RESEARCH CAPABILITIES
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http://www.ncat.edu/research/overview/index.html

INTRODUCTION: RESEARCH AT N.C. A&T

Our land-grant heritage positions us well for today’s great research challenges – nanotechnology and biotechnology, energy and the environment ... and more.

Our work extends beyond our traditional disciplines of engineering and agriculture, into areas including biomedical research, leadership development, and the social and behavioral sciences.

In emerging and converging disciplines all across the spectrum of science and engineering ... health disparities, aerospace, and computational science, to name a few ... Aggie researchers are creating new knowledge, spurring economic activity, and improving the quality of life for our community and the world.

N.C. A&T faculty and students work in laboratories and in communities, on farms and in cities, on the campus, across the states and around the world. We partner among academic units and disciplines, with other universities, and with corporate and government researchers.

We invite you to learn more about how research at N.C. A&T drives education, community engagement and economic development.

http://research.ncat.edu
aggieresearch.wordpress.com

DIVISION OF RESEARCH AND ECONOMIC DEVELOPMENT

Barry L. Burks, Ph.D., Vice Chancellor
Sanjiv Sarin, Ph.D., Vice Provost for Research, Graduate Programs, & Extended Learning
Mitzi D. Bond, Ed.D., Associate Vice Chancellor for Research Administration
Saundra Y. Evans, M.B.A., Assistant Vice Chancellor for Research Services & Project Mgmt.
Wayne A. Szafranski, M.S., Assistant Vice Chancellor for Outreach & Economic Development

Fort Interdisciplinary Research Center
1601 East Market Street, Greensboro, N.C. 27411, 336 334-7995
An expanded version of this brochure is at http://www.ncat.edu/research/overview/index.html.
Developing new systems, new materials, and new capabilities for missions on the seas, in the air, and beyond.

**FOCUS AREAS**

- Sensors & non-destructive evaluation
- Computational fluid dynamics
- Conventional and fuzzy logic controls and avionics
- Human factors
- Systems engineering
- Small satellite systems

**REPRESENTATIVE PROJECTS**

- Supersonic injection, mixing and combustion for hydrocarbon-fueled scramjets
- Thermal management for high heat flux components using spray cooling and surface enhancement techniques
- Structural performance of affordable composites for stealthy naval ships
- Ultra-lightweight microsystems mechanics
- Integrated topology and multi-scale optimization of protective structures
- Quantitative acoustic emission technique for monitoring hot spots in aging aircraft structures
- Overcoming communication time-delays in spacecraft formation flying

**CENTER FOR AVIATION SAFETY**

Funded by NASA, this center supports the agency’s Fundamental Aeronautics and Aviation Safety programs. Research objectives center on:

- Advanced composites and structures
- Integrated vehicle health management
- Aeromechanics and propulsion.

The center works in partnership with NASA’s Glenn and Langley research centers, major aerospace corporations, academic advisors, and small businesses. The educational objective is to develop a high-quality aerospace engineering graduate program.

**AEROSPACE & TRANSPORTATION SYSTEMS**

**BIOMEDICAL RESEARCH**

Mechanical engineering, materials science, and life sciences come together to create and apply new medical knowledge.

**FOCUS AREAS**

- Alzheimer’s disease
- Health disparities
- Nanomedicine
- Drug-delivery systems
- Mechanical scaffolding for tissues
- Metabolomics
- Proteogenomics
- Biodegradable medical implants

**REPRESENTATIVE PROJECTS**

- Direct-write based micro and nano manufacturing fabrication of diverse applications, including functionally gradient materials, regenerative tissue scaffolds, and bio-chim sensors that lead to next-generation devices and systems
- Merging quantitative proteomics with agricultural & environmental sciences
- Bioactive food compounds with applications in prevention and management of diabetes
- Wheat bran for colon cancer prevention: A targeted metabolomic approach

**NSF ENGINEERING RESEARCH CENTER FOR REVOLUTIONIZING METALLIC BIOMATERIALS**

The ERC is conducting research in biomedical engineering and nanobio applications. Its goal is to generate revolutionary advances in cardiovascular, orthopaedic and craniofacial medicine through technology for biocompatible and biodegradable implants for reconstruction and regeneration.

Research focuses on biodegradable metals (magnesium alloys), biofunctional surface modification, sensors and controlled degradation, and controlled release. A&T is leading a consortium that includes the University of Pittsburgh, University of Cincinnati and Hannover Medical School in Germany.

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Combine bioengineering and new paradigms in agriculture...and you get a land-grant university for the 21st century.

FOCUS AREAS
» Bioengineering
» Bioinformatics
» Sustainable agriculture, conservation agriculture
» Natural resources management

REPRESENTATIVE PROJECTS
» Evaluating the potential of winter legume and grass cover crops for carbon sequestration
» Enhancing urban sustainability through the application of permaculture principles
» Genetic transformation and use of applied plant biotechnology techniques for economic development, rescue of endangered species, and mass-propagation of rare species
» Rapid multiplication of plant species with high economic value
» Tissue culture techniques to produce bioactive compounds, plant-based medicines, and nutraceuticals
» Genetic transformation for biofuel production and value-added crops

BIOTECHNOLOGY & BIO SCIENCES

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NAT CULTURE: MIMICKING NATURE

Natuculture is a term originated by Dr. Manuel Reyes (above) for any human-made system that mimics nature in human-disturbed landscapes. Reyes, professor of biological engineering, is applying the concept in Cambodia and the Philippines to make the unnatural process of farming mimic the natural cycles of tropical rain forests. The practice offers farmers in tropical climates the best chance at maintaining sustainable harvests. It reverses soil erosion and degradation and increases crop yield and profits.

COMPUTER & COMPUTATIONAL SCIENCES

APPLYING THE POWER OF ADVANCED COMPUTING TO THE LIFE SCIENCES, PHYSICAL SCIENCES, AND TO COMPUTER SCIENCE ITSELF.

FOCUS AREAS
» Big data
» Social networking
» Evolutionary biology of organic and inorganic systems
» High-performance reconfigurable computing
» Computational modeling in non-physical domains and in physical and engineering sciences
» Data center operations and efficiency

REPRESENTATIVE PROJECTS
» Ph.D. program in computational science and engineering
» Center for Autonomous Control and Information Technology
» DataBridge: A sociometric system for long-tail science data collections
» Social network analysis and simulation systems
» A novel framework for community detection in large networks
» Improving the availability, reliability, cost efficiency of data centers
» Remote and reconfigurable computing environment

DataBridge is an e-science collaboration environment tool to assist scientists in searching for relevant data sets and collaborators. Scientists are creating millions of data sets, describing an increasingly diverse matrix of social and physical phenomena; this data boom continually shrinks the chances of an individual, unaided scientist finding all data relevant to a particular line of investigation. The DataBridge project is exploring a rich set of socio-metric tools and relevance algorithms and adapting them for defining different types of semantic bridges that link datasets and for semantically linking large numbers of diverse data into a socio-mapping network.

DataBridge: A Sociometric System for Long-Tail Science Data Collections
DEFENSE & NATIONAL SECURITY

Countering real-world and virtual threats and vulnerabilities at the national level, the community level, and the individual level.

FOCUS AREAS
- Cybersecurity
- Biometrics
- Information assurance
- Food security
- Border security
- Infrastructure protection
- Autonomous agents
- Modeling and simulation
- Network survivability
- Humanitarian logistics

REPRESENTATIVE PROJECTS
- Center for Advanced Studies in Identity Sciences
- Center for Cyber Defense
- Understanding network survivability under WMD attack
- Immunological techniques for food security
- Development of integrated food protection and defense education
- Engineering efficient and equitable food distribution under uncertainty
- Quantifying food-supply vulnerability

ENERGY & THE ENVIRONMENT

Basic and applied research in alternative energy and in sustainability ... in nature and in the built environment.

FOCUS AREAS
- Sustainable agriculture and natural resources management
- Bioremediation and waste management
- Energy efficiency, conservation and control
- Advanced multi-scale computational algorithms
- Climate change
- Sustainable energy
- Bioenergy and bioproducts
- Hydrogen fuel and fuel cells
- Solar power

REPRESENTATIVE PROJECTS
- NSF CREST Bioenergy Center
- Center for Energy Research and Technology
- Ph.D. program in Energy and Environmental Systems
- Waste Management Institute
- Interdisciplinary research in climate change and its social and economic impacts

CENTER FOR ADVANCED STUDIES IN IDENTITY SCIENCES

The center researches novel ways to solve the unconstrained biometrics problem centered on the face and head. The focus is on techniques that exploit the tightly coupled face, panocular, and iris, and the fusion of facial attributes to improve recognition results and to enforce sanity checks on recognition.

A second focus area is protection and privacy associated with cyber and mobile identity: Can identity be discovered via social media mining? How does one protect against the discovery of their identity? What other elements can be discovered about someone, and how can this be protected?

NSF CREST BIOENERGY CENTER

The Bioenergy Center conducts fundamental research toward the development of advanced thermochemical biomass conversion technology for the efficient, economic production of liquid transportation fuels and hydrogen. The center is working to make biomass a more viable source of renewable energy by developing basic science and technology that will make energy conversions more efficient and affordable.

Research thrust areas are 1) gasification of biomass, 2) developing specific catalytic materials and processes for clean biofuels and hydrogen production applications, and 3) fuel processing and reforming technologies for hydrogen production and separation as H₂ fuel with applications in proton-exchange membrane fuel cells.

The center’s work includes a cross-cutting economic assessment focusing on the relative profitability of the technologies.
Unlocking the potential for safer and healthier food and for food components that can help prevent disease.

FOCUS AREAS
- Global food security and hunger
- Metabolomics
- Food processing
- Food safety
- Food science and nutrition
- Functional foods
- International agricultural trade
- Animal science

REPRESENTATIVE PROJECTS
- Center for Excellence in Post-Harvest Technologies
- Bioactive food compounds for prevention and management of diabetes
- Ginger extract: Bioavailability and lung cancer preventive effect
- Carnosic acid enriched rosemary extract and its active components reduce weight gain and type 2 diabetes
- Controlling viral foodborne disease
- Grape pomace as a potential functional food ingredient for obesity prevention and weight control.

The center’s research adds value to agricultural commodities by finding new ways to make food safer, extend shelf life and preserve health promoting nutrients. It is located at the North Carolina Research Campus (NCRC) in Kannapolis and is working with academic partners there to expand into diverse areas such as nutrigenomics and metabolomics.

A&T is one of eight universities with facilities at the NCRC, a $1 billion, 350-acre biotechnology research park.

FOOD SCIENCE

HUMAN HEALTH, NUTRITION & WELLNESS

Strengthening the ability of science and society to improve health, well-being and quality of life for all people.

FOCUS AREAS
- Counseling
- Health disparities
- Childhood obesity
- Health and education interventions
- Health disciplines
- Health promotion and disease prevention
- Human performance
- Substance use

REPRESENTATIVE PROJECTS
- Center for Behavioral Health & Wellness
- Center for Outreach in Aging and Community Health
- Ph.D. program in rehabilitation counseling
- Genetic epidemiology of Alzheimer’s disease
- Six Sigma in public health clinics: Improving health outcomes
- Access to comprehensive health care for Guilford County
- Creating healthy communities through improved access to fresh produce

The center provides community-focused, evidence-based, and culturally competent services through the integration of best-practice research, training, and technical assistance.

The multidisciplinary team’s research focuses on participatory applied research in partnership with community agencies.

CENTER FOR EXCELLENCE IN POST-HARVEST TECHNOLOGIES

CENTER FOR BEHAVIORAL HEALTH & WELLNESS

Research and program evaluation
- Longitudinal research
- Community-based needs assessments
- Database creation and analysis
- Survey development
- Evaluation consultation and logic modeling
- Program evaluation
Faculty and students putting research into practice on city streets, country roads and in communities ready to create their future.

**FOCUS AREAS**
- Business development
- Economic development
- Economic empowerment
- Housing and infrastructure
- Leadership development
- Leadership for young African American men

**REPRESENTATIVE PROJECTS**
- Ph.D. program in leadership studies
- Community Empowerment Network of North Carolina
- Community empowerment and sustainable workforce development initiative
- Urban Education Institute (annual conference)
- Enhancing land stewardship by socially disadvantaged beginning farmers and ranchers
- Sustainable energy and economic development of rural communities: The green alternative

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**COMMUNITY EMPOWERMENT NETWORK OF NORTH CAROLINA**

Twelve pastors in Eastern North Carolina joined together to create the network in 2005. Located in seven counties across the region, they worked to advance their communities through economic development, education, and reduction of African Americans' health disparities. In 2007, they began a partnership with Dr. Forrest Toms of the Department of Leadership Studies. He initially helped develop a community development and capacity building program. Now, he and his Ph.D. students have been joined by the School of Technology and colleges of Engineering and of Arts and Sciences. A&T researchers now are delivering a distance-learning program, technical assistance, and other services. As a result, the network has been able to launch new programs, including job creation and STEM training. And to grow to 50 churches in 16 counties.

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**NANOTECHNOLOGY & MULTI-SCALE MATERIALS**

The workings, wonders, and endless surprises of matter at a level beyond reach, and imagining, a generation ago.

**FOCUS AREAS**
- Nano-, bio-, electronic, composite, polymeric, smart, and metallic materials
- Materials characterization and testing
- Modeling and simulation
- Nano and composite manufacturing
- Advanced and smart materials
- Biomaterials and regenerative engineering
- Nanoengineered materials
- Nanoscience and nanoengineering
- Cross-cutting applications

**REPRESENTATIVE PROGRAMS**
- Joint School of Nanoscience and Nanoengineering
- Ph.D. program in nanoengineering
- NSF Engineering Research Center for Revolutionizing Metallic Biomaterials
- High performance computing and enabling technologies for nano- and bio-systems and interfaces
- Cell-based toxicity assay-on-chip for next-generation CMOS technology

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**JOINT SCHOOL OF NANOSCIENCE & NANOENGINEERING**

What’s a greater feat: Unlocking the mysteries of nanotechnology or getting two very different universities to work together to create a scientific landmark? It’s an academic question, because N.C. A&T and UNC Greensboro are doing both with ground-breaking results. The Joint School offers A&T’s two advanced degrees in nanoeengineering and UNCG’s two in nanoscience. And it offers engineers and scientists common ground, literally and figuratively, to work together on such advanced research as nanomedical applications, material science requirements, and fabrication processes. For a selected list of equipment in use at the Joint School, see Page 14.
Brain and behavior, ethics, language and culture, economics, education: Understanding ourselves and each other.

FOCUS AREAS
» Cognitive science
» Cultural studies
» Ethics
» Interactive research in the arts
» Rehabilitation counseling
» Social systems
» Socio-economic, cultural, and political disparities
» Teaching tools and practices

REPRESENTATIVE PROJECTS
» Rehabilitation counseling Ph.D. program
» Academy of Teaching and Learning
» Culturally responsive instruction: Lesson design and delivery - A national dialogue
» Workforce development and addiction counseling
» Racial identity themes in television situation comedies
» Changing societal attitudes toward water scarcity
» Civic, community and political engagement among emerging adults

The doctoral counseling program is increasing the number of rehabilitation counselor educators by preparing culturally competent students to work as counselor educators, researchers, clinicians, and supervisors in academia. The curriculum includes rehabilitation counseling and behavioral addictions, vocational evaluation and work adjustment, marriage and family, counseling, crisis management and conflict resolution, rehabilitation psychology and behavioral medicine.

An interdisciplinary approach to mastering time and distance to meet human needs and business demands.

FOCUS AREAS
» Disaster relief
» Global transportation
» Manufacturing logistics
» Resource scheduling
» Supply chain strategy
» Warehousing and distribution
» Planning for disasters affecting transportation systems

REPRESENTATIVE PROJECTS
» Transportation Institute
» Maritime domain awareness and coastal/port security
» A supply chain management view of the humanitarian relief chain
» Engineering efficient and equitable food distribution under uncertainty
» Interactive simulation model for evaluating the impact of port disruptions
» Quantifying vulnerability in food supply
» Small Business Transportation Resource Center
» Economic contributions of N.C. ports

The institute is an interdisciplinary research, training, and technology transfer unit that draws faculty, staff, and students from the School of Business and Economics, the College of Arts and Sciences, the College of Engineering, and units throughout the University. The Transportation Institute serves as a national, regional, and local clearing-house for transportation education, research and outreach; offering seminars, workshops, lectures, publications, and other information for public and private transportation practitioners, decision-makers and the general public.

TRANSPORTATION & LOGISTICS

TRANSPORTATION INSTITUTE
One of the best ways of teaching is research. One of the most powerful impacts of research is education.

REPRESENTATIVE PROGRAMS
- Collaborative Earth systems science research: Atmospheric modeling, sensing and societal impacts
- Undergraduate Research Scholars Program (School of Agriculture and Environmental Sciences)
- Innovation Challenge (annual competition for undergraduates)
- North Carolina Louis Stokes Alliance for Minority Participation (faculty-mentored research in STEM fields and annual conference)
- Minority Access to Research Careers Program (biomedical and behavioral sciences)
- MBRS Research Initiative for Scientific Enhancement (research in biology, chemistry and psychology for students interested in graduate studies in biomedical sciences)
- iBLEND (biomathematical research)
- iCUBED (systems biology)
- Ronald E. McNair Research Symposium (annual event)

UNDERGRADUATE RESEARCH

The next generation of researchers and leaders in engineering and science is working in our labs today.

PH.D. PROGRAMS
- Computational Science and Engineering
- Computer Science
- Electrical Engineering
- Energy and Environmental Systems Concentrations: Atmospheric Sciences Sustainable Bioproducts Energy and Environmental Science and Economics
- Industrial and Systems Engineering
- Leadership Studies
- Technology Management (Joint with Indiana State University)
- Mechanical Engineering
- Nanoengineering
- Rehabilitation Counseling & Rehabilitation Counselor Education Education
- Master’s Programs
- MA English & African American Literature
- MAEd Elementary Education
- MAEd Reading Education
- MAT Master of Arts in Teaching
- MS Adult Education
- MS Agricultural Education
- MS Agriculture & Environmental Systems
- MS Applied Mathematics
- MS Bioengineering
- MS Biology
- MS Chemical Engineering
- MS Chemistry
- MS Civil Engineering
- MS Computational Science & Engineering
- MS Computer Science
- MS Electrical Engineering
- MS Food and Nutritional Science
- MS Health and Physical Education
- MS Industrial & Systems Engineering
- MS Information Technology
- MS Instructional Technology
- MS Management
- MS Mechanical Engineering
- MS Mental Health Counseling
- MS Nanoengineering
- MS Physics
- MS School Counseling
- MS Technology Management
- MSA School Administration
- MSW Social Work (Jointly with UNCG)
AVAILABLE TECHNOLOGIES

- Remediation using controlled release biodegradable polymers
- Food-grade process for the inactivation of peanut allergens
- Method for selectively sized direct-write micro- or nano-manufacturing
- Densifying carbon-carbon composites using fewer carbonization cycles
- Highly sensitive, temperature-independent differential pressure sensor
- Improvements in the preparation of palladium thin films
- Acoustic emission sensors for non-destructive monitoring of structures including composites
- Enhancing membrane flux in cross-flow filtration
- Newly configured building materials for temporary, structurally robust modules
- Production of carbon nanofibers from Alkali (Kraft) lignin
- Accelerated growth of Alexandrian laurel
- Aspirin conjugates as novel therapeutics
  - Therapeutics derived from ginger metabolites
- Increasing the fiber content of foods without affecting texture or taste

COMPANIES SPUN OFF FROM N.C. A&T

Bioadhesive Alliance: Produces a low-cost and durable adhesive that reduces the amount of petroleum needed in asphalt. It is a green product, obtained from swine manure. It gives pavement greater water resistibility and temperature tolerance. And it provides a use for one of the state’s most problematic waste materials.

Advaeero Technologies: Provides low-cost, high-quality carbon composite materials, components, and assemblies to the military, experimental, and commercial aircraft industries. Advaeero began by reverse-engineering and testing stronger and lighter components for the U.S. Marines’ out-of-production CH46 helicopter.

OUTREACH AND COMMUNITY ENGAGEMENT

EDUCATION OUTREACH

- Engineering Research Center Young Scholars Program (high school)
- Summer Bioengineering Institute (high school students and teachers)
- Summer High School Transportation Institute
- N.C. DOT Summer Internship Program
- Research Apprenticeship Program (high school students)
- Research experiences for teachers and other professional development

COMMUNITY ENGAGEMENT

- Health Care Access in Guilford County, a white paper commissioned by Cone Health Foundation.
- Community Empowerment Network (Eastern North Carolina), see Page 10.
- Center for Behavioral Health and Wellness (Greensboro), see Page 9.
- Community Empowerment & Sustainable Workforce Development Initiative (Greensboro), Workforce development for low-income adults in energy efficiency, green construction, and weatherization.
- Conservation Agriculture for Food Security (Cambodia and the Philippines)
- Malawi Leadership Program

N.C. A&T COOPERATIVE EXTENSION

Cooperative Extension provides research-based educational programs and information to individuals, families and communities. The program focuses on:

- Sustaining agriculture and forestry;
- Protecting the environment;
- Maintaining viable communities;
- Developing responsible youth; and
- Developing strong, healthy, and safe families.

Extension specialists on campus provide training and technical assistance to agents and paraprofessionals working in counties across North Carolina. These county personnel work one-on-one with the families and individuals in the various programs.
ADMINISTRATION
The Division of Research and Economic Development (DORED) administers N.C. A&T’s research enterprise. DORED provides services to faculty and student researchers, to current and potential research partners, funding agencies, and economic development agencies.

FORT INTERDISCIPLINARY RESEARCH CENTER
DORED is located in an 81,000 square foot building dedicated to research. The Fort IRC contains labs for the Engineering Research Center, Center for the Advanced Study of Identity Sciences, Center for Aviation Safety, and other projects. The design of the building focuses on creating architectural spaces that foster collaboration and encourage interaction among the various occupants of the center.

DATABASE OF RESEARCHERS
REACH NC is a Web portal for experts and assets at N.C. A&T and other North Carolina higher education and research institutions. REACH NC’s expert profiles can assist industry, community groups and university personnel in efforts to find information and potential collaborators for research and problem-solving.

http://reachnc.org/

BASIC RESEARCH: PHYSICS & ASTRONOMY
As a land grant university, N.C. A&T emphasizes applied research. But basic research has an important place as well. The Department of Physics, for example, conducts basic research in both nuclear physics and astronomy. That work benefits from access to outstanding off-campus facilities, both nearby and far away. Faculty and student physicists have access to the Thomas Jefferson National Accelerator Facility in Virginia and the Triangle Universities Nuclear Laboratory at Duke University in Durham. Astronomy research can be conducted at the Three Universities Observatory in neighboring Alamance County and at the Cerro Tololo Inter-American Observatory in Chile. A partnership with UNC-CH has opened opportunities at the National Radio Astronomy Observatory in West Virginia.

ABOUT NORTH CAROLINA A&T
PUBLIC, LAND-GRA nt UNIVERSITY
» Constituent institution of The University of North Carolina
» Historically black university
» Ranked No. 1 among public HBCUs by U.S. News and World Report
» Founded: 1891

POINTS OF PRIDE
» College of Engineering ranks No. 1 in degrees awarded to African Americans
» School of Agriculture and Environmental Sciences is the largest among historically black universities
» Ranks third in sponsored funding among UNC institutions

LOCATION
» In the city of Greensboro in the Piedmont Triad region of central North Carolina
» 300 miles south of Washington, D.C., and 350 miles north of Atlanta.

RESEARCH PARK
» 150-acre Gateway University Research Park, split into two campuses of 75 acres each. Founded and operated with UNC Greensboro.

COLLEGES AND SCHOOLS
» College of Arts and Sciences
» College of Engineering
» School of Agriculture and Environmental Sciences
» School of Business and Economics
» School of Education

» School of Nursing
» School of Technology
» Joint School of Nanoscience and Nanoengineering (founded and operated with UNC Greensboro at the Gateway University Research Park south campus)