



## NORTH CAROLINA AGRICULTURAL AND TECHNICAL STATE UNIVERSITY

### Description of Research Capabilities

The College of Engineering (CoE) at North Carolina A&T (NCAT) University currently has seven departments including the Electrical & Computer Engineering (ECE), Computer Science (CS), Mechanical Engineering (ME) departments and the Computational Science & Engineering (CSE), Industrial and Systems Engineering (ISE), Chemical, Biological, and Bio Engineering (CBBE), and Civil, Architectural and Environmental Engineering (CAEE).

The College has ranked first in the nation for the number of degrees awarded to African Americans at the undergraduate level for over 13 consecutive years and has been the leading producer of African American female engineers at the baccalaureate level in the U.S. for at least eight consecutive years. The College ranks second in annual research dollars among the four North Carolina public engineering schools.

The COE faculty members have expertise and track records in in STEM education and research and have actively collaborated, co-advised, and co-authored with many different institutions, industries and government agencies.

There are many different centers, institutions, laboratories in the CoE which actively conduct a multi-disciplinary research at the cutting edge domains. This document include some of the expertise and facilities in CoE particularly in “Autonomy” area. Currently, over 8,000 square feet of space has been allocated to research activities related to autonomy and over 20 million dollar of equipment and assets have been spent. A list of most related research centers and laboratories in autonomy have been provided as follows:

#### **1. Autonomous Control and Information Technology (ACIT) Institute**

The ACIT Institute, directed by Dr. Homaifar, fosters interdisciplinary work to carry out research and education in this autonomous control engineering and its application. The crossed disciplines include but not limited to information, control, communication, computation, autonomy, soft Computing, multi-agent systems, artificial intelligence, data analytics. The technology transfer role of the ACIT institute includes workshops, seminars and demonstration projects designed to move the new technologies from the laboratory to industry as well as to educate technical personnel and managers on the opportunities and uses of the new technologies. The culmination of these activities will increase regional economic growth fostered by the development, adoption, and effective use of new information, control, and energy technology.

## **2. TECHLAV DoD Center of Excellence in Autonomy**

Testing, Evaluation, and Control of Heterogeneous Large Scale Systems of Autonomous Vehicles (TECHLAV), sponsored by Department of Defense, is a multidisciplinary research center in autonomy. TECHLAV Center conducts research on the leading edge of Control, Communication, Computation, and Human Cognition to address two main problems:

1. Teaming and Cooperative Control of Large Scale Autonomous Systems of Vehicles (LSASVs) integrated with human operators
2. Testing, Evaluation, Validation, and Verification of LSASVs.

## **3. ACCESS Laboratory:**

The Autonomous Cooperative Control of Emergent Systems of Systems (ACCESS) Laboratory, Directed by Dr. Karimodini, aims to address fundamental problems in modeling, analysis, control and improvement of complex systems. The ACCESS laboratory hosts a multi-agent cooperative test-bed and is dedicated to conduct a cross-disciplinary research on control and coordination of large-scale systems. This test-bed consists of several autonomous unmanned aerial vehicles (UAVs) and ground vehicles (UGVs) which are of different capabilities and are supported by an accurate infrared based VICON motion capturing system and a reliable decentralized communication system for data exchange between the robots.

## **4. Dynamic Systems Laboratory (DSL):**

DSL, directed by Dr. Yin, aims at analysis and synthesis of autonomous control systems and implementation on dynamic systems that have hard-to-handle problems such as time-delays, uncertainties, and limited measurements. In this laboratory, currently, two ground robots (Dr. Robot and Lego Mindstorms) and three aerial robots (AR Drone) are being used for research.

## **5. The Speech Perception and Auditory Cognition Laboratory (SPAC)**

SPAC conducts basic scientific research to test theories of how the mind processes information mainly through experiments in which participants give simple responses to stimuli that are presented via computer. Research in the SPeAC Lab focuses on a variety of fundamental questions about cognition, such as: How does the mind categorize auditory and visual information, including speech sounds? How does the mind combine information from more than one source? How are perception and memory influenced by contextual information?

## **6. Robotic Club:**

In the Electrical and Computer Engineering Department of North Carolina A&T University, the Robotic Club has been established to involve the undergraduate and graduate students in robotics activities and prepare them for advance research on aerial and ground robots.

## 7. Faculty expertise:

Faculty members who are actively involved in autonomy related research projects of ACIT institute are listed as follows:

### a. Dr. Abdollah Homaifar

**Department:** Electrical and Computer Engineering

**Email:** [Homaifar@ncat.edu](mailto:Homaifar@ncat.edu)

**Phone:** (336) 285-3709

**Research interests:** Test and Evaluation, Machine learning, perception, robotics, intelligent systems, Control and coordination of multi-agent systems, Distributed decision making for large scale systems signal processing, soft computing and modeling, data streaming.

### b. Dr. Ali Karimoddini

**Department:** Electrical and Computer Engineering

**Email:** [akarimoddini@ncat.edu](mailto:akarimoddini@ncat.edu)

**Phone:** (336) 285-3313

**Research interests:** Flight control systems, Task management and resource allocation, Robust Control of Linear Systems, Fault tolerant control systems, Adaptive and optimal control systems, Control and coordination of multi-agent systems, cooperative control of distributed systems, Distributed decision making for large scale systems, Formal methods of verification and model checking, Advance robotic systems.

### C. Dr. Younho Seong

**Department:** Industrial engineering

**Email:** [yseong@ncat.edu](mailto:yseong@ncat.edu)

**Phone:** (336) 285-3734

**Research interests:** Human perception, Modeling human operators' judgment and trust, automated decision aids, human Performance

### D. Dr. Sun Yi

**Department:** Mechanical Engineering

**Email:** [syi@ncat.edu](mailto:syi@ncat.edu)

**Phone:** (336) 285-3753

**Research interests:** Feedback control design and implementation, vision-based control, dynamic system analysis, control of time-delay systems, observer-based control, and robust control of electro-mechanical systems, time delay control.

**E. Dr. Joseph D.W. Stephens**

**Department:** Psychology

**Email:** [jstephe@ncat.edu](mailto:jstephe@ncat.edu)

**Phone:** (336) 285-2266

**Research interests:** Human perceptual mechanisms, Memory & Cognition, Sensation & Perception.

**8. Current Active Projects**

- “Testing, Evaluation and Control of Heterogeneous Large-scale Autonomous Vehicles (TECHLAV),” DoD DAF Air Force Research Laboratory (AFRL), \$5,000,000, 2015-2020
- “Data-driven Intelligent Prediction Tool (DIPT),” DOD Test Resource Management Center, \$5,300,000, 2016-2020
- “Center for Advanced Transportation Mobility: UTC Tier 1 Competition application,” DOT, \$7,800,000. 2016 –2021.
- “Reliable and Flexible Teaming of Heterogeneous Autonomous Vehicles,” DoD Army Research Office (ARO), \$500,000, 2016-2017
- “Human Factors for Crash Imminent Safety in Intelligent Vehicles,” DOT, \$560,000, 2015-2017
- “Collaborative Research: Understanding Climate Change: A Data Driven Approach,” NSF, 2014-2017, \$940,000