NC State Engineering

Louis A. Martin-Vega, Ph.D.
Dean of Engineering
NC State University

NC State

- 34,000 students
- #8 best value among US public universities
- $400M in sponsored research in 2016
- 100+ Startup companies
- 800 active patents
- Centennial Campus
- 50 Research Centers
NC State Engineering

- 10,000+ undergraduate and graduate students
- 24th nationally in US News Graduate Rankings
- 12th among public engineering colleges in US News rankings
- $206 million in annual research expenditures
- 21 Research Centers

College of Engineering

Departments
Biomedical Engineering
Chemical and Biomolecular Engineering
Civil, Construction, and Environmental Engineering
Computer Science
Electrical and Computer Engineering
Edward P. Fitts Industrial and Systems Engineering
Materials Science and Engineering
Mechanical and Aerospace Engineering
Nuclear Engineering

Affiliated Departments in other colleges
Biological and Agricultural Engineering
Forest Biomaterials
Textile Engineering, Chemistry and Science
Students

Fall 2017 Enrollment
- Undergraduate 6,876
- Master’s 2,072
- PhD 1,286

Total 10,239

2016-17 Graduates
- Bachelor’s 1,508
- Master’s 1,027
- PhD 182

Total 2,717

Among all U.S. engineering colleges*
- 9th in BS degrees awarded
- 11th in MS degrees awarded
- 13th in PhD degrees awarded
- 13th in Undergraduate enrollment
- 7th in Total enrollment

* ASEE Profiles 2015

Faculty

- 300+ tenured and tenure-track faculty members
- 17 members of the National Academy of Engineering
- 2 National Medal of Technology and Innovation recipients
- 2 North Carolina Award for Science recipients
- 1 US Army Commander’s Award recipient
- 1 Emmy Award winner
- 3 National Inventors Hall of Fame members
- 6 National Academy of Inventors members
- 3 among AIChE 100 Engineers of the Modern Era
- 40 NSF CAREER Awards since 2006, or 4 per year on average
- 1 Presidential Early Career Awards for Scientists and Engineers (PECASE)
- 5 Presidential Mentoring (PAESEM) Awards
Research expenditures have grown from $129 million to more than $206 million, or 60 percent since 2009-10.

10th overall in the US in total research expenditures*

*ASEE 2017 data

NAE Grand Challenges for the 21st Century

- **Sustainability**
  - make solar energy more economical
  - provide energy from fusion
  - develop carbon sequestration methods
  - provide access to clean water
  - manage nitrogen cycle

- **Health**
  - advance health informatics
  - engineer better medicines
  - reverse-engineer the brain

- **Security**
  - restore and improve urban infrastructure
  - prevent nuclear terror
  - secure cyberspace

- **Joy of Living**
  - enhance virtual reality
  - advance personalized learning
  - engineer the tools of scientific discovery
Emphasis on the integration of research and education

COE STRATEGIC VISION

- Engineering Health Systems
- Bioengineering
- Nanotechnology
- Robotics & Sensor Technology
- Advanced Materials & Manufacturing
- Energy & Environmental Systems
- Transportation & Logistics
- Information & Communications Technology
- Security & Critical Infrastructure

NSF ENGINEERING RESEARCH CENTER COMPETITION

- Highest level of competition among colleges of engineering for National Science Foundation (NSF) funding
- Largest and most prestigious awards offered by the NSF Engineering Directorate … $40 million over 10 years
- 100+ universities compete in first round
- 16 or fewer are site visited
- 8 or fewer are invited for Blue Ribbon Final Competition
- 4 or fewer are eventually awarded
NSF ENGINEERING RESEARCH CENTER COMPETITION

• In its history, NC State has received three NSF ERCs
• 1988 – Center for Advanced Electronic Materials Processing (AEMP)
• 2008 – Center for Future Renewable Electric Energy Delivery and Management (FREEDM) Systems
• 2012 – Center for Advanced Self-Powered Systems of Integrated Sensors and Technologies (ASSIST)
• NC State is one of only two universities currently leading two ERCs
• NC State is one of only two universities ever to receive three ERCs

FREEDM Systems Center

NSF Engineering Research Center for Future Renewable Electric Energy Delivery and Management (FREEDM) Systems

• Center Director: Dr. Iqbal Husain
• “Top 10 Emerging 21st Century Technologies” ~MIT Technology Review
• Creating the “Internet for Energy” for renewable energy generation and storage
• Leader in development of smart grid technologies
• Catalyst for numerous clean tech energy companies in NC
Next Generation Power Electronics Innovation Institute (PowerAmerica)

- Dept. of Energy National Network for Manufacturing Innovation led by NC State
- $70M grant from U.S. Department of Energy
- $70M matching from state government, universities and industry
- Advanced manufacturing of wide bandgap semiconductors
- Spinoff from FREEDM Systems Center
- Enabler of smart grid and other technologies

ASSIST: Transforming US and Global Health Informatics

NSF Nanosystems Engineering Research Center for Advanced Self-Powered Systems of Integrated Sensors and Technologies (ASSIST)

- Center Director: Dr. Veena Misra
- Potential $40 million ten-year grant from NSF
- Awarded in 2012 and unconditionally renewed in 2015 for another five years
- Developing and employing nano-enabled devices and sensors to create innovative, battery-free, body-powered, and wearable health monitoring systems
- Currently has 33 industry partners
NC STATE Engineering

CASL: The Consortium for Advanced Simulation of Light Water Reactors
A DOE Energy Innovation Hub for Modeling & Simulation of Nuclear Reactors

- Renewed for a 2nd 5-years at $121.5 million in 2015
- Mission: Reduce capital & operating costs - Reduce nuclear waste – Assure nuclear safety
- Vision: Create a virtual reactor for predictive simulation of Light Water Reactors

NC State Leaders
Chief Scientist for CASL: Dr. Dave Kropaczek
CASL Education Director: Dr. Mike Doster

Core National Lab Partners
- Idaho National Laboratory
- Los Alamos National Laboratory
- Oak Ridge National Laboratory
- Sandia National Laboratories

Core Corporate Partners
- Tennessee Valley Authority
- Electric Power Research Institute
- Westinghouse Electric Company

NC State Leaders

CASL Education Director: Dr. Mike Doster

Core University Partners
- NC State University (Lead)
- University of Michigan
- MIT

NC STATE Engineering

Consortium for Nonproliferation Enabling Capabilities
A research and education hub for the development of enabling technologies and technical talent for meeting the grand challenges of nuclear nonproliferation

- 4 National Lab partners: ORNL, LANL, PNNL and LLNL
- Six University Partners:
  - University of Michigan
  - University of Illinois
  - NC A&T State University
  - Purdue University
  - Georgia Tech
  - Kansas State University

- Five-Year, $25 million, National Nuclear Security Administration grant
- NC State is the lead institution
- Leadership:
  - Dr. Yousry Azmy, Director
  - Dr. Robin Gardner, PI and Chief Scientist
  - Dr. John Mattingly, Co-PI and Technical Director

- 11 NC State faculty and staff in 6 departments from 3 colleges including College of Humanities and Social Sciences and College of Sciences
- Next generation of methods and tools:
  - Detect, locate, identify and characterize Special Nuclear Material (SNM)
  - Identify nuclear proliferation activities
NSA Science of Security Lab (SoSL)

- Based out of Computer Science
  - Led by Dr. Laurie Williams and Munindar Singh
  - 14 supported NC State faculty; 18 supported NC State students
  - Multi-disciplinary: 4 NC State colleges and institutes
  - 6 collaborating university partners
- Other NSA SOSL lablets: Carnegie Mellon, University of Illinois Urbana-Champaign, and University of Maryland
- Projected $2.0-$2.5M funding per year per lablet

Critical cyber systems must inspire trust and confidence, comply with applicable security and other policies, predictably protect the integrity of data and resources as well as the privacy of data owners, and perform reliably and safely. Therefore, a scientific basis for the design, analysis and operation of trusted systems is needed.

Center for Additive Manufacturing and Logistics (CAMAL)

- Support local and national industry interested in Additive Manufacturing
- Membership Center (7 active and 3 in progress)
  - Research projects funded by membership fees
- Industry sponsored research projects
- Federal and State funded research (NSF, DARPA, ONR, AFRL, DOE, DOD...)
- Short courses for industry
- Outreach (local schools, summer camp, Science museum)
- ABB is a member
  - Material development for high thermal and electrical conductivity
Centers, Institutes and Laboratories

- Analytical Instrumentation Facility (AIF)
- Center for Additive Manufacturing and Logistics (CAMAL)
- Center for Dielectrics and Piezoelectrics (CDP)
- Center for Educational Informatics (CEI)
- Center for Nuclear Energy Facilities and Structures (CNEFS)
- Center for Transportation and the Environment (CTE)
- Clean Energy Smart Manufacturing Innovation Institute (CESMII)
- Consortium for Advanced Simulation of Light Water Reactors (CASL)
- Consortium for Nonproliferation Enabling Capabilities (CNEC)
- Constructed Facilities Laboratory (CFL)
- The Ergonomics Center of North Carolina (TECNC)
- Institute for Next Generation IT Systems (ITNG)
- Institute for Transportation Research and Education (ITRE)
- Minerals Research Laboratory (MRL)
- Nanofabrication Facility @ NC State (NNF)
- National Institute for Innovation in Manufacturing Biopharmaceuticals (NIIMBL)
- NSF Nanosystems Engineering Research Center for Advanced Self-Powered Systems of Integrated Sensors and Technologies (ASSIST)
- NSF Engineering Research Center for Future Renewable Electric Energy Delivery and Management (FREEDM) Systems
- NC Clean Energy Technology Center (NCCETC)
- Nuclear Reactor Program (NRP)
- PowerAmerica
- Research Triangle Nanotechnology Network (RTNN)
- Research Triangle MRSEC on Soft Matter
- Water Resources Research Institute (WRRI)

21st Century Infrastructure

More than two-thirds of the College of Engineering is housed on Centennial Campus.

- EB I: Departments of Chemical and Biomolecular Engineering and Materials Science and Engineering
- EB II: Departments of Computer Science and Electrical and Computer Engineering
- EB III: Departments of Biomedical Engineering and Mechanical and Aerospace Engineering
- Biomanufacturing Training and Education Center (BTEC)
- NSF FREEDM Systems Engineering Research Center
- NSF ASSIST Engineering Research Center
Engineering Oval

- New home of
  - Department of Civil, Construction, and Environmental Engineering
  - Edward P. Fitts Department of Industrial and Systems Engineering
  - Dean’s Administration
- $154 million building with state-of-the-art classrooms and laboratories
- Infrastructure support for research in
  - Biomanufacturing
  - Advanced manufacturing
  - Rapid prototyping
  - Health systems in engineering
  - Construction engineering and management
  - Environmental engineering
  - Transportation systems
  - Other fields of great societal impact

Entrepreneurship

- Entrepreneurship Garage provides a space and tools and equipment for students to pursue their ideas and develop new products and new companies.
- Albright Entrepreneurship Living and Learning Village on Centennial Campus promotes innovative and collaborative entrepreneurship among students.
- Students in NC State’s Engineering Entrepreneurs program create solutions that have a global impact, including
  - A fingernail polish that can detect drugs in beverages, giving women a new tool to avoid sexual assault that is going to market this year.
  - The world’s first low-cost tuberculosis test that is now being used in rural India.
  - A tool that makes handling sewage safer and more efficient in third world countries that won $350,000 in Gates Foundation funding.
Minority Engineering Programs

- Summer Transition Program (STP)
- Minority Summer Research Program (MSRP)
- STudent Advancement & Retention Teams (START) Mentoring Program
- E144/E145 (Academic & Professional Development Courses for Freshmen)
- Minority Engineering Student Organizations Advising: (AISES, NSBE and SHPE)
- MEP Overnight Recruitment Stay
- Industry Access to MEP Students

K-12 Outreach

- Reaches >17,000 K-12 students and teachers across the state each year
- Summer camps for elementary through high school located across the state (42 camps in 2015)
- Teacher workshops/Research experience for teachers
- Family Engineering Nights for schools
- Engineering On the Road
- Partnership efforts (Girl Scouts, Marbles Museum, Boys and Girls Club)
- Freshman Engineering Design Day, featuring high school and middle school students
Engineering Economic Development 2012-2016

- 713 Patent Disclosures
- 416 Patents Filed
- 127 Patents Issued
- 34 Start Ups, including
  - 410 Medical, Inc.*
  - Novocor Medical Systems
  - Tribofilm Research, Inc.
  - WarpSpec Diagnostics
  - Atmospheric Plasma Solutions
  - Smart Material Solutions, LLC
  - Undercover Colors
  - ImagineOptix
  - Polymer Braille
  - Lumeova
  - Nicotrax
  - Augment Medical, Inc.

* Just launched first product on February 9, 2017

Long-Term Goal

“To become and be perceived as the leading public college of engineering in the country and one of the premier colleges of engineering in the world”
Our daily commitment to our students is to ensure that the “E” in Engineering truly stands for *Excitement.*