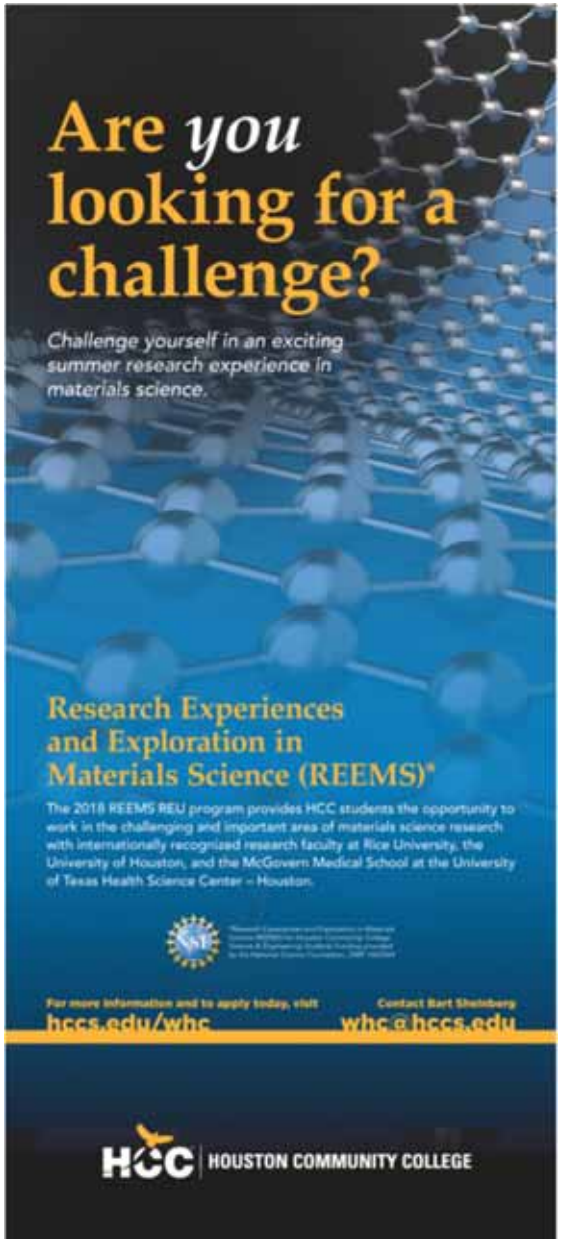
"…establishment of a merit based program to identify students demonstrating high levels of work ethic, motivation, and a passion to discover…."

Summary

Next steps – Continuation of the Conversations – REEMS as a Model?

Leverage regional partnerships among community colleges, universities and ARL to identify and develop future scientists & engineers with the capability, drive and expertise to accelerate discovery and innovation

Contact



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Richard A. Aló, Ph.D.

Executive Director

Big Data, Intelligence, Innovation and Entrepreneur EcoSystem [BDI2E2]

College of Science, Engineering & Technology

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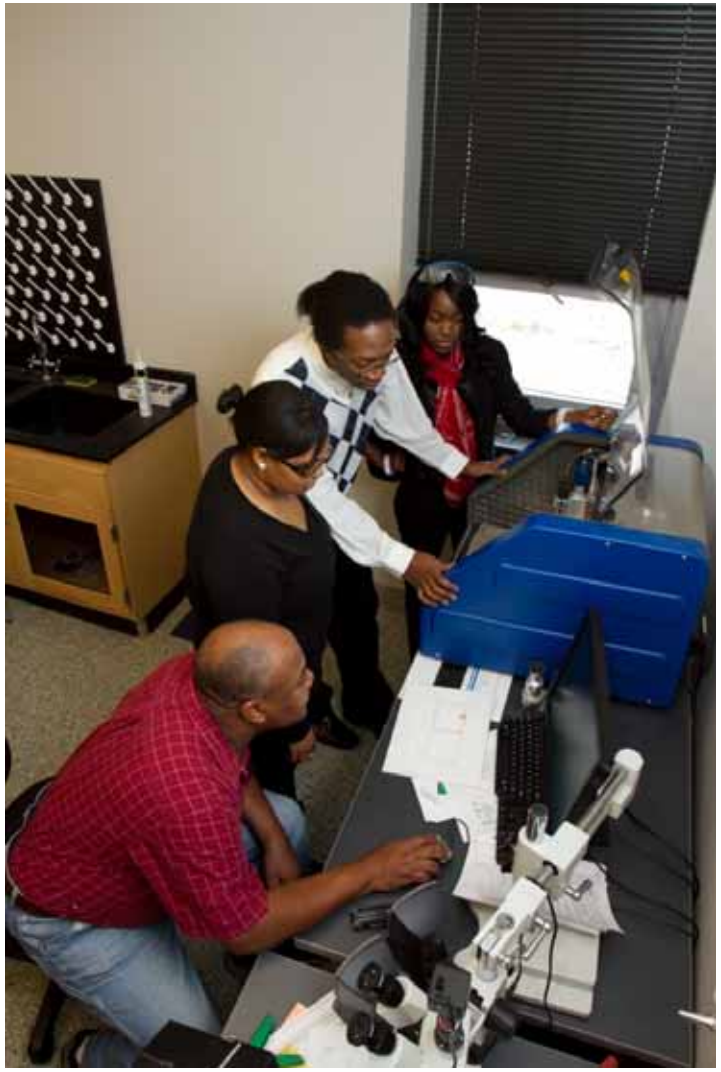
U.S. ARMY RDECOM ARL

Research Overview

- **1 of 2 HBCUs[105] Carnegie High Research Activity Designation**
- **Centers of Excellence in:**
  - Nano-toxicity (NSF)
  - Translational Research (NIH)
  - Multimodal Transportation (DOT)
  - Ship Systems Engineering (NGC)
  - Environmental Health (NIH)
  - Minority Health & Health Disparities (NIH)
- **Membership National Academy of Inventors**

JSU Engineering Research

- **Unmanned Aerial Vehicles**
- **High Performance Computing**
  - Cybersecurity
- **Environmental Engineering**
  - Visualization
  - Big Data Science/Engineering
- **Computational Fluid Dynamics**
- **Reconfigurable Computing**
- **Electromagnetic & Antenna Design**
  - Computer Networks
  - Engineering Education
  - Power Systems



Cybersecurity

- **Intelligent Intrusion Detection Systems**
- **Intelligent Intrusion Prevention Systems**

Data analytics: analyzing log files – detecting true anomalies

- **Reverse engineering of malware**
- **Tools and techniques for decryption of data & software**

Intelligent malware – delivery & software effectiveness [including stealth weapons]

- **Intelligent agents for monitoring configuration**
- **ICS/ SCADA (Industrial Control Security/ Supervisory Control & Data Acquisition) Security & vulnerabilities**

Visualization

Development of Advanced Visualization Instrumentation for Collaborative Exploration of Big Data * subcontract from NSF/MRI to University of California San Diego [Lead]

[includes University of Texas Medical Branch]

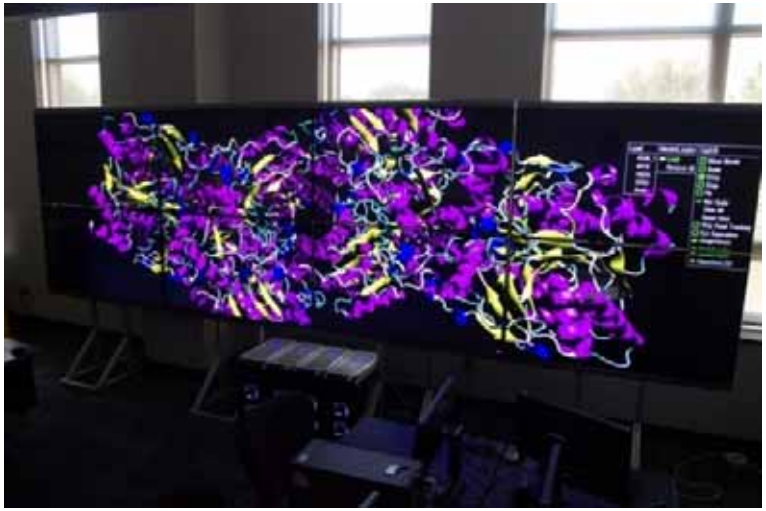
Development of the Sensor Environment Imaging (SENSEI) Instrument * subcontract from NSF grant to University of Illinois at Chicago with subcontractors:

- Jackson State University

• University of California San Diego

• Scripps Institute of Oceanography

• University of Hawaii at Manoa



32K Visualization Wall

Newly Established Degrees

COLLEGE OF SCIENCE, ENGINEERING & TECHNOLOGY

JACKSON STATE UNIVERSITY

NEWLY ESTABLISHED DEGREES

Ph.D. Computational / Data Enabled Science & Engineering
CDS&E (2014-2015)
M.S. Computational / Data Enabled Science & Engineering
CDS&E (2016)

Engineering
Ph.D. Engineering (2013-2014)
B.S. Biomedical Engineering (2014-2015)
B.S. Statistics Engineering (2014-2015)
B.S. Electrical Engineering (2013-2014)

Biology
B.S. Biotechnology (2016)

WHAT ARE THEY?

The convergence of Data Engineering, Mathematics, Statistics, Advanced Computing and Computational Infrastructure, Scientific Methods and Subject Matter Expertise

FOCUS

The collection, management and transformation of "Big Data" into actionable information that can answer some of the world's most pressing problems

NEED

Data science/engineer experts who efficiently interpret data into useful information for strategic decision-making. Properly Leveraged- Data can be driver to millions of solutions, cures and better processes

Big Data Research Areas

- Social Determinants Associated with Brain Images of Neurodegenerative Diseased Patients *(with Florida International University)*
- Predictive Maintenance for ‘Energy Producing Machines’ *[Machine Learning & Neural Network]*
- Brain Imaging for Identifying Stages of Alzheimer's
- Spectral Analysis of Disease-Disease and Gene-Gene Network based Gene-Disease Associations
- Interplay of Environmental/Genetic Factors Associated with Prostate Cancer
- Big Data Analytics & Natural Language *[text]* Processing in Manipulative Business Applications *[Customer Complaints, Predatory Practices, etc.]*
- Complex Disease Protein Relationships in Alzheimer's Disease *[Protein Interactions and Computational Gene Silencing]*
- Creating Prescriptive Decision Making Tools - Forecasting Demand *[tourism]*
- Prescriptive Methods for Cyber Security Intrusion/Detection Recognition

PRAIRIE VIEW A&M UNIVERSITY

Cajetan Akujuobi, MBA, Ph.D., P.E.
VP for Research, Innovation & Sponsored Programs

Ramaswamy Krishnamoorthi, Ph.D.
Director of Research Services & Center Initiatives

- A member of the Texas A&M University System
- Second oldest public university in Texas (1876)
- Land-grant university (1890)
- 50 baccalaureate, 35 master's, and 5 doctoral programs through 7 colleges and 1 school
- 8470 Students (7365 UG + 1105 G)
- 20:1 Student to Faculty Ratio
- 9 Research Centers and Institutes
- Total Research Expenditure (FY17) = $ 16.22 M

Center of Excellence in Research and Education for Big Military Data Intelligence CREDIT Center

Center of Excellence in Research and Education for Big Military Data Intelligence CREDIT Center

http://credit.pvamu.edu/

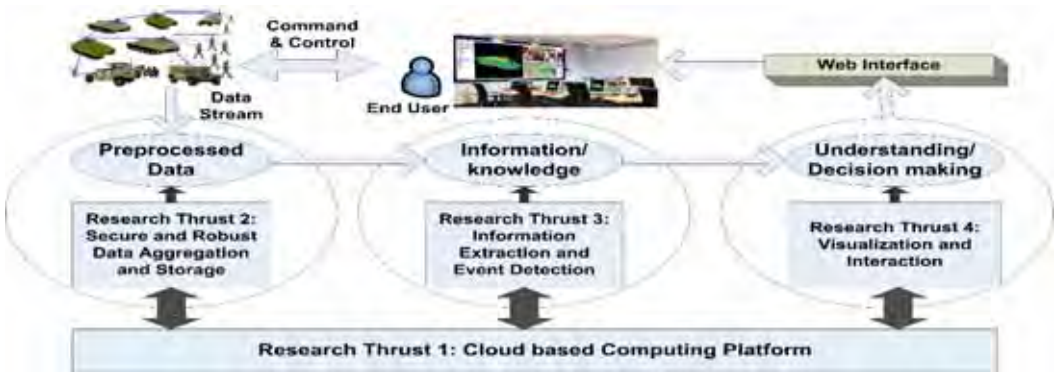
ERA: "Artificial Intelligence and Machine Learning"

Contact: Dr. Lijun Qian, Dept. of Electrical and Computer Engineering; 936-261-9908; liqian@pvamu.edu

Personnel: Dr. John Fuller, Dr. Xiangfang Li, Dr. Pamela Obiomon, Dr. Lei Huang, Dr. Yanggao Yang

Mission: accelerate research and education in predictive analytics for science and engineering to transform our ability to effectively address and solve many complex problems posed by big data, and train our students to become next generation data scientists and engineers.

Research Goals: (1) Integrated Big Data and High Performance Computing platform; (2) Secure and Robust Big Data Aggregation; (3) Deep Learning for Mission-Critical Applications; (4) Visualization and Validation.



Major Research Facilities:

1. *Deep Learning Lab*: 4 NVIDIA DGX-1 systems--32 Tesla P100 GPUs; 114,688 CUDA cores; 2,752 GB memory; 244 TB HDD; one Dell R920 server for user and resource management; 4 Dell R730 storage servers for large datasets.

2. *Cloud Computing Lab*: a high performance computer cluster with 4 racks of 56 IBM dual-core blade servers, 8 HP 16-core nodes, 24 IBM 16-core nodes with GPUs, and 4 Dell nodes for cloud virtual machine farm

SECURE Center of Excellence

SECURE Center of Excellence

ERA: "Cyber and Electromagnetic Technologies for Complex Environments"

Contact: Dr. Cajetan M. Akujuobi, Department of Electrical and Computer Engineering;
Phone: 936-261-1585; cmakujuobi@pvamu.edu

Personnel: Dr. Cajetan M. Akujuobi, Dr. Musa Sarhan, Dr. Na Li, Dr. Emmanuel Opara, Dr. Shumon Alam, Dr. Matthew Sadiku, Dr. Kiran Bellam, Dr. Suxia Cui, and Dr. Louis Ngamassi

Mission: Promote research, education and development of well-trained workforce in cybersecurity through multidisciplinary and integrative research initiative.

Research Goals:

- Cyber Threat (malware, virus, intrusion, DoS) Detection & Protection
- Internet of Things (IoT) and Cloud Computing
- Communication Security (wireless and wired) in Social Networking and Virtual Environments
- Artificial Intelligence in Cybersecurity
- Cybersecurity in Power-grid and Smart technologies
- Block-Chain
- Cybersecurity Education

SECURE CENTER OF EXCELLENCE
Systems to Enhance CYBERSECURITY for Universal Research Environments

Research Accomplishments:

- Smart City and cybersecurity-related solutions
- Machine/Deep learning-based data analysis
- Wavelet transform-based system design (image, ADC/DAC test system, and secure imaging)
- Compressed Sensing/Compressive Sampling Systems
- Wireless Communications (cellular, ad-hoc and sensor nets, cognitive systems)
- Collaboration with Cloud Juncxion, Nokia Bell Labs, and Yahoo

Research Facilities:

- ***Virus and Malware Research Lab, Wireless Security Lab, IP Networking Lab*** for IDPS Research
- ***Virtual Private Cloud*** with Google, Amazon Wave Services, and Microsoft's Azure

Center for Advancing Innovations in Smart Microgrids

Center for Advancing Innovations in Smart Microgrids

ERA: "Tactical Unit Energy Independence"

Contact: Dr. John O. Attia, Prairie View A&M University, Department of Electrical and Computer Engineering, Phone: 936-261-9916, email: joattia@pvamu.edu

Personnel: Dr. Warsame Ali, Dr. Penrose Cofie; Dr. Matthew Sadiku, and Dr. Lijun Qian

Vision: to create multitude of smart microgrids in the world that are reliable, sustainable, secure and more environmentally-safe.

Research Goals:

- Enhance power quality for Microgrid
- Optimize the electromagnetic compatibility of electronic devices in Microgrid
- Provide secure and robust data collection and exchange in Microgrid
- Design novel fault detection, protection, and control of Microgrid
- Design of a test bed for experimental validation

Accomplishments:

- Power Quality and Reliability (NASA)
- Modeling and Testing of Advanced Mixed Signal System (NSF)
- Radiation Effects on DC-DC Converters (NASA)
- Investigators:
  - more than 100 combined years of research experience
  - more than 50 books and book chapters
  - one IEEE Fellow member
  - holders of US Patents
  - 15 PhD Degree awardees advised by investigators.

Major Research Facilities:

1. ***Power and Power Electronics Lab***: dSPACE, power converters, Chroma programmable AC and DC power sources, Lab Volts training systems, synchronous and induction motors
2. ***Wireless Communications Lab***: software radio test bed and wireless sensor test bed

Materials Research at Mechanical Engineering Dept.

Materials Research at Mechanical Engineering Dept.

ERA: "Manipulating Physics for Robust Performance of Materials"

Contact: Dr. Jianren Zhou; Phone: 936-261-9960 ; email: jizhou@pvamu.edu
Personnel: Dr. Paul O. Biney, Dr. Stephanie Burrs

Research Areas:

- **Lightweight structural materials research**
  - Lightweight structural composites
  - Mechanisms of degradation of polyimide composites in hygrothermal and thermo-oxidative environments
  - Formulation and processing of matrix resins with improved stability
- **Nano Materials Research**
  - Novel approaches for dispersing nanofibers into polymers of desired dispersion for multifunctional materials
  - Low cost processing methods for fabricating nanocomposites for medium and high temperature applications
  - Characterization of the materials at the nano, micro and the macro levels
- **Graded Materials Research**
  - To design, build and test graded materials manufacturing system that is capable of metering, mixing, and curing graded material consisting of a polymer powder and ceramic powder.
- **Physics of Failure for Stimuli Responsive Polymer-based Composites**
  - ***Research Interests***: biosensors, wearable sensing technology, novel bio-nano-composite materials
  - ***Research Strengths***: Fabrication of nanometal, nanocarbon, hydrogel bio-composite materials
  - ***Future Goals***: Synthesis of Stimulus responsive polymers and nano-metal composites with self-healing capability

Materials Research Accomplishments:

- Research impacted 70 undergraduate and 20 graduate students
- 20 conference presentations and 20 peer-reviewed journal publications
- 20 proposals submitted; grants awarded = about $7.0 million
- Establishment of state of the art materials research lab for processing, fabrication and characterization of materials

Center for Applied Radiation Research

ERA: "Manipulating Physics for Robust Performance of Materials"

Contact: Dr. Richard Wilkins, Department of Electrical and Computer Engineering,
Phone: 936-261-9913, email: rtwilkins@pvamu.edu

Personnel: Dr. Brad Gersey, radiation physicist; Dr. Kelvin Kirby, project management and outreach; Dr. Jianren Zhou, multi-functional materials.

Mission: Apply unique expertise in radiation engineering and science research to space exploration, medical research, national security studies, and energy production.

Research Interests and Accomplishments: (2005 –present):

- New radiation shielding materials
- New radiation detectors using nanotechnology
- Radiation effects on silicon carbide power devices
- Radiation measurements on payload to the International Space Station
- Research Training: 56 undergraduate students, 20 graduate students
- 75 conference presentations and 30 peer-reviewed journal publications.
- Grants awarded = about $8.0 million

Future Goals:

- Establish nuclear security center for research, education and training.
- Continue work on radiation effects and radiation detection using nanotechnology

Major Research Facilities:

1. ***160 kV x-ray source***; ionizing dose rate about 5.9 krad/min; Keysight Technologies B1500A semiconductor device parametric analyzer system
2. ***Hitachi SU3500 high resolution scanning electron microscope*** with chemical analytic capabilities (to be installed in June 2018)

RICE

Dr. Yousif Shamoo
Vice Provost for Research

V2C2 Goals

"Our vision and plan for the next decade is driven by our mission, our values, our essential attributes, our history and a driving ambition to contribute to our world through excellence in education and research."

PROVIDE	Transformative Undergraduate Education	
	Nationally and Internationally Renowned Graduate Programs	BUILD
INVEST	Faculty to Achieve Preeminence	
	Access, Diversity and Inclusiveness	EXPAND
ELEVATE	Research Achievement and Reputation	
	Rice Reach and Impact	EXTEND
ENGAGE	Houston and Empower Its Success	

Recent and Upcoming Investments

2015

$49M in molecular nanotechnolgy

$43M in data sciences

$58M to promote research competitiveness

V2C2

Strategic investment to achieve internationally recognized excellence

Synthetic & Physical Biology

Neuroengineering

Data Sciences

Shared Equipment

Innovation District

"Engage Houston and Empower Its Success"

9.4-acre property

$100M renovation to be completed by 2020

Focus on energy, health care, data and logistics

Partnerships with Houston innovation ecosystem (TMCx, GHP, Station Houston) & local higher education institutions

Incubators & accelerators

Entrepreneurship support & training

Prototyping facilities

State of the art resources

Institutes Ecosystem ARL Partners

RICE | SCI
SMALLEY-CURL INSTITUTE

Smalley Curl Institute

Dr. Naomi Halas

Dr. Alberto Pimpinelli

- Tactical unit energy independence
- Manipulating Physics of Failure
- Manufacturing at the point of need
- Discovery

RICE | IBB
Institute of Biosciences and Bioenginseering

Institute of Biosciences & Bioengineering

Dr. Zachary Ball

Dr. Paul Cherukuri

- Discovery

RICE | KEN KENNEDY
INSTITUTE FOR INFORMATION TECHNOLOGY

Ken Kennedy Institute for Information Technology

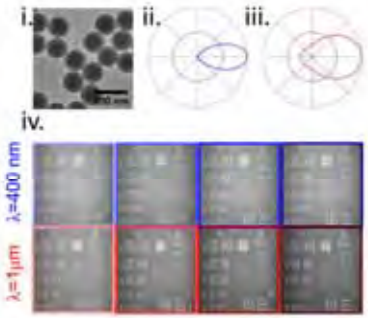
Dr. Moshe Vardi

Dr. Jan Odegard

- Artificial intelligence & machine learning
- Accelerated learning
- Manufacturing at the point of need
- Human agent teaming
- Discovery

SCI Research Highlights

RICE | SCI
SMALLEY-CURL INSTITUTE

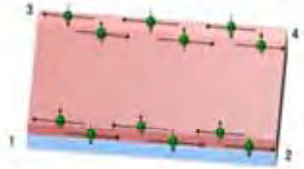


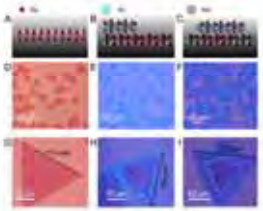
Plasmonics & Nanophotonics

Brain & neurosciences

Carbon Nanotechnology

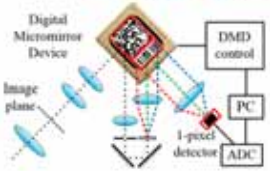
2D & Quantum Materials

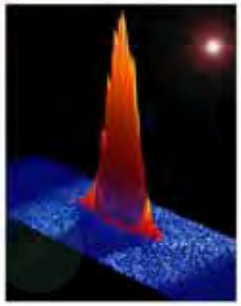




Photonics & Plasmonics	Carbon Nanotechnology
Condensed Matter Physics / Quantum Matter	Nano / Advanced Materials: 2D polymers
Atomic, Molecular, Plasma, and Chemical Physics	Biophysics
Neurosciences	Applications – Emerging Technologies

Emerging technologies



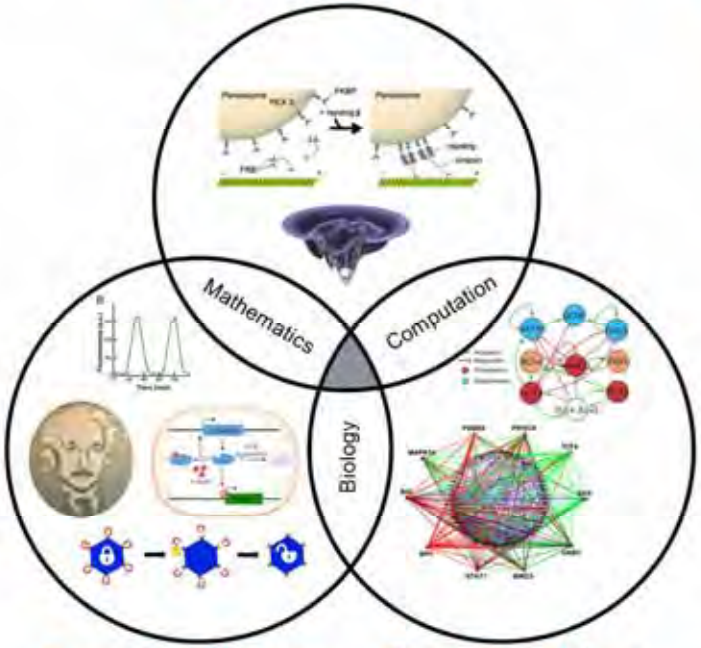


Atomic & Molecular Physics

IBB Research Highlights

RICE | IBB
Institute of Biosciences and Bioengineering

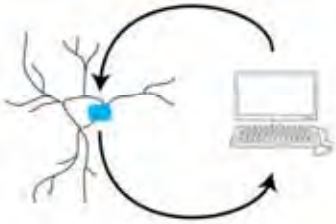
Physical Biology



Synthetic Biology

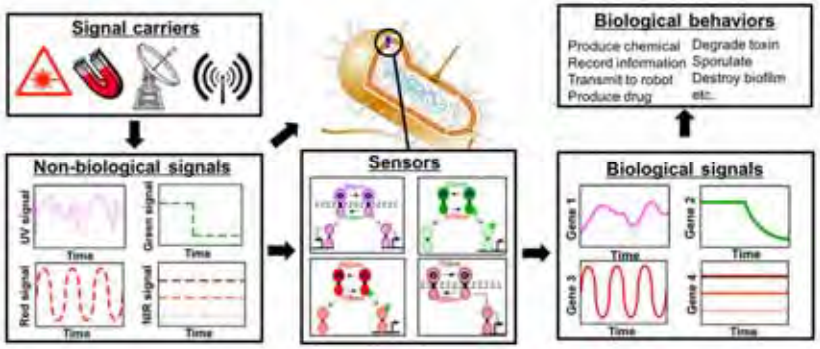
Systems Biology

Nano-neuro Interfaces



Artificial Embryos

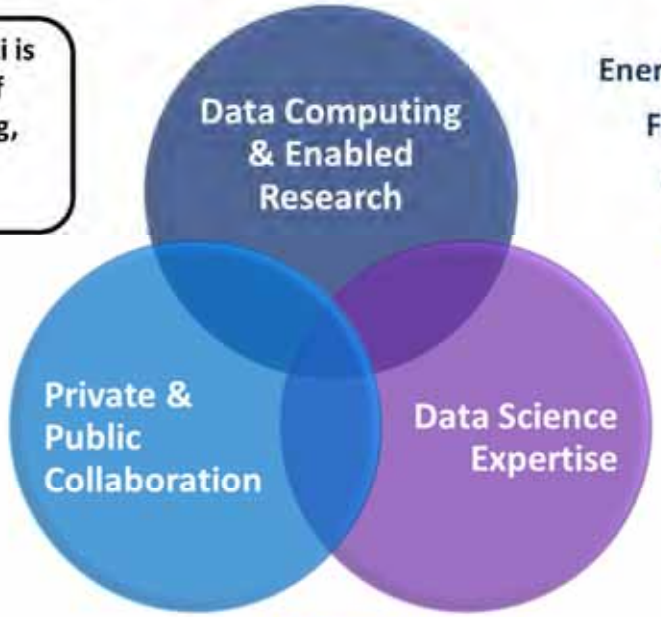
Optogenetics



K2i Capabilities

RICE | KEN KENNEDY
INSTITUTE FOR INFORMATION TECHNOLOGY

With over 150 faculty members, K2i is dedicated to the advancement of research in the fields of computing, data science and information technology.



Biology & biophysics

Energy exploration & production

Fluid-structure interaction

Infrastructure resilience

Simulation & modeling

Bootcamps in Data Science & HPC

Data to Knowledge Lab

Data Sciences & HPC annual conferences

Algorithms & theory

Deep learning

Statistical analysis & efficiency

Robotics

Accuracy & computational complexity

Artificial intelligence

Topical workshops, symposia, lectures & tutorials

Machine learning

Supervised & unsupervised learning

TEXAS A&M UNIVERSITY®

The Texas A&M University System

Service

22 million citizens served annually through service/extension agencies and organizations

Education

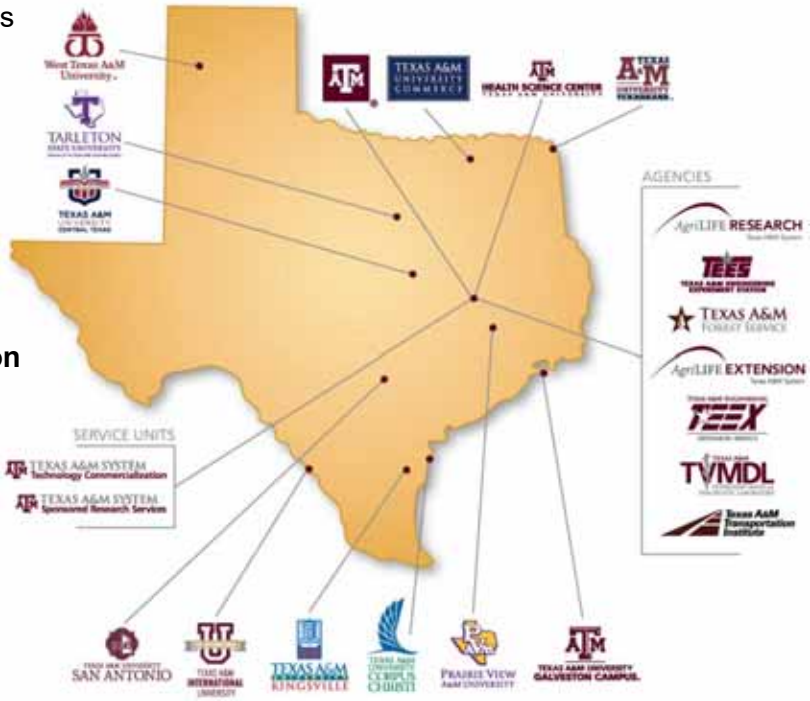
120,000 students are taught annually by **28,000 faculty/staff** at our **11 campuses**

Research

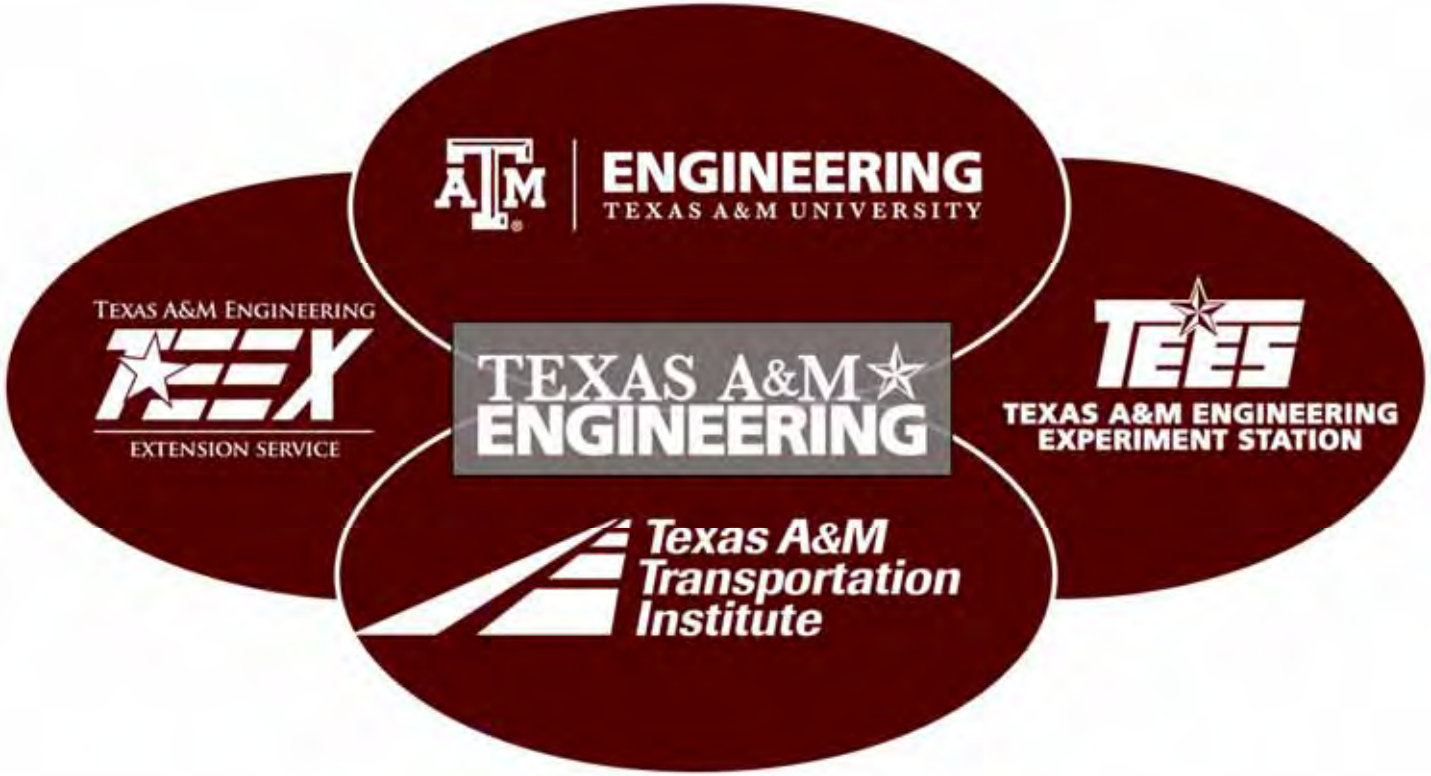
Annual expenditures $972 million primarily driven by agriculture, engineering, environmental and public health research and development

Training

180,000 individuals from 80 countries trained in fire fighting & emergency services, security, search & rescue, public works



Texas A&M Engineering Program



College of Engineering

Consistently ranked among the Top 10 public engineering programs

1st in 50 Best Value Bachelor's and Graduate Engineering Programs

2nd in the nation in research expenditures

14 departments
More than 19,000 students

MORE THAN 600	2.1 MILLION	65	LARGEST CLASS OF FEMALE FRESHMAN ENGINEERING STUDENTS	100%
FACULTY	SQUARE FEET OF LEARNING SPACE	PROFESSORS OF PRACTICE	IN THE NATION (FALL 2017)	OF ENGINEERING CLASSES LESS THAN 100 STUDENTS

Zachry Engineering Education Complex
A high tech, active-learning environment for undergraduate engineering education.

Engineering Experiment Station

Poster Topics

Accelerated Learning Synthetic Bio	Autonomous Systems Power & Energy
Cybersecurity Materials Manufacturing	TEES College of Engineering

The Texas A&M University System RELLIS "Smart" Campus

- Gated, secure area for private independently-managed businesses
- High-tech environment with collaborative opportunities
- Connection to nation's top faculty, researchers, and students
- Ideal location to test new technologies

TEXAS A&M UNIVERSITY
SAN ANTONIO
A MILITARY EMBRACING UNIVERSITY

ARL Related Strengths

Mike O'Brien, Provost

Marvin Lutnesky, Chair, Department of Science and Mathematics

Dawn Weatherford, Assistant Professor of Psychology

Izzat Alsmadi, Assistant Professor of Computer Science

M.K. Balasubramanya, Dean, College of Arts and Sciences

U.S. ARMY RDECOM ARL RESEARCH LABORATORY

Brief History of A&M-SA

- Texas A&M University-Kingsville System Center-San Antonio was created in January 2000
- Began as a 2-Year Transfer Institution
- Stand-alone University on May 23, 2009
- Comprehensive 4-year University in Fall 2016
- Offers 37 programs leading to B.S. and M.S. degrees
- Programs include Computer Science, Mathematics, Biology, and Psychology
- Fall 2017 enrollment = 6,460, FTE (12/9) = 5,422
- 68% Hispanic, 66% Female, 78% First Generation

Cybersecurity

- Security Controls
- Cyber Physical Security
- Software Security
- Secure Software Reverse Engineering
- Job Based Network Slicing in High Performance Computing
- Automated Classification of Users' OSN Behaviors
- Extraction of Actionable Knowledge from Dark/Deep Web
- Drone Based Package Delivery

Human Sciences

- Unusual Threat Identification = Rare Target Identification (RTI) Program on Overcoming the Cause of RTI problem
- Age related differences in Executive Attention, Working Memory, and Motor Control
- Post-injury Biological and Neurological Health Indicators to Enhance Therapeutic Outcomes
- Detection of Group Movements of Bats
- Transcriptome Signatures as a Function of Power Transfer from Electroshocked Fishes
- Tools and Technical Skills in Experimental Design, Data Collection, and Analysis

Tactical Unit Energy Independence

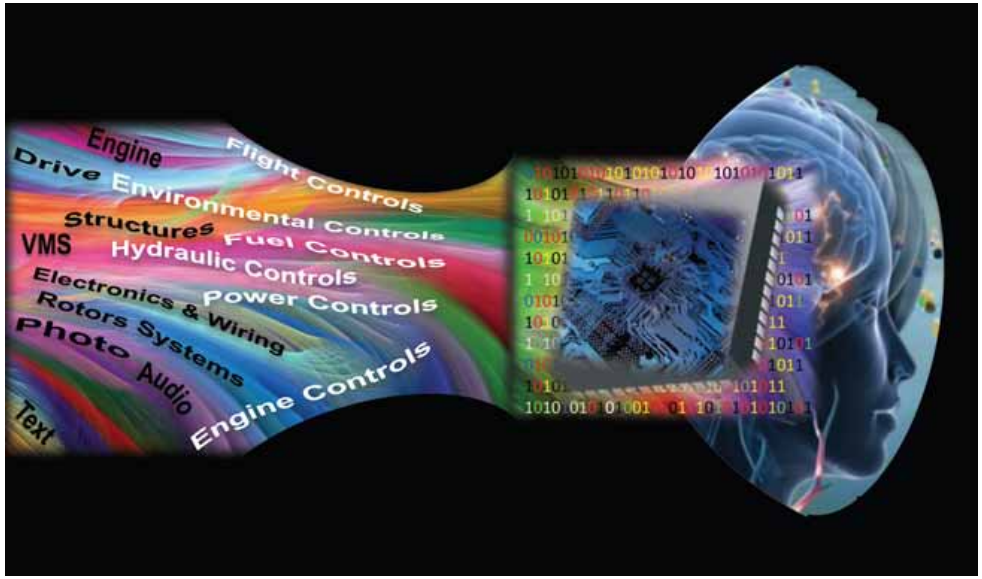
- Stirling Hybrid Vehicle (SHV) Technology
- Stirling Engine's High Thermal Efficiency is Coupled with Li-ion Batteries and Ultracapacitors
- Multi-Fuel, High Efficiency, Low Thermal Signature
- Collaborative Project with Industry Sponsorship
- Collaborative Opportunity - Stirling Hybrid Test Vehicle

TEXAS TECH UNIVERSITY

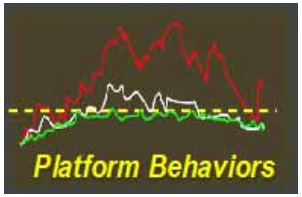
Dr. Joseph A. Heppert

Vice President for Research

Fabrics of Artificial Intelligence Technology for Healing (FAITH)



Artificial Intelligence & Machine Learning Model-based System of Systems Framework



This system will enable FVL platforms with autonomous capabilities to:

1. Identify the ingredients of system longevity or precursors of the onset of a particular failure;
2. Allow the cognitive cueing and human machine teaming, interaction, and communication in real-time; and
3. Facilitate system behavior changes to disrupt the failure cascade.

Dy.d.le@ttu.edu

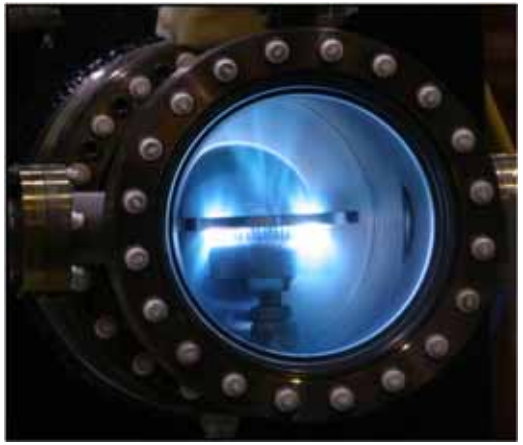
Additive Manufacturing of Energetic Materials

- Introducing stabilized explosives into reactive plastic that can be printed into bullets and many other traditional munitions
- Stabilizing the solid-liquid slurry to prevent settling during printing
- Optimizing metal fuel combustion

Michelle.pantoya@ttu.edu

Center for Pulsed Power and Power Electronics

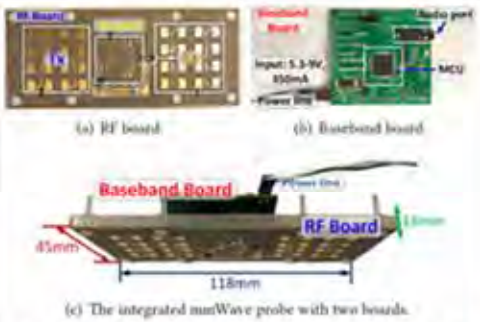
- High power microwave generation
- High power switching
- Advanced electrical and thermal packaging
- High bandwidth monitoring and control of electric machines



- Large power IGBT's
- Ultra High Power SCR's
- Electric space propulsion engines
- Plasma synthesis of thin films

p3e@ttu.edu

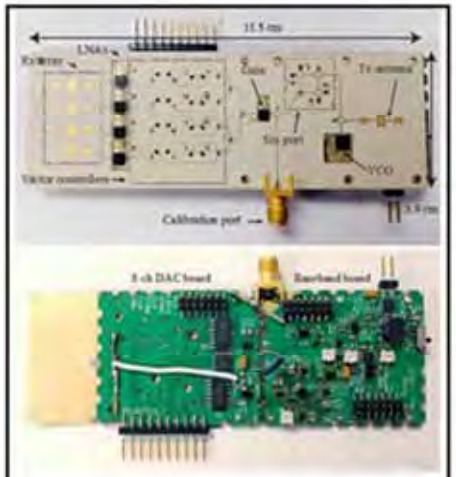
Electromagnetic Sensing Technologies



K-band multi-function radar

Radar sensor

1) Human tracking
2) Physiological monitoring
3) Electronic device identification
4) Linear/nonlinear characterization
5) Adaptive beamforming



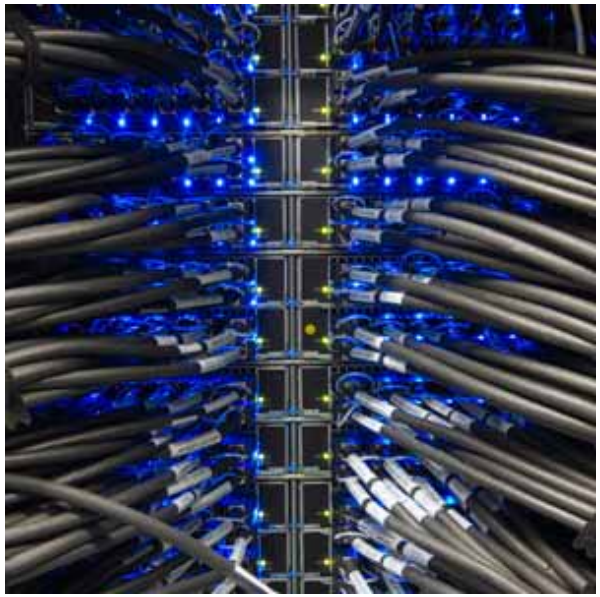
2-D beamforming radar

3-D MIMO radar

Changzhi.li@ttu.edu

Machine Learning

- Cyber security (designing both defensive and offensive technologies — e.g. continuous authentication and behavioral biometrics, adversarial device fingerprinting and inference of authentication credentials)
- Augmentative and Alternative Communication (e.g., gesture-based communication)
- Web anomaly detection (e.g., phish and spam detection)

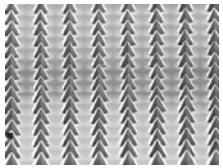


Abdul.serwadda@ttu.edu

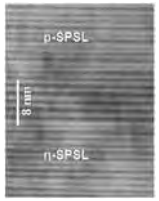
Nano Tech Center

Research Overview

Nanoscale Materials Growth

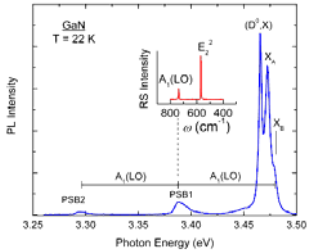


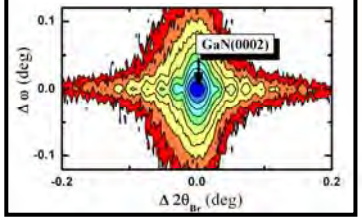
Selective Nanocrystal Growth



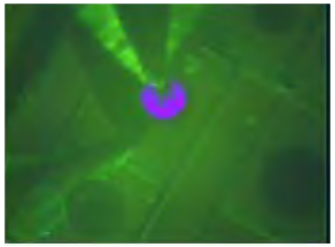
Superlattices

Fundamental Research and Metrology

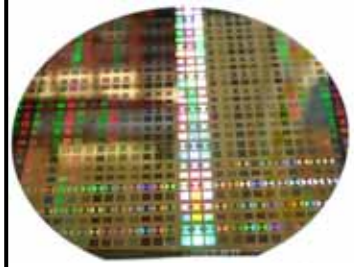




Devices



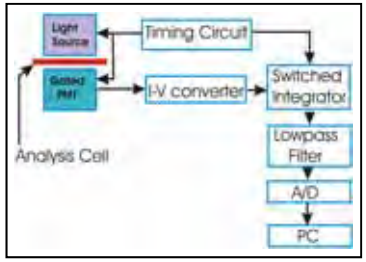
Deep UV LED



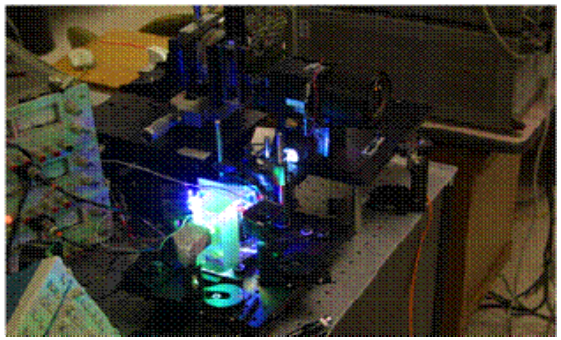
Biologically Inspired Nanowires: Sensing

Systems

Ultrafast Pulses



Anthrax Sensor Layout



Optical Design

ayrton.bernussi@ttu.edu

TTU's Innovation Hub

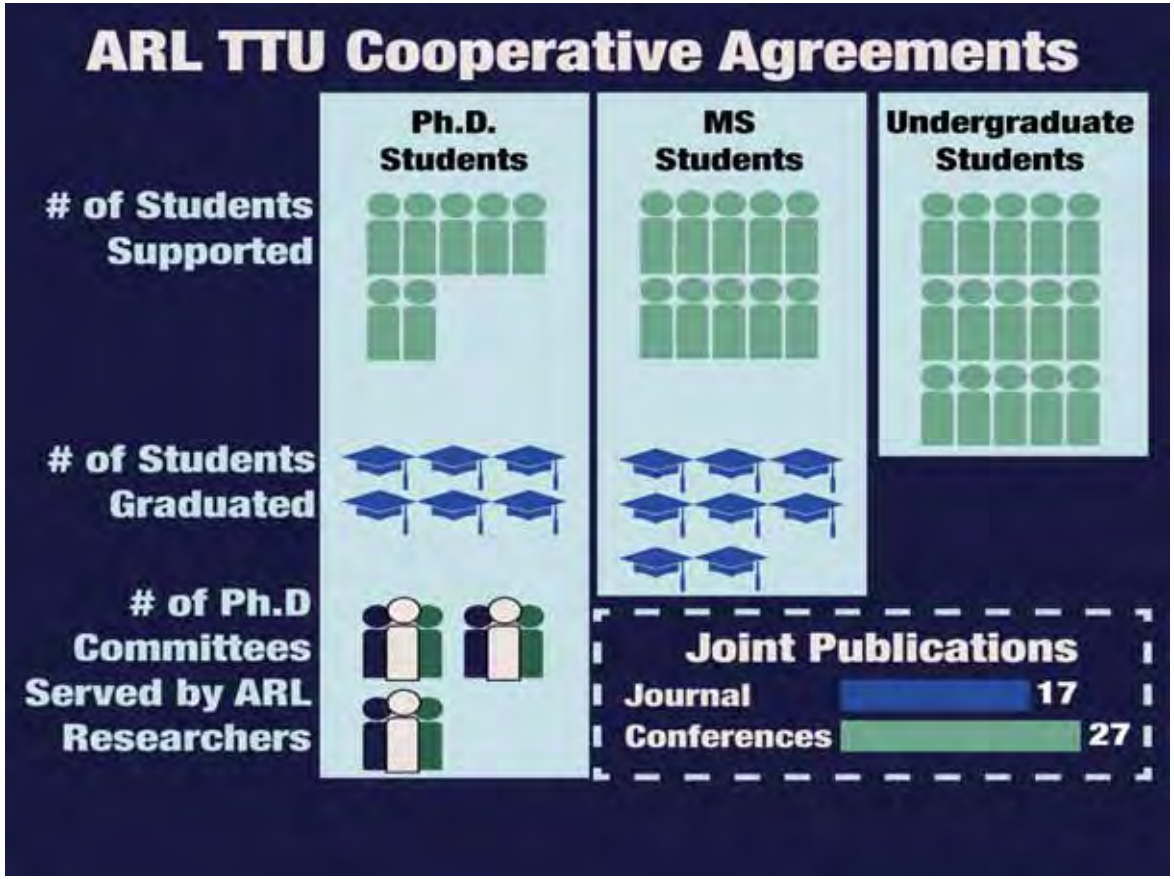
- Red Raider Startup
- Red Raider Idea Competition
- Hub Camp
- Young Entrepreneur Academy
- Faculty Innovate
- Faculty Scale
- Faculty Startup

- NSF I-Corps
- TTU Accelerator & Startup
- iLaunch Competition
- Innovate Texas Tech Mentor Program
- Basecamp & Rapid Prototyping Lab

The Hub

Collaboration with ARL

- Reliability of wide bandgap power device for Army applications
- Physic based modeling of Silicon Carbide (SiC) Power Devices
- Failure Analysis of SiC power devices using Scanning Electron Microscope (SEM) and Focused Ion Beam (FIB)
- Thermal modeling of SiC devices operating under high voltage and high current conditions
- High temperature performance of wide bandgap power devices
- Developed the Safe Operating Area of SiC power devices



UNIVERSITY of HOUSTON

Research at a Glance

1065 **Ranked Faculty**	$109M **Sponsored Funding**	$169M **Research Expenditures**

15 **NAE Members**	4 **NAS Members**	60 **NSF CAREER Award Winners**	1 **Nobel Laureate**

National Centers

ASMI **Advanced Superconductor Manufacturing Institute**
National Institutes of Standards and Technology (NIST)

BTI **Borders, Trade, and Immigration Institute**
Department of Homeland Security (DHS) Center of Excellence

NCALM **National Center for Airborne Laser Mapping**
National Science Foundation (NSF)

SSI **Subsea Systems Institute**
Texas Commission on Environmental Quality RESTORE Act Texas Center

TCLD **Texas Center for Learning Disabilities**
National Institutes of Health (NIH) NICHD Learning Disabilities Research Center

www.uh.edu/research

Innovation & Entrepreneurship

$33.8M	30	66	11
Royalty Earnings	**U.S. Patents**	**Disclosures**	**NAI Members**

UH is the top royalty-earning institution (without a medical school) in the United States

Research Thrusts

Institutional research thrusts will address a number of research challenges aimed at boosting economic development and improving the quality of life

Cyber and Physical Security

Drug Discovery and Development

Sustainable Communities and Infrastructure

Accessible Healthcare

Natural Sciences and Mathematics

Research Capabilities

Artificial Intelligence and Machine Learning

- AI, Deep Learning and Machine Learning
- Unconstrained Facial Recognition
- Predictive Analytics, Real-Time and Embedded Systems
- Power-Aware and Green Computing
- Evolutionary Computing, GIS

Tactical Energy Independence

- Materials for High Temperature Ionic Devices
- Properties of Materials for Device Performance
- Solar Generation of Hydrogen from Water
- Nanoparticle Synthesis and Applications
- Body Heat and Movement Power Conversion
- Solar Energy Conversion
- Utilizing Earth-Abundant Materials for Solar Cells, Fuel Generation and Sensing

Manipulating Physics of Failure

- Spectroscopic Studies of the Solid-Liquid Interface in Materials Structure, Composition and Failure
- Modeling of Amorphous and Crystalline Materials for Materials Failure
- Sensor/Responder Porous Materials

Cyber and Electromagnetic Technologies for Complex Environments

- Electromagnetic Fields for Covert Communication and Active Protection Against CEMA Threats in Tactical Environments
- Time-Reversed (TR) Electromagnetic Wave Propagation

Science for Manufacturing at Point of Need

- Superhard Materials Synthesis and Modeling
- Roll-to-Roll Manufacturing of Superconducting material

Discovery

- Superconductors with Ultrahigh Superconducting Transition Temperatures
- New Topological Materials and Phases of Matter
- Exploration and Detection of Unusual Broken Symmetry Phases

Engineering

Research Capabilities

Human Agent Teaming
- Intent Detection
- Human-in-the-Loop Methods

Artificial Intelligence and Machine Learning
- Adaptive Agents
- Information Fusion in Complex
- Heterogenous Sensor Networks
- Machine Learning, Deep Learning
- High Performance Computing
- Brain/Machine Interfaces
- Complex Humanoid and Bioinspired Robots
- Advanced Thin Film, Nanowire and Bulk Materials
- Electronics, Solid-State Lighting and Thermoelectrics

Artificial Intelligence and Machine Learning
- Advanced Thin Film, Nanowire and Bulk Materials for Energy and Electronics Applications Using Superconductors, Photovoltaics, Flexible Electronics, Solid- State Lighting and Thermoelectrics

Tactical Energy Independence
- Wearable Electronics including Flexible/Stretchable Electronics and Micro-Electro-Mechanical Systems
- Flexible/Stretchable Energy Storage using Polymer Nanocomposite Electrolytes

Cyber and Electromagnetic Technologies for Complex Environments
- Sensors and Sensing Technologies including LIDAR and Hyperspectral Image Acquisition, Data Analysis and Feature Extraction
- Electroactive Polymer Actuators and Sensors

Technology

Research Capabilities

Human Agent Teaming
- Optimized Training and Task Learning, Mental Tasks verses Movement Accuracy and Speed

Artificial Intelligence and Machine Learning
- Semantic and Visual Trajectory Analytics for Machine and Deep Learning Capabilities for Military Mobility
- Hyperspectral Scanning for Skin Lesion Assessment
- Biomarkers of Mild Traumatic Brain Injury Deep Learning Assisted High-Resolution Inversion of Low Frequency Electromagnetic Data

Accelerated Learning for a Ready and Responsive Force
- Diverse Teaching Methods to Tailor Domain-Specific Instructional Content to Individual Learner State and Learning Style
- Optimized Cognitive Readiness for Preparedness for Optimum Mission Planning and Deployment

Tactical Energy Independence
- Portable Power Modules
- Fast Charging and Wireless Charging Mechanisms
- Efficient Energy Conversions
- Power Conditioning of Novel Renewable Power Sources (Fuel Cells)
- Adaptive Protection Schemes for Isolated Micro-Grids
- Electric Motors and Motor Drives

Cyber and Electromagnetic Technologies for Complex Environments
- Managed Topology Service: Enabling SDN Adaptive Data Routing with Cognitive Gateways

Science for Manufacturing at Point of Need
- Low Cost Manufacturing of High and Intermediate Temperature Solid Oxide Fuel Cells Producing Light Weight Bio-Composites

Discovery
- Development of an Adaptive Neural Network Approach for the Identification of a Model for the Control of the Vibration in a Blackhawk Helicopter

Research Synergies

UH and the U.S. Army Research Laboratory

Advanced Manufacturing Institute

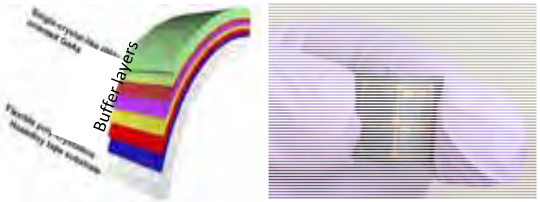
- Central manufacturing research organization of UH to scale up a wide range of technologies being developed by UH faculty to manufacturing and commercialization
- 17,500 sq. ft. high-tech facilities and unique manufacturing equipment in Energy Research Park
- Engineering and Scientific Staff with vast experience in manufacturing scale up
- Developing novel tools for in-line QC and process control for high-yield manufacturing

Roll-to-roll Manufacturing of Advanced Materials

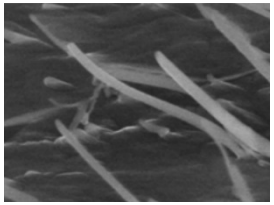
World's first Roll-to-roll compound semiconductor MOCVD system

- Low-cost, high-throughput manufacturing of thin films and coatings of metals, semiconductors and dielectrics on metal, glass and ceramic substrates by physical and chemical vapor deposition, solution coating and liquid phase processing methods

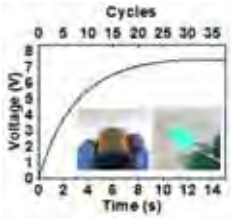
Energy devices on flexible, light-weight platforms



High-efficiency GaAs photovoltaics on flexible, lightweight, high-temperature resistant substrate → technology transferrable to thermophotovoltaics



High-performance nanowires on flexible, light-weight platform for Energy harvesting



Safe (lead-free) wearable self-charging power cell with flexible piezoelectric generators and storage

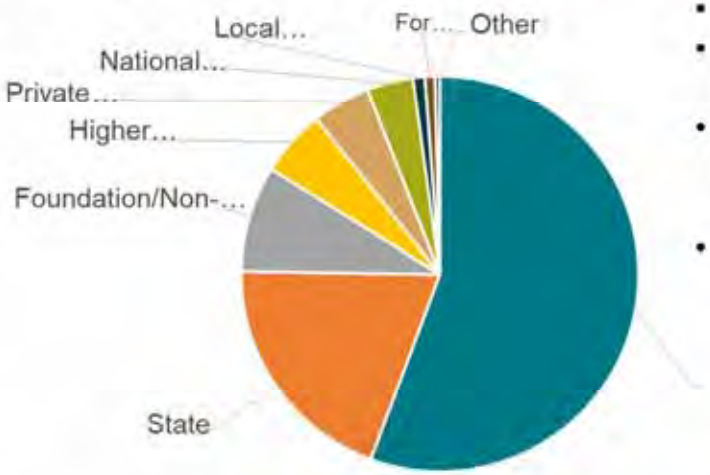
Superconductor wires carry 600X the current of comparably-sized copper wires

THE UNIVERSITY OF NEW MEXICO

OFFICE OF THE VICE PRESIDENT FOR RESEARCH

Discover more at RESEARCH.unm.edu

FY 2017 Awards
UNM Main & Branch Campuses



Research is Education!

- Research I, Hispanic Serving Institution
- 24,000 students; 4000 graduate students
- More than 50% of students are from minority groups under-represented in STEM
- Focus on innovation; 113 start-ups & 597 patents

- Over 360 Active Principal Investigators
- Over 940 Sponsored Projects
- $143 Million Awarded

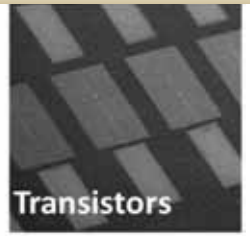
MARY JO DANIEL | Director, Faculty Research Development

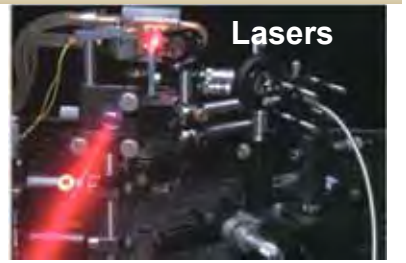
University of New Mexico | mjdaniel@unm.edu | 505-277-0168

Center for High Technology Materials

Director: Dr. Arash Mafi

Photonic & Microelectronic Devices

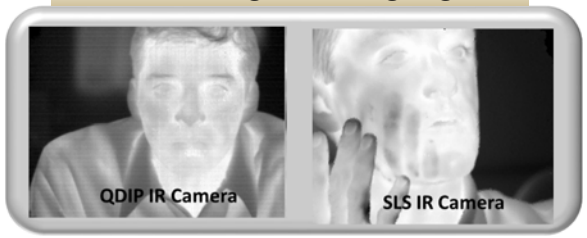




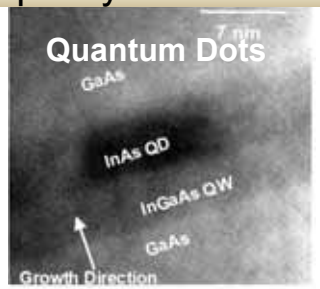
Promoting Research and Education in:

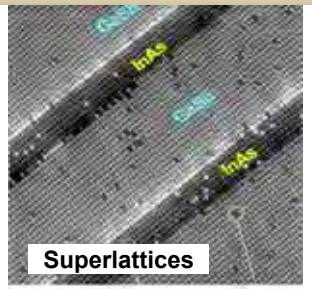
- Photonics
- Microelectronics
- Nanoscale Materials, Devices and their Applications

Sensing & Imaging

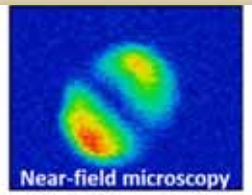


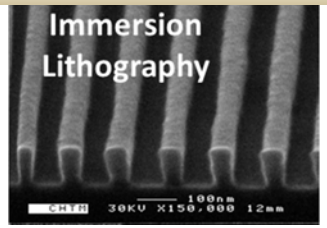
Epitaxy & Nanoscale Materials: UV to IR



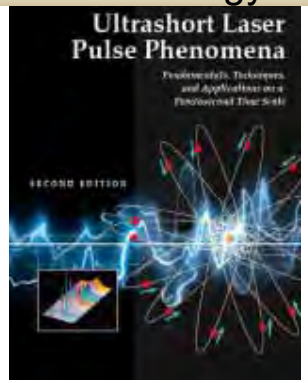


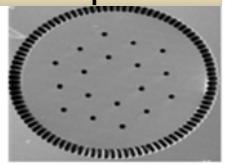
Nanoscale Lithography & Microscopy





Ultrafast Metrology & Fiber Optics



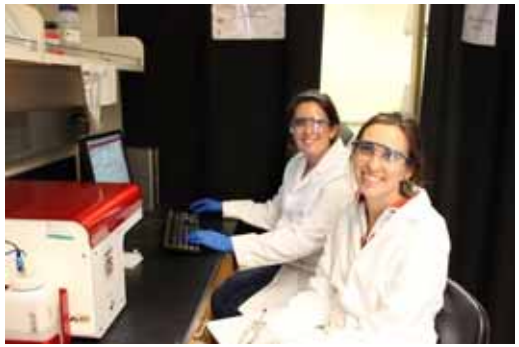


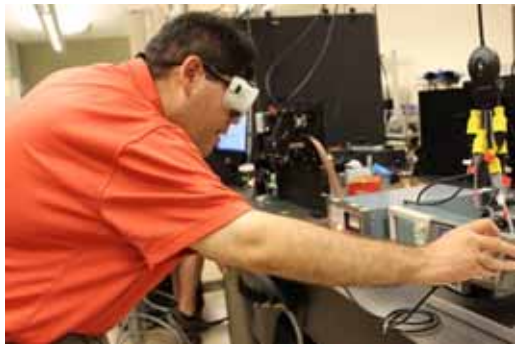
Fibers

Center for Biomedical Engineering

Director: Dr. Steven Graves

- Research at the interface of engineering, biological sciences and medicine
- Support academic programs leading to graduate degrees in Biomedical Engineering
- Enable economic development through entrepreneurial ventures, training courses, workshops, and intellectual property generation





Biomaterials and Biointerfaces

polymeric materials for tissue engineering applications

- **Instrumentation and Diagnostics**

development and application of flow cytometry instrumentation and bio-analytical methods

- **Computation and Modeling**

modeling of energy flow in natural and biomimetic material systems

Center for Advanced Research Computing

Director: Dr. Patrick Bridges

An interdisciplinary community that uses computational resources to create new research insights.

- Research – conducting research to improve the state of the art in cyberinfrastructure
- Education – training the next generation of computational and data scientists
- Service - providing cyberinfrastructure and associated support to the UNM community

Develop Cutting Edge System Software for Large Scale Systems

- Performance
- Robustness
- Security
- Maintainable

Current Project: Global measurement of censorship and surveillance of the internet

Collaborative Autonomous Agents

Dr. Lydia Tapia

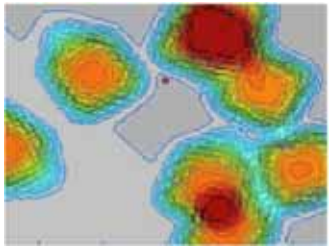
Dr. Marina Kogan

Dr. Melanie Moses

Dr. Meeko Oishi

Computer Science and Electrical and Computer Engineering with expertise in:

- Human-autonomy collaboration
- Autonomous agent collaboration
- Swarm behaviors
- High-dimensional machine learning
- Social dynamics
- Navigation and control



COSMIAC

Director: Mr. Craig Kief

Promotes aerospace innovation through the reliable and responsible use of configurable technology in military and defense systems.

Current Projects in:

- Additive Manufacturing and Micro Dispensing
- Radiation Testing, Radiation Hazard Assessment Sensor and Compact Environmental Anomaly Sensor
- Satellite Communications
- Machine Learning
- Acceleration and Incubation of Businesses

Psychology Clinical Neuroscience Center (PCNC)

Director: Dr. Vince Clark

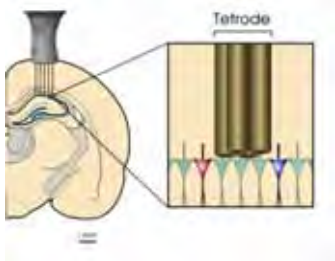
How normal and abnormal behavior and cognition arise from the brain

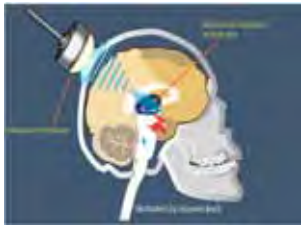
Facilities & Resources

- High Density Electroencephalography
- Eye-tracking
- Transcranial Direct Current Stimulation
- Transcranial Magnetic Stimulation
- Transcranial Focused Ultrasound Stimulation

Animal Research Facility:

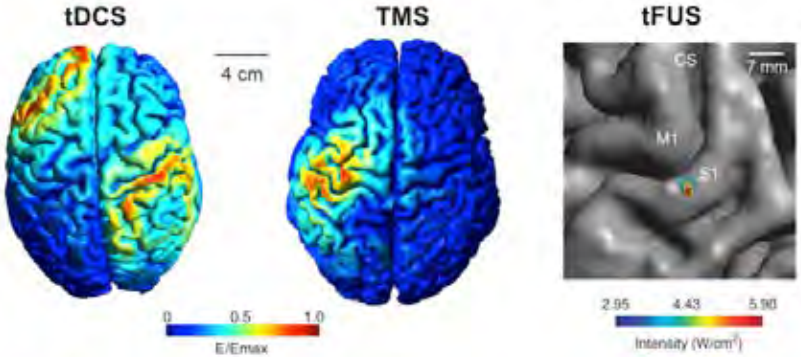
- Slice Electrophysiology
- in vivo Electrophysiology
- Microscopy and Neuron Morphology
- Optogenetics and Chemogenetics





PCNC Research Areas

- Learning and Memory
- Cognitive Control & Decision-making
- Attention
- Development
- Mindfulness Meditation
- Mood
- Fetal Alcohol Spectrum Disorders
- Alzheimer's
- Parkinson's
- Addiction
- Sleep
- Pain



Center for Quantum Information and Control

Director: Dr. Carlton Caves

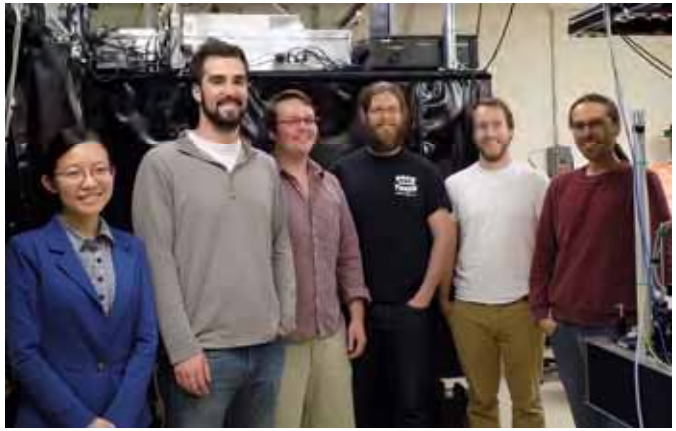
Outstanding research in Quantum Information Science (QIS), focused on coherence, control, and measurement of complex quantum systems

CQuIC Research

Development of platform-specific and platform-independent tools for control of complex quantum systems:

- Quantum technologies for optical communication
- Quantum complexity and simulation
- Quantum control and measurement of Qudits
- Foundations of quantum tomography and control theory

A multi-investigator research center and NSF-funded Focused Research Hub in Theoretical Physics (FRHTP)



Research has led to:

- New tools for controlling high dimensional quantum systems
- Demonstration of possibility of ultra-high resolution sensor
- Demonstration of the power of natural systems as a resource for quantum computing
- Foundational studies for advanced quantum communications

CMEM Materials Characterization User Facility

- Transmission Electron Microscopy, Focused Ion Beam Facility and X-ray Diffraction Facilities
- Scanning Electron Microscopy and Powder Characterization
- X-ray Photoelectron Spectroscopy and X-ray Fluorescence
- Atomic Force Microscopy and Confocal Raman Microscopy

Confocal Raman Microscope with AFM

UNT UNIVERSITY OF NORTH TEXAS

Denton, Texas

Overview: Research & Infrastructure

Narendra Dahotre
Professor
Vice President of Research & Innovation
Phone: (940) 565-3943
E-mail: Narendra.Dahotre@unt.edu

UNT-ARL Collaborations: Activities & Accomplishment

- Establishment of CA and CRADA

  Cooperative Agreement No. W911NF-13-2-0018: Development of Multi-Physics Based Hybrid Manufacturing for Unique Microstructures
  - hybrid laser-friction stir welding for enhanced structural performance; ultrasonic aging for microstructural design; friction stir welding and processing of high performance metallic materials; design of a multi-field materials processing system; deformation behavior of exceptionally tough high entropy alloys; computational design of high-strength, low-alloy magnesium alloys
- Commencement of Multi Year (7 years) Research Program in 2016: Advanced Ballistic Technology – Materials Development, Characterization, and Computational Modeling Activities

  Involved 10 faculty, 2 research faculty, 4 post-docs, & 8 students
  - Static and dynamic deformation behavior of high entropy alloys; Development and characterization of novel precipitation hardenable heterogeneous microstructures in High entropy or complex concentrated alloys; SHPB testing of additively manufactured (AM) Ti-6Al-4V; Site-specific mapping of plastic deformation using high-speed nano-indentation and in situ SEM pico-indentation; Processing, characterization and deformation of B_4C-based ceramic composites; Molecular dynamic simulation and first-principle simulation; Multilayer ceramics for high strain rate impact
- Cold Spray Research Project

  (2017 – 1 year). 3 faculty, 3 graduate students, MS thesis completion in 2018, joint UNT-ARL publication, award winning STLE conference presentation by grad student, new PhD project in Additive Manufacturing

  Design and evaluation of Ni-WC cold spray composites for wear and friction reduction at elevated temperatures
- Establishment of Satellite Office of ARL South at UNT

  UNT has a dedicated ARL South Office, which is used by ARL scientist on their short and extended visits to help interact with students and faculty. Over 20 ARL scientists had visited UNT in 2017/2018 under ARL South Connection.

January 2018 – UNT group of 12 faculty visited ARL

Dr. Jeff Lloyd, ARL/WMRD 4 week research stay in UNT

Tyler Torgerson, UNT PhD student testing Ni-WC cold-sprayed composite

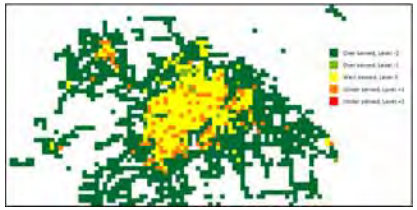
Computer Science and Engineering Area of Excellence: Cyber Security and Intelligent Systems

Cyber Security:

- Only program certified by the National Security Agency as Center for Academic Excellence in Information Assurance Education and Research and Cyber Defense Research
- Only NSF funded PhD program with focus on cybersecurity
- Involves 18 faculty across UNT

Intelligent Systems:

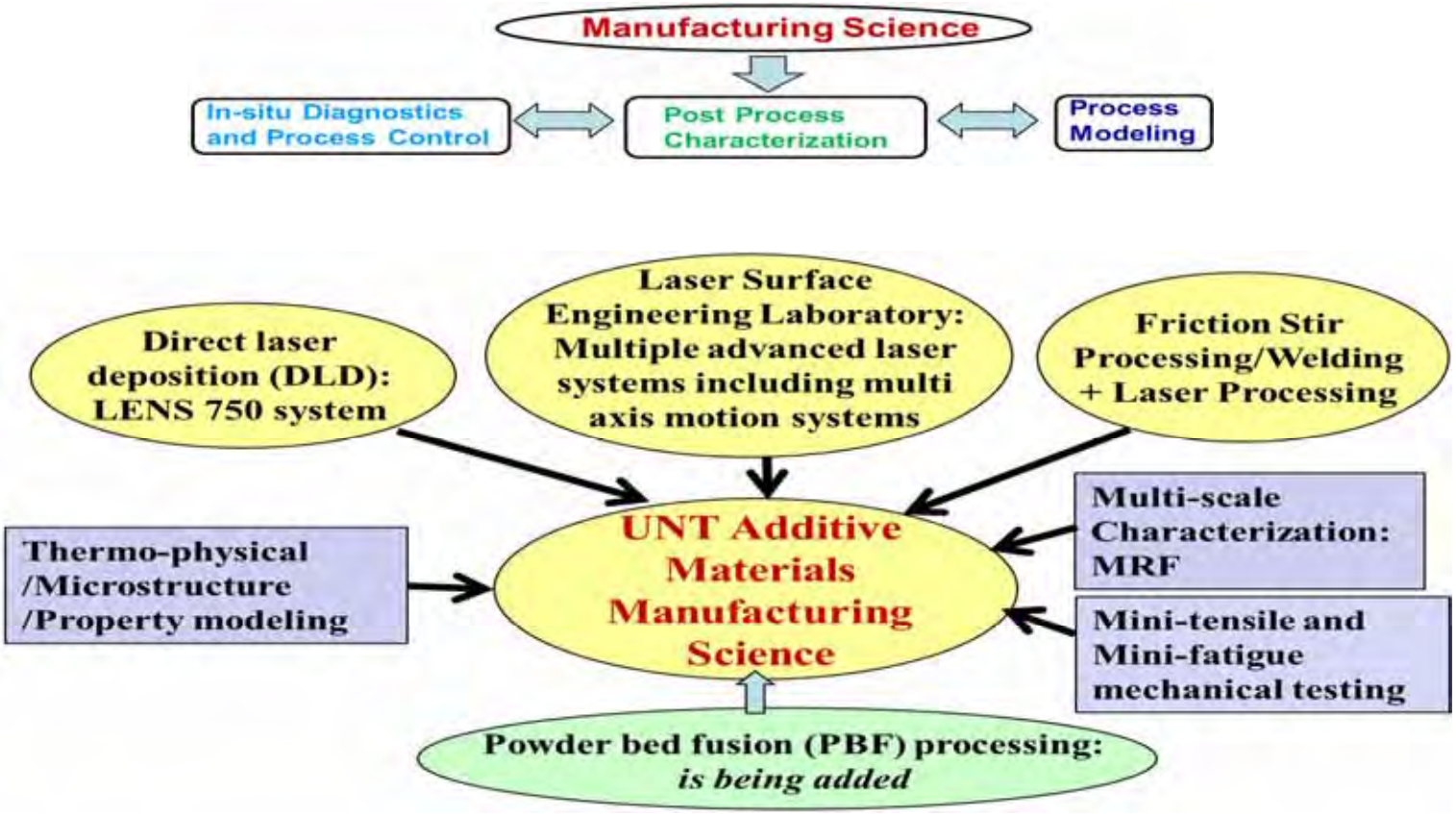
- Research in machine learning, spatial temporal reasoning, text summarization, natural language processing, reinforcement learning, computer vision
- Involves 10 faculty and over 30 graduate students



Additive Manufacturing (AM) of Advanced Materials

Additive Materials Manufacturing Science

A comprehensive approach to Additive Manufacturing



Towards developing a close-cycled loop between additive manufacturing – materials – multi-physics process modeling - microstructural evolution and multi-scale characterization – site-specific local properties

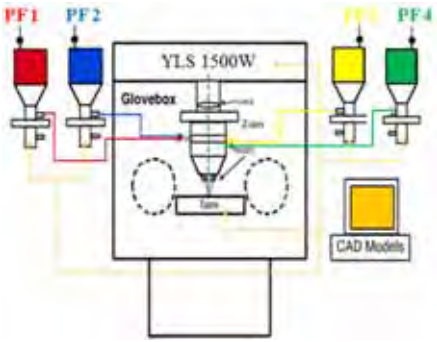
Strength Related to AM at UNT

- Extensive *experience and history in laser based surface engineering, joining, and remanufacturing*
- *Novel materials for AM*: Laser additive processing of *Ti and Al base alloys, metal-matrix composites, magnetic materials, compositionally/functionally graded materials – advanced materials beyond current generation AM materials*
- *Laser-Material Interactions:* Extensive experience in fundamentals of laser interactions with various materials during processing and manufacturing
- *Process Modeling:* Expertise in multi-physics modeling of materials deposition using energy sources (laser/e-beam)
- *Advanced characterization*: Expertise in 2D/3D microstructure characterization + site-specific mechanical properties
- *Hybrid Processing*: Laser additive processing of Hybrid processing approaches coupling friction stir processing (FSP) and joining with laser processing
- Close the loop on processing – Processing/manufacturing/engineering, process modeling – microstructure – property for AM processes – *in house capability*

AM Infrastructure at UNT

Laser Engineered Net Shaping (LENS)

Optomec LENS™ 750



AconityMIDI: Selective Laser Melting (SLM) R&D System by Aconity3D

Open Platform and Open Architecture System

- Process parameters can be accessed, selected, and controlled as per desire and need
- External diagnostic instruments can be added/integrated with the system

Technical Features

- Process Chamber
  - Diameter of build platform (Φ) ≈ 170 mm
  - Maximum vertical displacement of build platform ≤ 200 mm
  - O_2 sensor 10-210,000 ppm measurement range
  - Pressure and flow rate sensors
- Exchangeable Process Chamber + Docking Station for Parallel Setup
  - Build platform, powder reservoir and powder deposition
  - Atmospheric/inert gas chamber
- 1 kW CW Single Mode Fiber Laser
- 3D Scanning Unit for "On the Fly" alteration of Focused Spot Size
  - Focus range: 80 – 500 µm
- Automated Vertical Displacement for Scanning Unit
  - 400 mm vertical displacement
- Process Monitoring System
  - High-speed CMOS camera and illumination camera
- Pyrometric Measurement for Heat Radiation from Melt Pool
  - 2 high speed pyrometers
  - Spatial resolved evaluation of on line heat emission
- High Temperature Inductive Heating of Build Platform
  - Maximum temperature ≤ 1200°C
  - Size of build platform (Φ) ≈ 70 mm

Additional AM Relevant Laser Systems

IPG3000:
3kW, CW Ytterbium YAG Laser (1.06 µm, 5-axis CNC workstation, 10 m fiber optic beam delivery, high speed (>1m/s) galvanometric scanning mirror system, 18"x18" scanning coverage)

Rofin Sinar Starweld 250:
250JJ, Nd-YAG Pulse Laser (1.06 µm, 5 m - dual fiber optic beam delivery system, two separate CNC work stations with optical vision sensor)

Lumonics JK 701:
400W, Nd-YAG Pulse Laser (1.06 µm, 5 m - single fiber optic beam delivery system, pulse shaping capability, 4-axis CNC workstation)

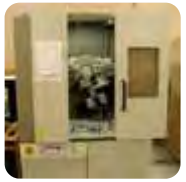
Materials Research Facility (MRF)

Advanced Characterization Infrastructure

High Resolution Analytical TEM

Dual Beam FIB/SEM

Local Electrode Atom Probe (LEAP)



High Resolution X-ray Diffraction

Environmental SEM

X-ray Photoelectron Spectrometer

Scanning Auger Nanoprobe

Atomic Force Microscopy

Variable Angle Spectroscopic Ellipsometer

Raman Spectrometer

Materials Science and Engineering Area of Excellence:

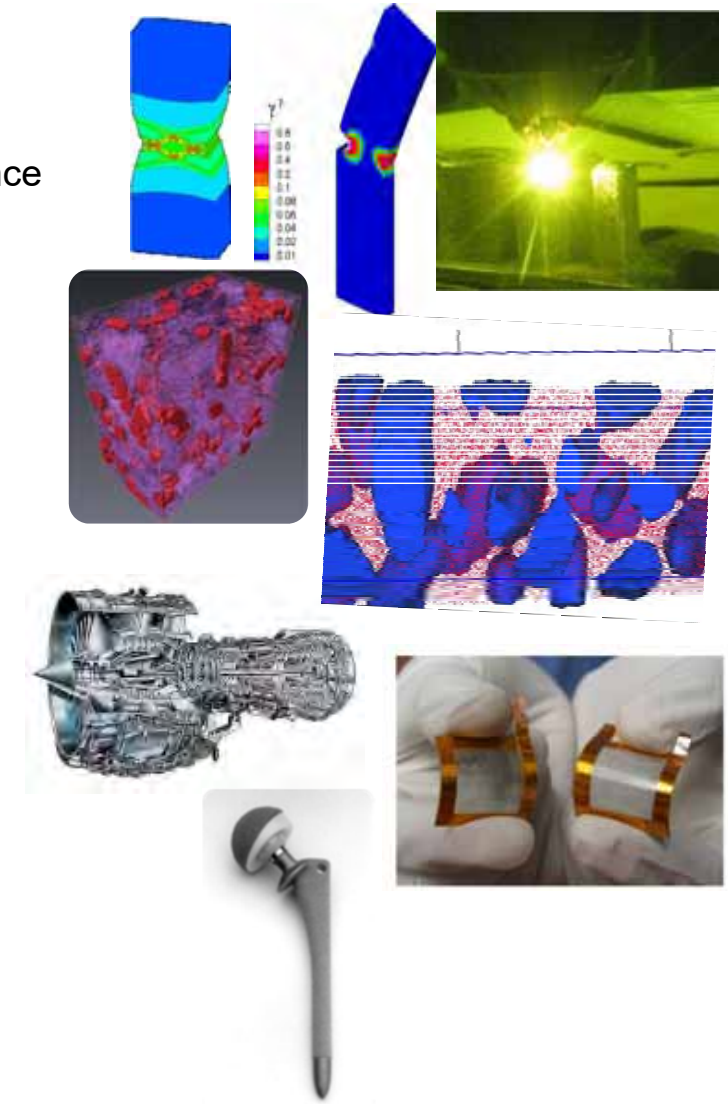
High-Performance Materials Design and Processing

Metal alloys for extreme mechanical loadings:
- High entropy alloys for high toughness and strength
- Metal glasses for mechanical and corrosion resistance

Additive Manufacturing (AM) Processing:
- Laser assisted AM of metal alloys
- Friction stir welding processing

Ceramics for Extreme Environments:
- Radiation stable amorphous ceramics
- High temperature lubricating oxides

Next Generation Electronic Materials:
- Molecular thin (2D) semiconductors
- Flexible opto-electronic materials
- Carbon nanostructures for battery applications



Hip Joint

The UNIVERSITY of OKLAHOMA

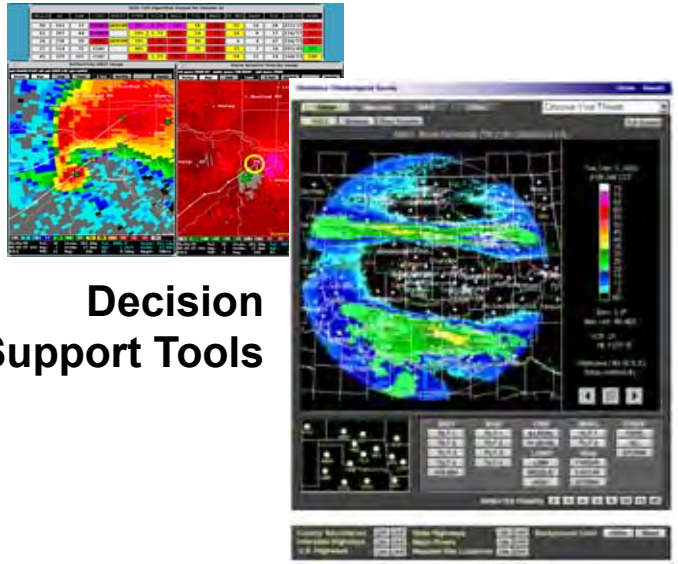
Research Campus

National Weather Center

Convergence of Academia & Government

- Confederation of 13 Federal (NOAA) & State entities + OU; started in 1962
- Inspired by Teaching Hospital Concept: Co-locate academic & research programs with “Operational” facilities
- Employs more than 800 professionals
- Largest group of operational, research, and academic meteorologists in the nation
- Over $500M in observational infrastructure
- Fixed and mobile radars, and surface mesonetworks
- Annual research expenditures of $100M

Theory, Process and Field Studies



Decision Support Tools

Advanced Radar Research Center

The Advanced Radar Research Center (ARRC)

- Interdisciplinary group of 140 scientists and engineers
- Capabilities to sense & understand the electromagnetic environment within CEMA (Cyber Electromagnetic Activities)

The RIL (Radar Innovation Lab) 35,000 sq. ft. facility

- Two anechoic chambers
- Micro-fabrication, machine shop, high-bay garage, large microwave lab, lithography, 3D printing, electro-plating, etc.

National Environmental Simulation & Testing (NEST) Facility

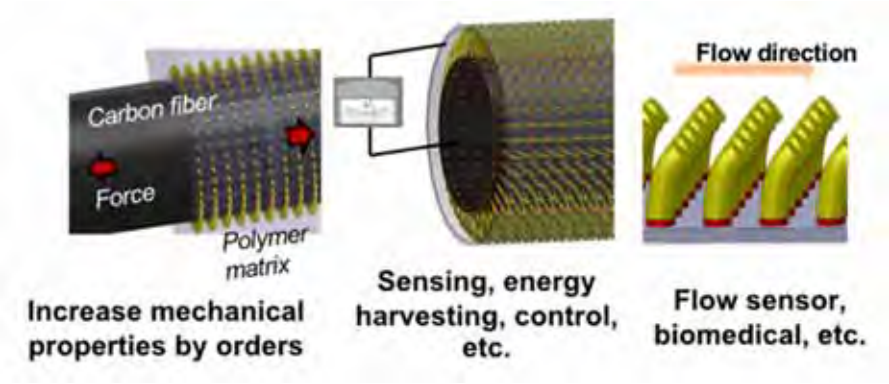
Full-scale testing and certification

- Sophisticated computer modeling
- Multiple simultaneous phenomena*
  Wind (150kts), rain (15 in/hr), hail (3 in), snow, temp (-60o - +160o), altitude, vibration, dust, anechoic, acoustic, lightning, flooding, salt, fog
- Climatic reaction wall
- Rolling road
- Altitude/Climatic wind tunnel

Segmented/Protected Testing; Operational by 2023
Government, Commercial, Research, Educational

Manipulating Physics of Failure for Robust Performance of Materials

- **Multifunctional composites**
  - Hybrid structural fibers
  - Self-sensing composites
  - Self-healing composites
  - Prediction of
    - structural remaining useful life
    - mechanical properties
  - Multifunctionality in composites attributed to nanowires
- **Polymeric and (Nano)Composite Material Platforms**
  - Design: synthesis to engineering function
  - Nano- and Micron-sized Particles
  - Self-Assembled Monolayers/Thin Films/Polymer Brushes/Surface Modification
  - Novel Polymerization Schemes
  - Stimuli Response
- **Nanocomposites for Pressure Sensing**
- **Electrospinning Processing of Nanofibers**



Sciences for Maneuver

Goal

- Design smart & autonomous air vehicles in support of ground troops in military missions

Technical challenges

- Autopilots to assist untrained pilots
- Aerial robotics: tilt-rotor UAS + Robotic Arm
- Machine learning & Artificial intelligence to improve analysis and prediction large numerical data sets
  - UAS programming
  - Improved weather prediction

Human-Agent Teaming

Goal

- Agent-supported decision making
- Mixed agent-human teams

Technical challenges

- Balancing human and agent strengths and weaknesses
- Dynamic team creation and division of responsibilities
- Evaluation of agent performance and breakdowns
- Emergence of cognitive and automation biases
- Deskilling, abdication of responsibilities

Accelerated Training

Understanding the Training and Trainee

- Eye tracking data analytics
- Integration of eye movements and situation awareness
- Other ongoing research topics in advanced training interventions
- Electroencephalography (EEG) experiments, including ERP, and electro dermal activity (EDA) to study neurocognitive and physiology responses

TEXAS
The University of Texas at Austin

The University of Texas at Austin and the Army Research Laboratory

Robert Hebner, Ph.D.
Director, Center for Electromechanics
Liaison with ARL-South

U.S. ARMY RDECOM ARL RESEARCH LABORATORY

Collaboration Builds on Success

- DOD has track record of success with UT Austin
- Examples include:
  - Electromagnetic Aircraft Launch (EMAL)
  - Electromagnetic gun technology
  - Tactical sonar

Value both Large and Small Interactions

- Large - Collaborating with ARL researchers and managers to explore the potential for and the benefits of major capability improvements
  - Multi-institutional
  - Multidisciplinary
  - Develop notional research and implementation roadmap
- Small - Numerous effective and valuable single investigator research projects

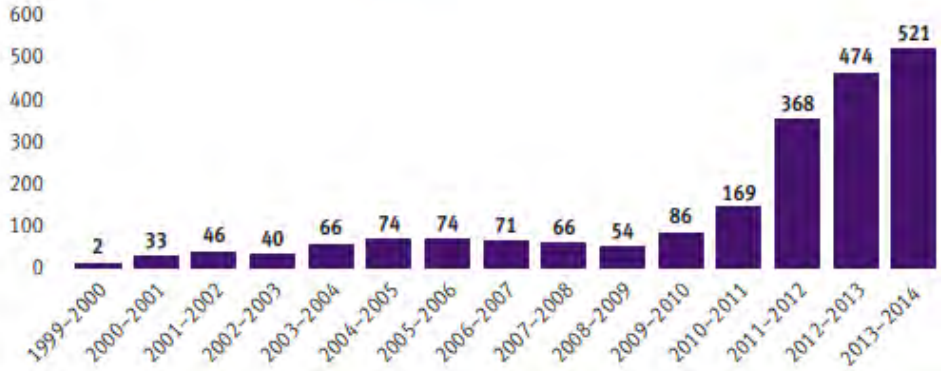
Leading Edge Research Supporting Army Priorities

Army Priority	Examples UT Supporting Research
Long-Range Precision Fires	EM gun technology, laser power, electromechanical guidance test facility to $6x10^4$ x gravity's acceleration
Next Generation Combat Vehicle	Autonomous vehicles, efficient drive trains, technology for enhancing soldier effectiveness and reducing maintenance
Vertical Lift Platforms	Design and build, light weight power, quiet operation
Army Network	Electromagnetics, communication systems, cybersecurity,
Air and Missile Defense	Advanced radar, signal processing
Soldier Lethality	Power, manufacturing in theater to maintain tempo, exoskeleton-human interactions

Sensitive to STEM / Diversity

- #2 – Engineering Program for Hispanics
  - (Hispanic Business Magazine, 2014)
- #1 – Producer of Minority Graduates in Texas and Fourth in the Nation
  - (Diverse Issues in Higher Education, 2014)
- #10 – Graduate Engineering Program in the U.S.
  - (U.S. World News & Report, 2017)
- Uteach
  - Bringing STEM to disadvantaged schools

Figure 1. Annual UTeach Graduate Production



Teaching Credentials Awarded to UTeach Partner Program Graduates Through Spring 2013

1,132 MATHEMATICS

865 SCIENCE

23 COMPUTER SCIENCE

12 ENGINEERING

UNIVERSITY OF TEXAS ARLINGTON

A Research-1 University on the Move

Education:
- 41,000+ Texas-based students
- 58,000+ worldwide students
- 184 degree programs
- 12,700+ graduates in 2016-17
- 200+ PhD graduates
- Hispanic Serving Institute

Research:
- $94+ million per year
- Rapid growth in health research
- ~ 600 tenure/TT faculty

Infrastructure:
- 420 acres on the main campus
- 17 acres at UT Arlington Research Institute
- >$200M Construction ('16-'18)
  - $125M SEIR Building

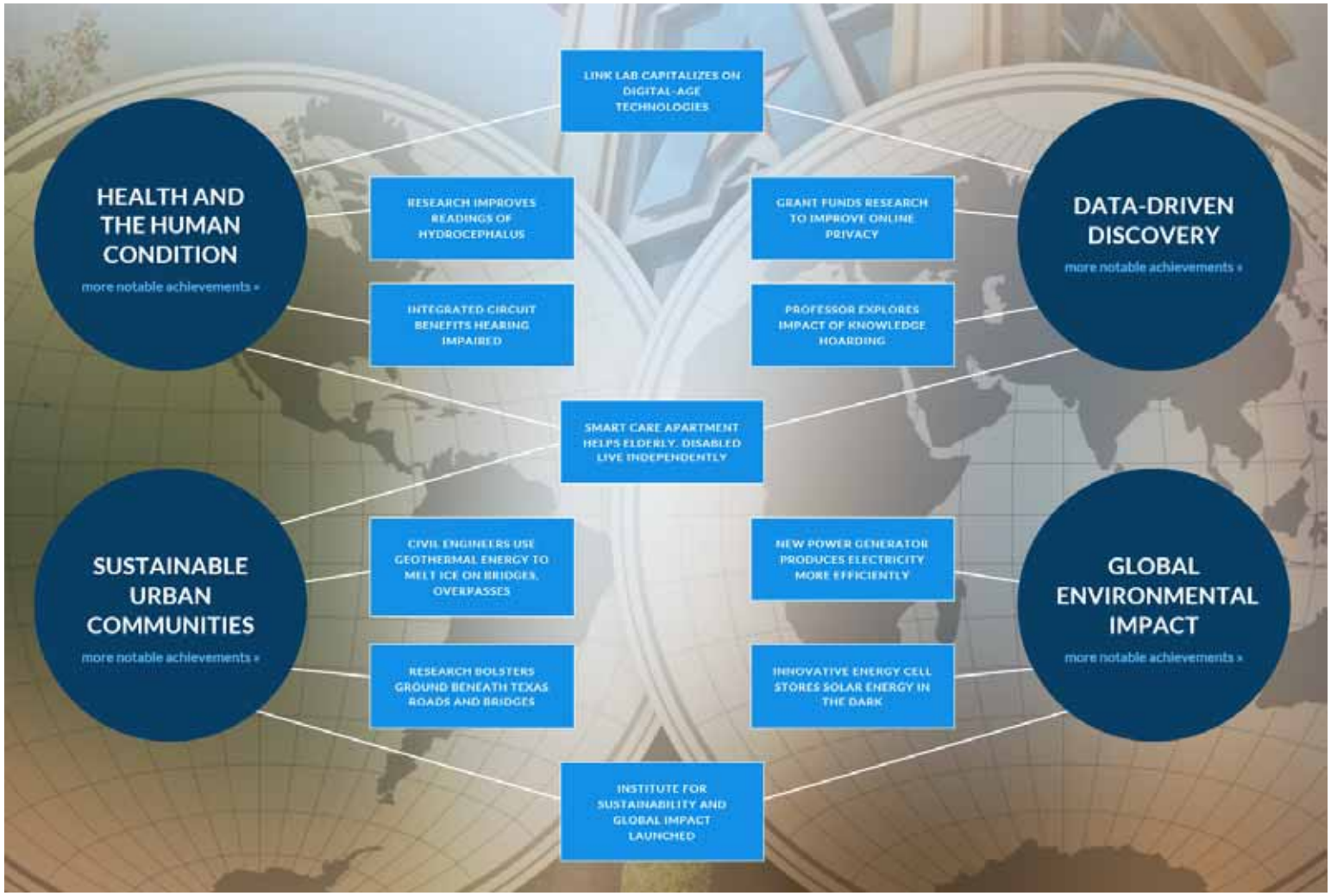
Impact:
- $13.6 billion economic impact (2012)

College of Engineering:
- 7,248 students
- Third largest in Texas
- 11 baccalaureate, 14 master's, and 9 doctoral degree programs
- 20% Student Population - Female

Research:
- Total Research Expenditures in 16-17- $48.8 M
- 2 NAE Members, 9 NAI Fellows, 44 Fellows
- 18 NSF CAREER & 4 ONR Young Investigators

Infrastructure:
- 417k sq.ft of Teaching and Lab Space

University Strategic Areas



https://www.uta.edu/strategicplan/

Sub-Focus Areas: ARL South

Aerodynamics
- Hypersonics
- Computational Fluid Dynamics
- Vertical Lift/rotorcraft Aerodynamics
- Wind Turbine Aerodynamics

Big Data/HPC
- Machine Learning & deep learning
- Data Analytics
- Data Mining & Databases
- HPC and Cloud Computing

Communications and Networks
- Optical Communications
- Computer Networks
- Mobile Communications

Automation/Artificial intelligence
- Robotics
- Artificial Intelligence
- Machine Learning
- Assistive technologies
- Unmanned aerial systems

Built Infrastructure
- Sustainable and Resilient Structures
- Pipeline Engineering
- Earthquake engineering and Hazard Mitigation
- Solid Waste
- Structural Health Monitoring

Energy
- Oil/Gas excluding extraction
- Renewable Energy
- Batteries
- Power electronic conversion
- Electric Power grids
- Solid Waste to Energy
- Thermal Management of Electronic Devices

Sub-Focus Areas: ARL South

Internet of things
- Radar and sensor networks
- Mesh communications
- Distributed processing

Logistics
- Globally integrated sustainable manufacturing
- Energy production and distribution
- Community services (police, fire, public transportation)
- Medical services
- Intermodal transportation systems(air/road/rail/water)

NanoTechnology
- Nanopore electronics
- Optical resonant surfaces
- Optical ring resonators
- Photonic devices
- Nonlinear and quantum optics

Manufacturing
- Composites
- Sustainable Manufacturing
- Micro Manufacturing
- Automation
- Simulation
- Additive manufacturing & Certification

Materials
- Composites
- Biomaterials / Tissue Engineering
- Electronic Materials
- Sustainable Materials

Security
- Hazardous substance detection
- Radar sensor networks
- Cybersecurity

Sub-Focus Areas: ARL South

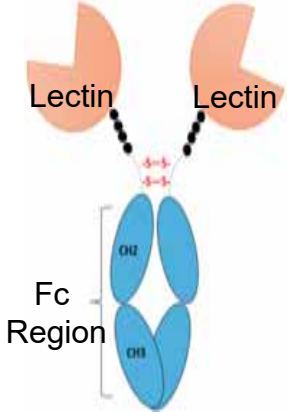
Healthcare
- Large scale analysis of genome, Proteome
- Gene sequencing and functionality
- Protein production and modification

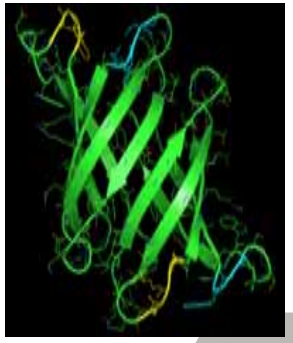
Smart Cities
- Underground Transportation Systems
- Smart transportation systems, traffic mitigation, livable communities, pipeline systems
- Solid Waste to energy conversion
- Resilient infrastructure
- Disaster recovery
- Integration of community services Energy utilization

Engineering of Biomedical System
- Bio-electric devices for disease monitoring and treatment
- Personalized and precision monitoring and treatment

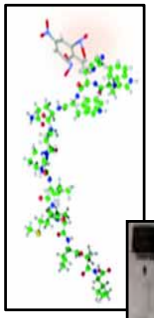
Water
- Flood Mitigations
- Health Impact
- Water Resources
- Water supply and demand
- Hydrology

Synthetic Biology at UTA





Applications:
- Antibody Mimics
- Targeted Reporters



Applications:
- Diagnostics for Bio-toxin Poisoning
- Small Molecule/ Explosive Sensing
- Receptor Discovery
- Enzyme/Substrate Screening

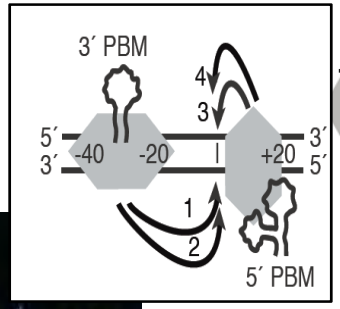
Engineered Fusion Proteins

Directed Evolution of Proteins

Synthetic Biology @ UTA

Transposable Genetic Elements

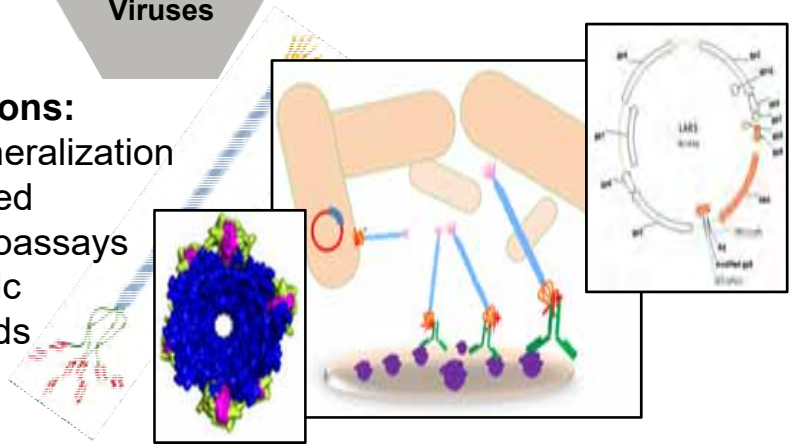
Engineered Viruses



Applications:
- Rewiring of Gene Networks
- Generation of New Genes
- Gene Regulation

Shawn Christensen, Dept. of Biology

Applications:
- Bio-mineralization
- Improved Immunoassays
- Catalytic Scaffolds



Justyn Jaworski, Dept. of Bioengineering

UT Arlington: Computer Science and Engineering

Overall

- 26 Tenure Track faculty, with 5 new positions for this year
- Strong enrollment growth: 2014 students in Fall 2017 (1270 Bachelor's, 634 Master's, 110 Ph.D.)
- Over $4M per year in research expenditures for the last 3 years
- $7.6M research grants in FY17, growing from $3.1M in FY16
- Construction of the $125-million, 220,000-sq. ft. Science and Engineering Innovation and Research (SEIR) building is expected to be completed in 2018.
    - CSE research labs and lecture rooms will be strategically placed in SEIR and the other multidisciplinary building---the 2011-built, $116-million, 234,000-sq. ft. Engineering Research Building (ERB).

Research Focus

Big Data/HPC

- Data Analytics, Data Mining
- Machine Learning & Deep Learning (ranked 60)
- Databases, Storage Systems (ranked 17)
- HPC and Cloud Computing (ranked 20)

Security

- Cybersecurity

Automation/Artificial intelligence (ranked 29)

- Robotics
- Artificial Intelligence
- Assistive technologies

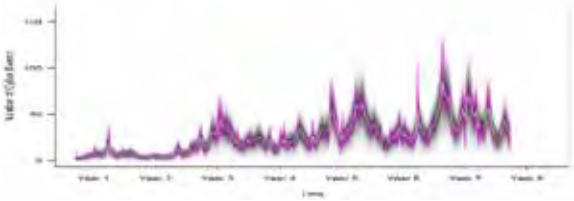
Other Related Areas

- Sensor networks
- Distributed processing
- Healthcare

Cyber-Security Research Projects in CSE@UTA

PI Gautam Das

- **Social Networks Analytics (supported by ARO)**
  - Community Discovery, Information Flow, Topology Evolution
    - E.g., link prediction, detecting secret connections, path analysis
- **Malware Forecasting (collaboration with Jon Bakdash and Laura Marusich, ARL South)**
- **Collaborating Worker Groups and Hidden Profile Task Learning (collaboration with Jon Bakdash and Laura Marusich, ARL South, and Paul Paulus and Jared Kenworthy, UTA Psychology)**



PI Chengkai Li

- **Fact checking, Fake News Detection, Computational Journalism**

PI Christoph Csallner

- **SEMU: Analyzing sophisticated computer malware**

PI Jiang Ming

- **Software Security and Malware Analysis**
- **Binary Code Difference Analysis**

UTD THE UNIVERSITY OF TEXAS AT DALLAS

UT DALLAS
The University of Texas at Dallas

Cyber Security and AI/ML Capabilities at The University of Texas at Dallas

http://csi.utdallas.edu

Ms. Rhonda Walls, Project Coordinator
rhonda.walls@utdallas.edu, (972) 883-2731

Dr. Bhavani Thuraisingham, Founding Executive Director
bhavani.thuraisingham@utdallas.edu, (972) 883-4738

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FEARLESS engineering UTD

U.S. ARMY RDECOM ARL RESEARCH LABORATORY

UTD Cyber Deception Research

PIs: Drs. Kevin Hamlen & Latifur Khan

- **Goals:**
  - **Delay cyberattack progress during critical mission phases**
  - **Misinform + misdirect enemy to gain tactical advantages**
  - **Reduce asymmetric cyberwarfare advantages of attackers to favor defenders**
- **Relevant Army Needs:**
  - **Cyber Technologies for Complex Environments**
  - **Artificial Intelligence & Machine Learning**
- **UT Dallas Research**
  - **Cyber Deceptive Software Engineering**
    - **Embedded honeypots, Deceptive-by-design software**
  - **Artificially Intelligent, Deceptive Firewalls**
    - **Embedded honeypots, Deceptive-by-design software**

Example #1: "Honey-patching"

[Drs. Frederico Araujo and Kevin W. Hamlen, CCS'14]

- **Main idea: Automatically transform software security patches so that patched software *appears to be unpatched.***
  - **Frustrates attacker vulnerability probing (Which vulnerabilities are real?)**
  - **Impedes *informed adversaries* (e.g., insider threats)**
    - ***All* software has embedded traps, not just the dedicated honeypots**
  - **Misdirects adversaries for tactical advantages (divulge fake secrets)**
- **Case study: Heartbleed honey-patched w/i hours of public disclosure**

THE ECONOMIC TIMES

Software

New technique Red Herring fights 'Heartbleed' virus

PTI Apr 15, 2014, 05.17PM IST

WASHINGTON: US cybersecurity researchers have developed a technique that fights the 'Heartbleed', and detects and entraps hackers who might be using it to steal sensitive data.

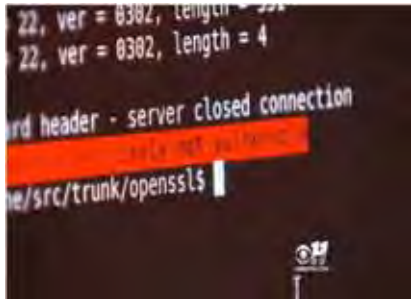
The Heartbleed bug, which became public last week, has set alarm bells ringing across the globe, including in India, for fear of exposing millions of passwords, credit card numbers and other sensitive information to hackers.

CW33 KDAF-TV CBS

THE ECONOMIC TIMES

e! Science News

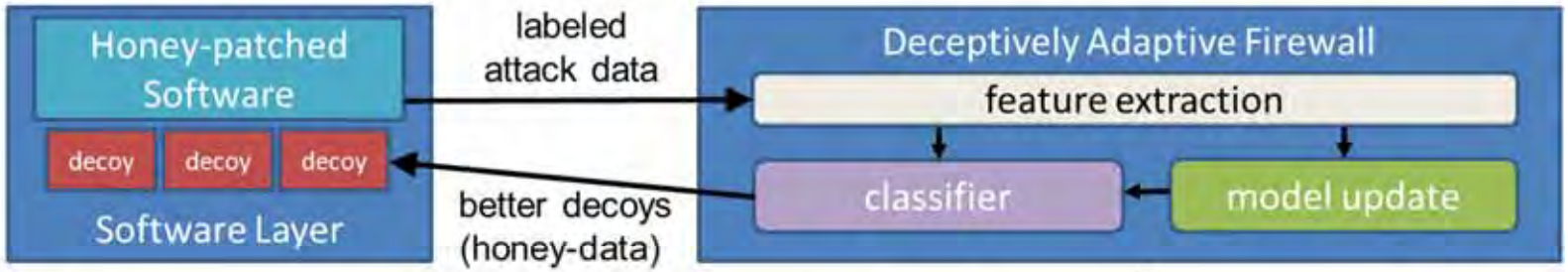
ScienceDaily

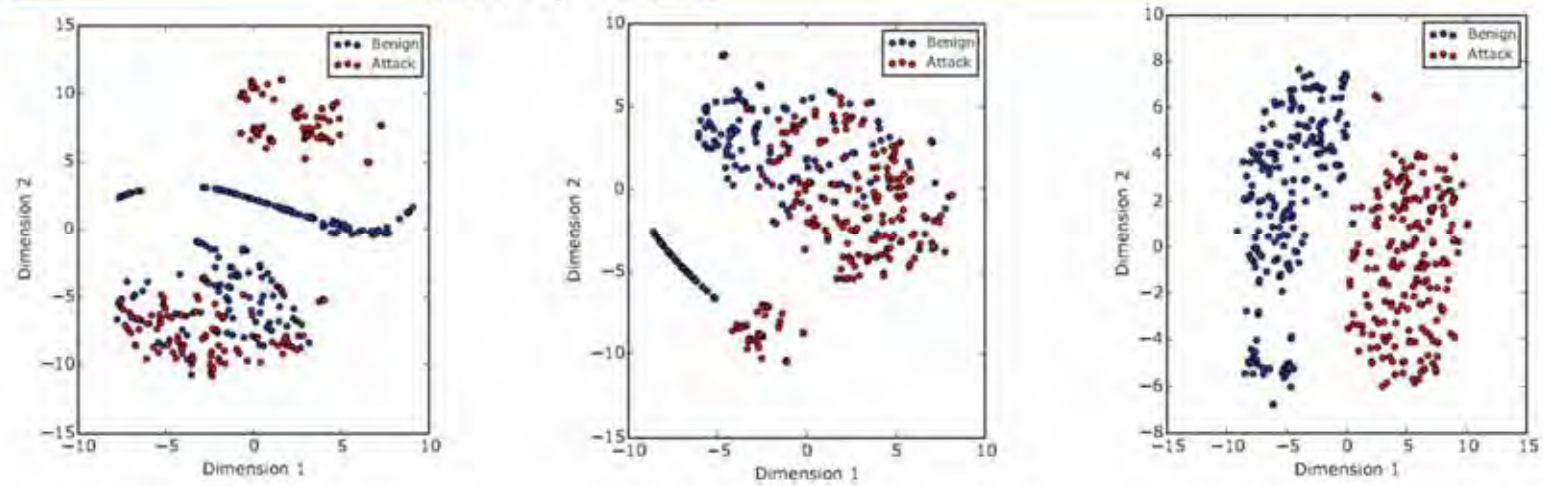


Example #2: Intelligently Deceptive Firewalls

Drs. Kevin Hamlen & Latifur Khan

- **Main idea: Treat detected attacks as *pen-testing opportunities*. Rather than disconnect, return deceptive responses that trick attackers into revealing their TTPs and obfuscation strategies.**





Adversarial Machine Learning: A Game Theoretic Approach (Prior ARO Research)

Dr. Murat Kantarcioglu et al.

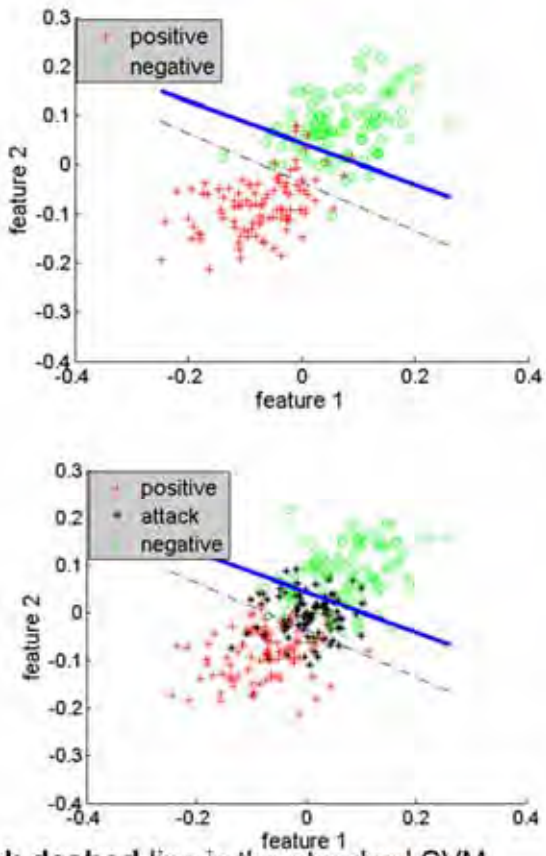
Project Goal: Develop innovative adversarial machine learning tools using a game theoretic framework.

Accomplishments:

- Developed novel support vector machine resistant to adversarial attacks
- Developed ensemble of classifiers that are resistant to multiple attacks (PAKDD best paper award)
- Developed game theoretic feature selection framework

Anticipated Future Army Impact:

- Adversarial Machine learning tools that are more resistant to manipulation
- Choosing features that are useful for more robust machine learning model building



black dashed line is the standard SVM classification boundary, and the blue line is the Adversarial SVM (ADV-SVM) classification boundary

Adversarial Unsupervised Learning (Current ARO Research)

Dr. Murat Kantarcioglu et al.

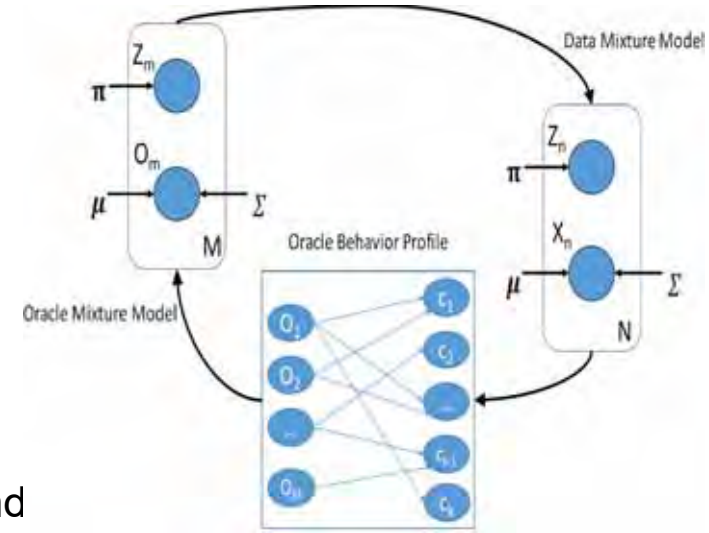
Project Goal: Develop innovative adversarial unsupervised learning and active learning to defeat malicious manipulations and attacks

Addressing the Scientific Barrier: The results will address important scientific questions such as how to build a resilient and robust information infrastructure for cyber situation awareness framework that leverages unsupervised learning-based intrusion detection, and how to incorporate human input for intrusion detection and prevention.

Approach:

- Perform *leader vs. follower game theoretic study for Gaussian mixture model*
- Based on game theoretic results, come up with optimal "defensive wall" that protects against attacks
- Develop active learning techniques that are resistant to adversarial manipulation by exploring duality between data modeling and adversarial oracle modeling

Adversarial Active Learning



Human / Machine Collaboration for Cyber Deception (Current ARL Collaboration)

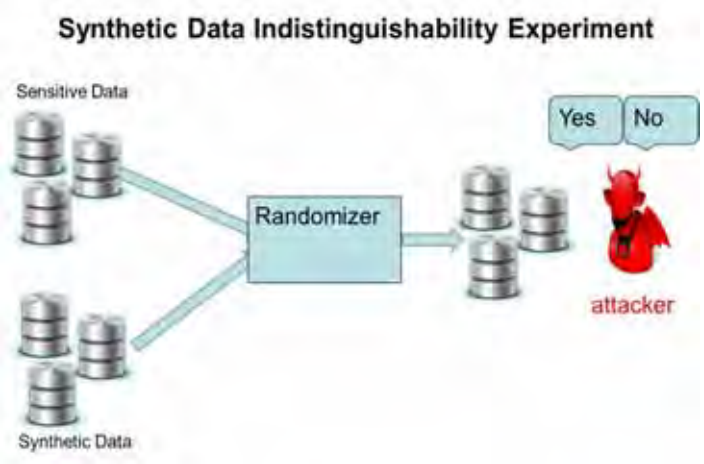
(Current ARL Collaboration with Dr. Jonathan Bakdash, Murat Kantarcioglu, Daniel Krawczyk and Jennifer Holmes et al.)

Project Goal: Understand cyber deception techniques especially in the context of human and machine interaction (e.g., machine learning- based spam detection, combined with human clicking on emails in spam that passed the spam detection)

Addressing the Scientific Barrier: Understand how deception impact humans and machine learning-based systems. What type of deceptions are more effective against humans? How to help humans using machine learning? How to help machine learning models using humans?

Approach:

- Human subject experiments on Amazon Turk for understanding impact of deception techniques
- Synthetic deceptive data generation using deep learning techniques to understand deception better



Artificial Intelligence / Machine Learning Research to Address Army Needs

Drs. Vibhav Gogate, Sriraam Natarajan and Nicholas Ruozzi

- **Army Needs**
  - **Explainability and programmability for AI and ML**
  - **AI & ML with integrated quantitative models**
  - **AI & ML with highly heterogenous data**
  - **AI & ML with small samples, dirty data, high clutter**

- **UT Dallas Research**
  - **Explainable AI (DARPA grant)**
  - **Communicating with Computers (DARPA grant)**
  - **Statistical Relational Artificial Intelligence**
  - **Hybrid Probabilistic Models for handling noise and uncertainty**
  - **Human guided learning for knowledge rich, data scarce domains**
  - **Some of the research funded by ARO YIP and other ARO grants**

Intrusion Detection for IoT

Dr. Alvaro A. Cardenas

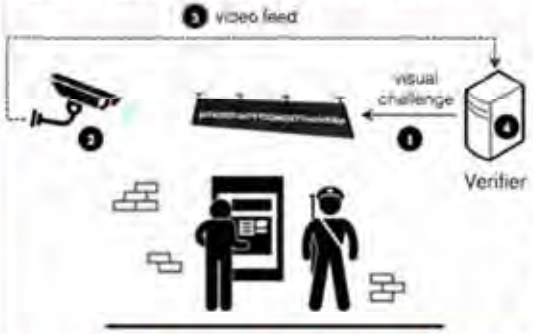
Research:

Intrusion Detection Systems (IDS) in IoT by monitoring the "physics" of cyber-physical systems

Sponsors:

NIST MITRE NSF intel

Example 1: Visual Challenges verify that video feed hasn't been modified

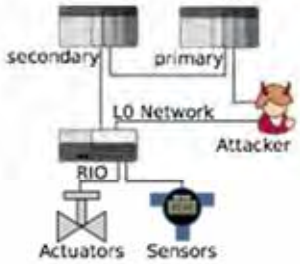


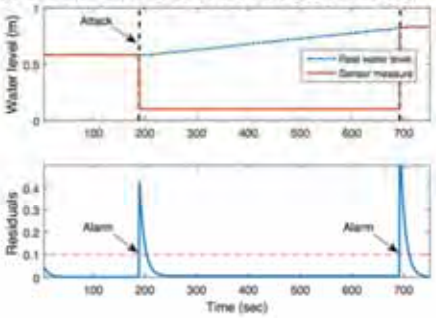
If image captured by camera does not show our challenge, we detect an attack

Second Place: ACM student research competition GHC 2015

Example 2: IDS for SCADA systems

Deployment in two water treatment facilities





Example 3: IDS for AMI

Best Paper Award IEEE Smart Grid Communications Conference 2014

Trustworthy Analytics SGXRand: Securing Data Analytics on SGX with Randomization

Dr. Khan et al.

Laboratory to be developed with part of ARO DURIP Grants

- Motivation
  - Naïve computation within an SGX enclave suffer from side channel attacks.
  - Existing defenses against this attack are computationally expensive, i.e., they result in large computational overhead.
- Objective
  - Reduce computational overhead with a tradeoff in privacy, particularly on analytical models with the underlying representation as a tree.
  - Evaluate privacy trade-off vs. computational efficiency.
- Threat Model
  - Trained model evaluated on untrusted third-party resource.
  - Test data provided by the user.
  - User is not an adversary.

- Approach
  - Idea: Contaminate execution traces observed by adversary.
  - Generate dummy data instances similar to given test instances.
  - Use data oblivious shuffle before model evaluation to hide identity of data from adversary, and use oblivious comparison to ignore results of dummy instances.
  - Use evaluation algorithm as is, but hide model tree structure using dummy nodes.
- Evaluation
  - Attacker can observe memory traces on execution.
  - Privacy Guarantee: Ratio of fake traces and total traces.
  - Large reduction in time overhead (> 50%) compared to fully oblivious solution, with small loss in privacy.
  - Security evaluation using Intel Pintool confirms finding.

Chandra, Swarup, Vishal Karande, Zhiqiang Lin, Latifur Khan, Murat Kantarcioglu, and Bhavani Thuraisingham. "Securing data analytics on SGX with randomization." In *European Symposium on Research in Computer Security*, pp. 352-369. Springer, Cham, 2017.

THE UNIVERSITY OF TEXAS AT EL PASO

25,000 Students

80% Hispanic American

>85% Regional

7.5% International (2/3 Mexican Nationals)

Existing Connections

Department of Defense

- ARO/ARL
- AFOSR/AFR
- DARPA
- MDA
- ONR
- OSD
- SOCOM

Intelligence Community

- CIA
- DHS
- DIA
- DOE
- DOJ
- FBI
- NGA
- NRO
- O/DNI

Special Faculty Connections

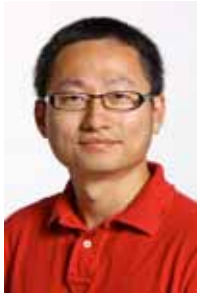
- **Dr. Ann Gates:** Naval Research Advisory Committee
- **Dr. Ryan Wicker:** NRC Panel on Mechanical Science and Engineering at the Army Research Laboratory
- **Dr. Raymond (Tipper) Rumpf:** DARPA Young Investigator

Awards and Recognitions

- **DNI:** IC/CAE National Security Studies Institute
- **NSA:** National Center of Academic Excellence in Cyber Defense
- **NSA:** National Center of Academic Excellence in Cyber Operations
- **NSA/DHS:** National Center of Academic Excellence for Information Assurance Education
- **NSF/DHS:** Scholarships for Service Program (Cybersecurity)

WM Keck Center for 3D Innovation

- 30,000 sf facility: w/ >60 devices from nanoscale to BAAM
- Satellite Center of America Makes
- Hybrid Additive Manufacturing (AM)
- 3D Printed Electronics
- Polymer, Metal, and Ceramic AM
- AM Material and Process Development
- Biomedical Printing Applications
- Rapid Prototyping & One-of-a-kind production
- DOD-focused AM Training



Dr. Yiron Lin
Keck Center
ylin3@utep.edu

Electromagnetics & Photonics

EM Lab

- Metamaterials & photonic crystals
- Antennas & frequency selective surfaces
- Spatially-variant periodic structures
- Diffractive optics & nanophotonics
- Devices for high power microwaves and extreme environments
- Computational electromagnetics and lithography
- 3D printed electronic devices

Dr. Raymond Rumpf
rcrumpf@utep.edu

Computer Science

- Software Engineering
- Information Assurance
- Data Science & Engineering
  - Big data analytics
- Cyber security
- Cyber operations
- Collaboration through cyber infrastructure
- ARL CyWAR Center
  - Cyber Security through Workshops, Analysis & Research
- NSF Cyber-ShARE Center
- DHS/NSA Academic Center of Excellence in:
  - Cyber Defense
  - Cyber Operations
- NSF/DHS Cyber-Corps® University:
  - Scholarships for Service

Dr. Salamah Salamah
isalamah@utep.edu

Dr. Ann Gates
agates@utep.edu

Electrical & Computer Engineering

- Signal & Image Processing & Analytics
  - Image and data compression,
  - Radar signal processing,
  - Hyperspectral remote sensing
  - Synthetic Aperture Radar
- Materials & Devices
  - Solar cell and device fabrication, memristors
- Electric Power & Energy
  - Smart grid, integration of renewables, pulsed power, energy storage

Dr. Heidi Taboada-Jimenez
hataboada@utep.edu

CRADA, MOU, MOA, etc.

UT System CRADA

- ARL: 4 Joint Work Statements
- ARL South (UTEP, UTSA, UTD, UTA)

UTEP CRADA

- US SOCOM: 1 task proposed
- AMRIID: 1 task (internships)

IDIQ contract

- **ARL/SLAD @ WSMR**
- **Can be used by other agencies with ARL consent**

- Ft. Bliss MOA
- White Sands Missile Range MOU
  - UTEP, NM Tech, NMSU, & UNM
- MSRDC
  - Umbrella cooperative agreement w/ Edgewood Chem Bio Ctr
- IDIQ contract
  - ARL/SLAD @ WSMR
  - Can be used by other agencies with ARL consent

UTEP Contacts for DoD Matters

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Nate Robinson
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915-747-5745

The University of Texas Rio Grande Valley™

RGV Background Information	USA	Hidalgo	Cameron
Population in 2014 (estimate)	323,127,513	849,843	422,135
% change in population April 2010 to July 2016	4.7%	9.7%	3.9%
% of people under 18 years old in 2015	22.9%	33.4%	31.3%
% of people age 25+ with HS or higher/ Bachelor's degree or higher in 2011-15	86.7%/ 29.8%	62.1%/ 16.7%	64.8%/ 16.4%
Median household income, 2010-2014	$53,889	$34,782	$33,266
% of people below poverty level	13.5%	31.1%	32%
Source: US Census Bureau, https://www.census.gov/quickfacts/			

Karen Lozano, PhD
Director NanoTechnology Center of Excellence

UTRGV FACTS

- New institution resulting from the merger of UTPA and UTB
- >27,500 students
- 89% Hispanic
- 92.7% local students (RGV)
- 62% are first generation college students
- Average entry ACT 20
- UTRGV 1st year retention rate 77% (Full Time)
- 4th yr graduation rate, 21.6% (UTPA class of 2011 with a 75.4% 1st yr retention)
- 76% financial aid, 60% Pell grants

Research Expertise

- Magnetoelectric Effects in Perovskite Complex Metal Oxides
- Lithium-ion Batteries
- Synthesis of Conjugated Polymers for Photovoltaics and Electrolyte Gated Transistors (EGTs)
- Homeostasis of Cultured Mammalian Cells in a Nanofiber Environment
- Cellular Imaging Using Persistent Luminescent ZnB'_2O_4 Spinel Nanoparticles
- **Nanofiber Systems**
- **Additive Manufacturing**
- Composite Materials (Shielding of Electromagnetic Interference)

Outreach

Numerous presentations to K-12 in a variety of venues/events: Girls in Engineering, HESTEC week, NEURONS 2017, Mothers-Daughters program, multiple STEM camps and tours of the facilities. >10,000 K-12 students have benefitted from presentations from the MG.

Outreach

MATERIAL™ ADVANTAGE

The Student Program for Materials Science and Engineering

facebook.com/mautrgv/

instagram.com/material_advantage_utrgv/

- Chapter is 2 years old
- Recognized Nationally
- Involves over 300(+) students
- All officers and chairs participate in research
- Focused on helping members conduct research in materials science

Research Opportunities

Research opportunities at UTRGV transform an entire community

Example of Research Outcomes from the NSF PREM

- >120 peer-reviewed articles/proceedings
- >200 oral and poster presentations
- 16 patent applications
- Research opportunities for 231 students (179 UG)
- ***Achieved 100% retention and graduation***
- 48.5% success rate in promoting graduate careers

UTSA®
The University of Texas at San Antonio™

Areas of Research Excellence

Cloud, Cybersecurity, Computing, Analytics & Data Science

Integrated Biomedicine (Neuroscience / Brain Health; Infectious Diseases; Regenerative Medicine)

Advanced Materials & Manufacturing

Social and Educational Policy & Innovation

Sustainable Communities and Critical Infrastructure

BERNARD ARULANANDAM, Ph.D.
Interim Vice President for Research, Economic Development and Knowledge Enterprise
210-458-8176 | MB 2.106 | Bernard.Arulanandam@utsa.edu

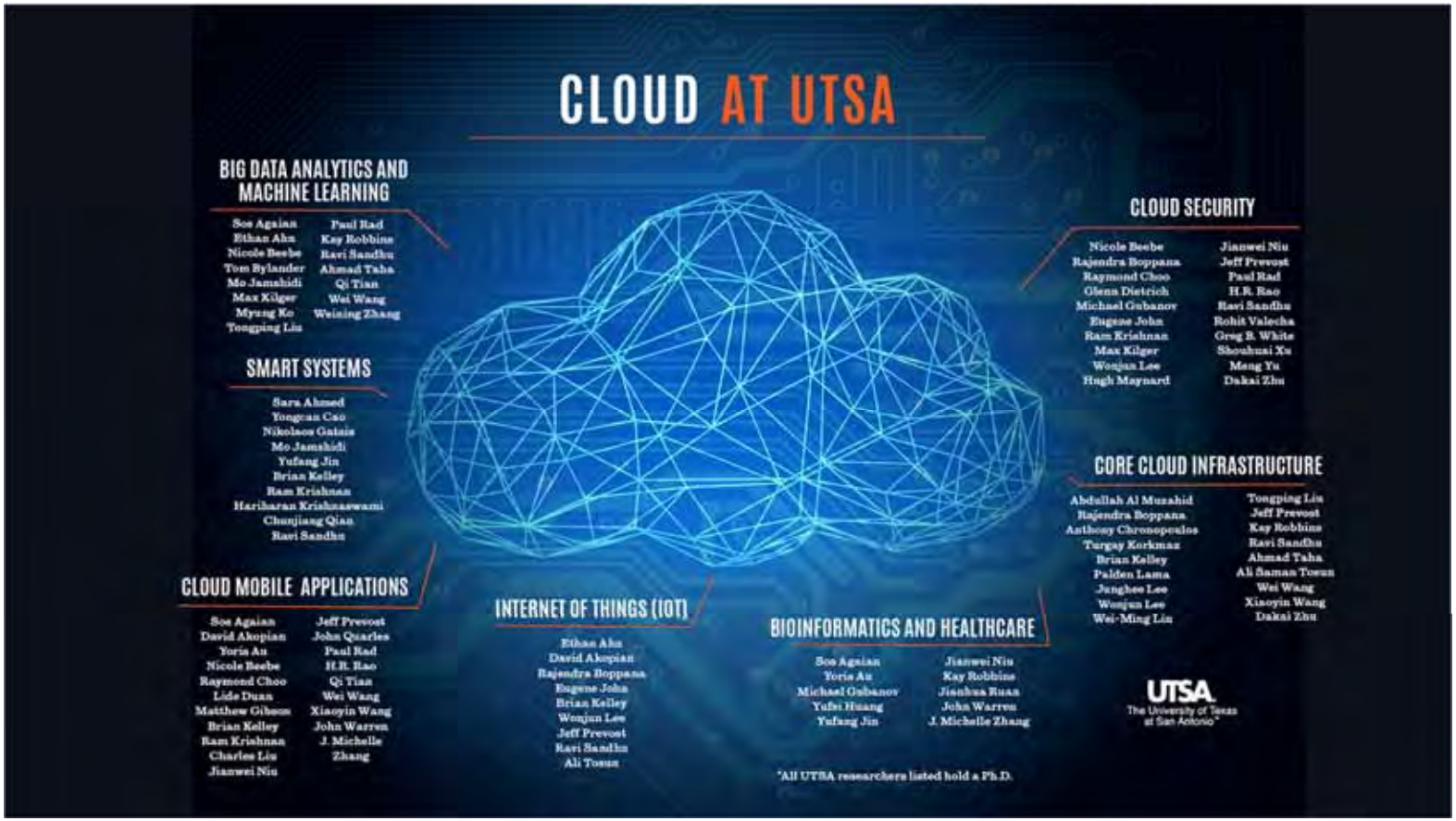
Areas of Research Excellence

Cloud, Cybersecurity, Computing, Analytics & Data Science

- Critical mass of talent: 79 faculty members across three colleges.
- Nationally ranked cyber programs (#1 undergraduate, #2 graduate)
- Embedded in Four Seven Colleges: Architecture and Construction Planning, Business, Education and Human Development, Engineering, Liberal and Fine Arts, Public Policy, Sciences
- $120M+ in sponsored projects since 2000
- Centers of Excellence in Education and Research (DHS & NSA)
- Federal presence on campus:
  - *National Security Agency (NSA)*
  - *Army Research Laboratory (ARL)*

Cybersecurity at UTSA

Cloud at UTSA



Fall 2017: Graduate Certificate in Cloud Computing

Cluster Hiring: Analytics & Data Sciences

- **Dept Management Science & Statistics** (2): Expertise in applied statistics and experience with big data within a multidisciplinary environment
  Dept Information Systems and Cyber Security (1): Expertise in conducting research and developing tangible solutions to security challenges, particularly with the utilization of cyber analytics
  Dept of Marketing (1): Expertise in conducting research and teaching that utilizes sophisticated marketing analytics approaches
- **Dept of Kinesiology, Health and Nutrition** (1): Expertise in biostatistics, epidemiology, health data analytics, public/community health and/or health disparities
- **Dept of Electrical and Computer Engineering** (1): Expertise in machine learning and big data analytics
- **Dept of Sociology** (1): Expertise in social networks or public health
- **Dept of Demography** (1): Expertise in spatial analysis, life course, epidemiology, health and environment
- **Department of Computer Science** (2): (a) Expertise in game-related areas, with a focus on computer graphics and/or human computer interaction and (b) Expertise and interest in cyber security and data analytics

=10 T/TT positions

National Security

UTSA Vision / National Need

Develop the **National Security Collaboration Center** connecting academic, government and industry relationships to catapult the advancement of national security research, education, and workforce development in Texas.

- Providing office space, state-of-the-art research laboratories, and incubator capabilities to both government and industry partners
- Give public and private entities the ability to collaborate on scientific investigation and business enterprise
- Offer companies a competitive advantage for attracting customers, talent, and funding to grow their businesses
- Partners will have expedient **access to UTSA faculty, core research infrastructure, and students**

This initiative is the **next major step in UTSA's path toward national recognition as a research-intensive university** and serves our strategy to ensure UTSA's competitive advantage and reputation as **America's premier national security program**.

NCSS: Regional Cyber Hub

Secured Compartmentalized Information Center

Classified Research/Federal Partners/Contractors

- A sensitive, compartmented information facility (SCIF) to support classified research and information exchange

Cyber Protective Operations Center

Federal Partners

- Operational, research, and training environments for cyber protection operations and investigations

Innovation Factory

Early Stage Technologies/Student & Faculty Start Ups

- A business incubator to assist faculty, students, and external partners in rapidly developing prototypes and concepts to be commercialized for the public good

Research Centers

C3A (Cyber, Cloud Computing and Analytics Research Centers) and Collaborative Research Space

- Access to one of the largest Open Cloud platforms in academia using OpenStack software

Computational Technology

Visualization Labs, High Performance/Cloud Computing, Data Center, Research IT Service Center

- State-of-the-art visualization laboratory for translating data into images for large scale, high resolution digital walls or other devices
- High-performance computing center to support the research and development of algorithms

6. List of Symbols, Abbreviations, and Acronyms

A2I2	Army Artificial Intelligence Institute
AI	Artificial Intelligence
ARL	US Army Research Laboratory
D5	Dirty, Dinky, Dynamic, and Deceptive Data
ERAs	Essential Research Areas
ML	Machine Learning
MRN	Mind Research Network
NASA	National Aeronautics and Space Administration
STEM	Science, Technology, Engineering, and Mathematics